Encyclopaedia of Library and Information Science in the Digital Age

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Contents

(Vol. 3)

Preface

There are millions of pages of information on the World Wide Web, and finding relevant and reliable information can be a challenge. Search engines are powerful tools that index millions of web sites. When entering a keyword into a search engine, you will receive a list with the number of hits or results and links to the related sites. The number of hits you receive may vary a great deal among different search engines. Some engines search only the titles of the web sites, and others search the full text. One place to begin a web search is on the search pages that are maintained by Netscape Navigator and Internet Explorer. If you click Search on the Netscape Navigator menu bar, you will go to a page that provides quick access to many different search tools. You can select the search engine you want to use from those pages rather than accessing each search engine site directly.

On the other hand, an electronic book [eBook] has none of these harmful side effects. An eBook can be stored and transmitted at virtually zero cost. When you consider the economic and environmental prospective, eBooks are an obvious choice of any cost conscious person. We would like to think, in the near future, all published books and works will use an eBook format instead of paper. A close observer of publication dates will note that one of these books has been sitting on my 'to be reviewed' shelf for rather longer than it ought to have been. However, perhaps that has turned out to be for the best, since it offers the chance to examine three books that deal with the concept of the digital library. Rather ironic, to have so many 'old-fashioned' artefacts like books that deal with such a modern idea. Two of the books (Ar ms and Borgman) are in the same MIT Press series on Digital Libraries and Electronic Publishing (the series editor is Arms), while the third, and earlier publication is in the Morgan Kaufman Series in Multimedia Information and Systems, edited by another well-known figure in the digital libraries field, Ed Fox of Virginia Tech. As might be expected when three books deal with essentially the same subject area, there is some overlap — this is most readily seen in Arms and Lesk: for example, both deal with text conversion standards, information retrieval, usability issues, multimedia, archival concerns, economics, and intellectual property.

However, they cover these topics in different ways, and each includes topics that they other omits: for example, Lesk deals to a greater extent with digital library initiatives around the world, while Arms says more about meta-data and about organisational issues. Lesk's work has more and better illustrations, a better index (although neither is a perfect model), and a bibliography. Shamefully, Arms provides neither footnotes nor a bibliography, leaving his readers scrambling to find, 'A 1998 article in the *New York Times*...' or other, similarly disguised citations, as well as the appropriate sources for the numerous standards he mentions — how the publishers can have allowed this is beyond me. Although these two books cover much of the same ground, they are complementary and both will be of value anyone seeking an understanding of what the digital library idea means today.

This book contains advanced information about this subject. This book will be a boost for the learners and an essential subject manual. Designing of the book is such that the students will be benefited as far as the their knowledge and examination is concerned.

—Author

1

Introduction

This chapter is concerned broadly with the consequences of two types of experience which may be designated as direct experience and mediated experience, their partial equivalence and substitutability, and their differing potential roles in the intellectual development and acculturation of children. Our analysis will begin with the problem of the nature of direct experience and its effect on development. A clearer conception of the processes involved in direct experience will permit us to better examine the manner and extent to which mediate experience may complement, elaborate, and substitute for that direct experience.

Much of a child's experience is formalized through schooling. Whether for reasons of economy or effectiveness, schools have settled upon learning out of context through media which are primarily symbolic. Schooling generally reflects the naive psychology which has been made explicit by Fritz Heider. The general assumption of such a naive psychology is that the effects of experience can be considered as knowledge, that knowledge is conscious, and that knowledge can be translated into words. Symmetrically, words can be translated into knowledge; hence, one can learn, that is, one can acquire knowledge, from being told.

Congruent with this is the belief that what differentiates child from adult is also knowledge and that the chief mission of school is to impart it by the formal mode of pedagogy. Concern for 'character' or 'virtue' centres not upon the school, but upon the home and the child's more intimate surroundings, the sources that provide models.

The assumptions that knowledge was central to the educational enterprise and that it was independent of both the form of experience from which it derived and the goals for which it was used had several important and persisting effects on educational thought. First, it led to a certain blindness to the effects of the *medium* of instruction as opposed to the content, a blindness that McLuhan has diagnosed well; and, secondly, it led to a deemphasis of and a restricted conception of the nature and development of *ability*. As the effects of experience were increasingly equated to the accumulation of knowledge, experience was considered less and less often the source of ability. Since knowledge was all, ability could be taken for granted—simply, one *had* abilities that could be used to acquire knowledge. Abilities were, then, projected rather directly into the mind in the form of genetic traits. Culture and experience were both ignored as possible candidates to account for the development of abilities. The effect of this strange turn has been to downgrade the task of cultivating abilities in students, often thereby making schooling a poor instrument for the performance of this important task.

Education critics have, of course, long attacked educational goals formulated in terms of the simple acquisition of knowledge. Dewey's concern with the relationship between knowledge and experience has much in common with contemporary reanalysis. In his view, genuine experience involved the initiation of some activity and a recognition of the consequences that ensued. Experiences of this sort would result, Dewey argued, in the natural and integrated development of knowledge, skills, land thinking. Schooling, on the other hand, attempted to develop the three independently of each other and with little regard for the experience of which they were products. No surprise, then, that schools frequently failed to achieve any of them. Dewey's revised conception of the relation between experience and knowledge reappears in the current attempts at educational reform which emphasize the role of process rather than content, or, more specifically, emphasize activity, participation, and experience rather than the acquisition of factual information. The contemporary critic and Dewey alike would attack the assumption that knowledge is acquired independently of the means of instruction and independently of the intended uses to which knowledge is to be put.

That knowledge is dependent on or is limited by the purpose for which it was acquired has been illustrated in experiments by Duncker, by Maier, and by many other students of thinking and problem-solving. The conventional use of a pliers as a gripping instrument makes them difficult to perceive as a pendulum bob. Knowledge *per se* does not make it possible to solve problems. The same appears to be true of verbally coded information. Maier, Thurber, and Janzen showed that information which was coded appropriately for purposes of recall was, as a consequence, coded inappropriately for purposes of solving a problem. Information picked up from experience is limited in important ways to the purpose for which it is acquired—unless special means are arranged to free it from its context. But this conclusion is at odds with the naive view that one can substitute 'instruction' for 'learning through experience.'

We must, then, re-examine the nature of direct experience and its relation to both knowledge and skills or abilities. Of course, the term 'direct' experience is somewhat misleading in that all knowledge is mediated through activity, and the resulting knowledge is not independent of the nature of those activities. But, if we consider both the knowledge of objects and events that results from experience and the structure of activities involved in experiencing, we may come closer to an adequate conception of 'direct experience'. We will then be in a better position to contrast it with mediated or, more accurately, the symbolically encoded and vicarious experience that is so important in acculturation.

Direct Experience

Psychology, mirroring an earlier physics, often begins an account of the nature of experience with the concept of the 'stimulus'. What occurs in behaviour is thought to be a reflection of the stimulus acting upon the organism. At a more abstract level of analysis, the shape of the effective stimulus is seen as the result of certain physical filterings or transformation of the input given by the nature of the nervous system and its transducers. This conception is much too passive and nonselective with respect to what affects organisms. Living systems have an integrity of their own; they have commerce with the environment on their own terms, selecting from the environment and building representations of this environment as required for the survival and fulfilment of the individual and the species. It follows that our conception of physical reality is itself achieved by selective mediation. The search for a psychological account of behaviour must begin with the organism's activities and then determine the nature of the 'reality' sustained by that type of activity. It is a point that is explicit and central to Piaget's conception of adaptive behaviour in general and intelligence in particular: objects and events are not passively recorded or copied but, rather, acted upon and perceived in terms of action performed.

What does this view imply about the nature and consequence of experience? As we have said, we have a picture of reality that is biased by or coded in terms of our actions upon it; knowledge is always mediated or specified through some form of human activity. But note that any knowledge acquired through any such activity has two facets: information about the *world* and information about the *activity* used in gaining knowledge. In an aphorism: from sitting or chairs one learns both about 'chairs' and about 'sitting'. This distinction is reflected in ordinary language in the terms *knowledge* and *skill* or *ability*. There are, therefore, two types of invariants that are specified through experience. The set of features that are more or less invariant across different activities may be considered as the structural or invariant features of objects and events that constitute our *knowledge* about those objects and events. Similarly, the set of operations or constituent acts that are invariant when performed across different objects and events may be considered as the structural basis of the activities themselves —that which we call *skills and abilities.* It is our hypothesis that 'knowledge' reflects the invariants in the natural and social environment while 'skills or abilities' reflect the structure of the medium or performatory domain in which various activities are carried out. Obviously, major significance must be attributed to *both* facets of experience.

Consider more specifically how both facets are realized in practice. The performance of any act may be considered a sequence of decision points, each involving a set of alternatives. These decision points are specified jointly by the intention motivating the act, the goal or end point, and the structure of the medium or environment in which the act occurs. A skilled performance requires that the actor have information available that permits him to choose between these alternatives. Problem-solving is a matter of trying out various means and assessing their contribution to the achievement of the end state. He must assess the means while keeping the end criteria in mind. It is a universal routine— in love, in war, in writing a paragraph or solving an equation, or, indeed, in managing to get hold of objects during the initial phases of the infant's mastery of reaching.

From this point of view, mastery depends upon the acquisition of information required for choosing between alternative courses of action that could lead to a sought-after end. The most obvious way to acquire such information is through active attempts to achieve various goals in a variety of performatory domains. The most obvious way to learn about a country is to walk its streets, read its poets, eat its foods, work in its fields, and so on. In so doing, one will learn both about the country (*that* the country is poor or hilly, etc.) and how to proceed in the activities required to be of that country (*how to* mend a net or tell a story). This is surely what is meant by learning through one's own direct contingent experience.

Mediate Experience

But there are other ways to acquire information. From seeing a man struggle with his load, one can make some estimate of its weight. That is, one can experience vicariously or mediately. Psychological studies have repeatedly shown that learning can occur when neither of the primary conditions for learning through contingent experience—self-initiated action or direct knowledge of its results—is fulfilled. Bandura has summarized a wide range of data showing how behaviour can be modified and new behaviour patterns acquired by exposing the learner to modelling stimuli even in rather artificial laboratory situations. An illustrative experiment was performed long ago by Herbert and Harsh. Two groups of cats learned to pull strings and open doors by observing other cats. One group of cats saw only the final errorless performances of cat models while the other group saw the early error-filled performances as well as the correct performances. Both groups of cats learned to solve the problems more quickly than the control cats, who learned only from their own contingent experience. But the cats that saw the error-filled performances learned more readily than those who saw only the error-free performances.

Another alternative to learning directly is through symbolically coded information, that is, the information that is transmitted through the media—the spoken or printed word, film, diagram, and so on. It is learning through these symbolic systems that most readily substitutes for direct experience in formal schooling. Vygotsky and Bruner have emphasized the extent to which language provides the means par excellence for teaching and learning out of context, out of a situation in which action is in process and contingent consequences are most direct. Language, as we shall see, provides an opportunity for acquiring knowledge which, while it is less useful for any particular line of action, has the advantage of ordering knowledge in a form compatible with the rules of abstract thought.

We have, therefore, three modes of experience, which map roughly onto the three forms of representation discussed elsewhere as enactive, iconic, and symbolic: the first is related to direct action, the second to models, and the third to symbolic systems.

More important to our purposes is the fact that these three modes of experience map into evolutionary development. While all animals learn from contingent experience, primates are distinctive in their capacity for learning by observation—there is an enormous amount of observation of adult behaviour by the young, with incorporation of what has been learned into a pattern of play. The human species is, of course, marked by its reliance on symbolically coded experience—so much so that the development of language is taken as the distinctive characteristic of the human species and the development of literacy in various symbolic codes is the primary concern of formalized schooling. It follows that these three forms of experience differ greatly in the assumptions they make about the organism; that is, they differ primarily in terms of the skills they assume and develop in the learner.

On the Acquisition of Knowledge

To this point, the burden of our argument has been to show that one can learn from three very different forms of experience and that these forms of experience, whether mediate or direct, qualify what is learned. This section of the paper is directed to an examination of what is common to different forms of experience; the next section is concerned with what is distinctive about them. Our conclusion will be that different forms of experience converge as to the knowledge they specify, but they diverge as to the skills they develop.

The assertion to be examined here is that different forms of experiencing an object or an event can be mapped onto a common underlying structure—a coherent and generalized conception of reality. Information about a particular event, regardless of the activity or medium through which it is obtained, has in common the property that it permits the differentiation of that event from the alternatives with which it is in danger of being confused. Consider the experience of actually seeing a zebra with that of hearing the instructional statement 'A zebra is a striped, horse like animal.' The same features detected in the act of discrimination are specified in the statement; hence, they are informationally equivalent and they can both be mapped onto an underlying conception of zebras, horses, animals, and so on. This is not to deny that each mode has a residual uniqueness, but only to point out that they share a common structure as well. The range of topographically dissimilar forms of experience, including various forms of instruction, may be considered as various 'surface structures' which relate in their special ways to a common underlying structure of knowledge. Indeed, it is the very fact that information relevant to action can be acquired through means *other* than direct action itself that makes instruction possible. Thus, one can learn to sail, perhaps only to a limited extent, through watching films and reading books. There is considerable evidence from controlled laboratory experiments to show that common learning results from different types of experience. A child can learn to construct a diagonal either through activity coupled with reinforcement, through an appropriate demonstration, or through verbal instruction. Others have shown that children can learn difficult-to-teach Piagetian conservation tasks through quite different training techniques. And it is well known that there is almost an infinite number of ways to teach reading. The problem is to specify as far as possible the structure of information in these various instructional forms of surface structures and to see how they each relate to the underlying structure described above. Once these forms or instruction have ben specified, it may be possible to indicate how each of them relates to the various technologies involved in their production and distribution.

All three forms of *instruction* can only be extensions of basic forms of interaction with the world and its symbols. They may be characterized as 'instructional' only when their use is marked by the intent of another person who for some reason, usually institutionally derived, accepts responsibility for the learner. *Learning from one's own contingent experience* can be regarded as instruction only in special circumstances, such as when the environment is intentionally prearranged by another person. The learner's role in this process is readily described as 'learning by doing', and the instructor's role is primarily that of selecting, simplifying, or otherwise ordering the environment so as to make the consequences of the action, the reinforcement, both obvious and safe. The second form of instruction may be designated *observational learning.* The learner's role may be described as 'learning by matching,' and the instructor's role is primarily that of providing a demonstration or model and perhaps some feedback. The third form of instruction involves the *use of various symbolic systems,* including a natural language. The learner's role is primarily that of 'learning by being told' and the instructor's role is that of telling—providing facts descriptions, and explanations.

The three categories of instruction depend (as do the modes of learning on which they are based) upon the three modes of representing experience, namely, enactive, iconic, and symbolic. In our view, these forms of instruction and the related modes of representation reflect different surface structures of experience that share an underlying informational or *knowledge* structure. To see how each of these surface structures relates to the common underlying knowledge structure, we must determine what information is invariant to all instruction and how information is coded in the instructional programmes we have considered to this point. We shall accordingly examine reinforcement, modelling and verbal instruction.

Reinforcement

Firstly, consider the instructional effects of contingent experience, that is of reinforcement. Reinforcement broadly conceived is knowledge of the consequences of an act. Reinforcement assures a means of determining when an appropriate choice among alternatives has been made. Reinforcement, by its universality across species, provides a medium of information exchange whereby a Skinner can communicate with a pigeon, and vice versa, for organisms are potent sources of consequence for the actions of other organisms. This assumes that organisms respond systematically to the responses of others—though not necessarily by a simple calculus of good and bad outcomes. And, obviously, reinforcement mediates much interacting with the inanimate environment. But while the discovery of new knowledge may be dependent on our direct contingent experiences with nature and with other organisms, reinforcement has the limitation of being ambiguous in outcome. When a teacher reinforces a child for asking a question, the child may not know if it was the question-asking that she approved or the merits of the specific question. Reinforcement can rarely indicate the critical alternatives but can indicate the consequences of the final performance. Gutherie's cats, for example, did not know what aspect of their action in the puzzle box was critical for obtaining their release; hence they preserved many irrelevant ones. And given the fact that other human beings—with their obvious variability—

are often the principal source of reinforcement, the ambiguity is confound. It is surprising how uncritical many people accept the idea of control of behaviour by reinforcement, in view of the constrained circumstances necessary for it to be effective at all. And more important for instruction, a child obtains no relevant information from a reinforcement if he happens not to be considering the critical alternatives. Modern theories of discrimination learning move increasingly in the direction of distinguishing between feature selection (attention) and reinforcement to deal with this point. Given such considerations, one can account not only for the effects of this type of instruction but also for some of the anomalies in reinforcement theory.

Three devices are widely used to render reinforcement less ambiguous. One is by immediacy: tagging the reinforcement directly to the act. The second is by disambiguating the feature of the stimulus to be attended to by placing it in a context that differentiates it from an alternative. The third is through 'scientific method,' by unambiguously assigning certain sequel to certain prior events so that the necessity of the conceptual link cannot be overlooked.

This is typically the way of 'guided discovery' which, as with the other two techniques, relies on control of attention. In time, one who must learn by direct encounter comes to control his own attention in one of the three ways suggested: by keeping an eye 'peeled' for immediate results, by being selective in his scanning of features, and by attending to necessity and regularity of relationship. Obviously, there is a technology and a form of materials that must go with the learning of such 'discovery or reinforcement skills.' It would be foolish to assume that such learning is not crucially dependent on education. If such were not the case, there would be far more learning from direct experience than there seems to be.

Modelling

One of the more transparent instructional approaches is that of meddling or providing demonstrations, an approach that makes up an important part of Montessori programmes. How is information conveyed through modelling? Complex acts cannot be imitated unless the performer already knows how to carry out the act. That is, modelling may initiate or instigate known behaviour but not, in any simple manner, produce learning. Yet, learning does occur in some situations.

How can informations be conveyed appropriately through modelling? In line with the general theory advanced above, information permits a choice between alternatives. That is, consciousness of the alternatives is a necessary prerequisite for the pick-up or acquisition of new information. In another context it was reported that a Montessori teacher successfully modelled, for a three-year-old child, the process of reconstructing a diagonal pattern, a task that is normally solved only by four-or five-year-olds. The demonstration consisted of showing the child each of the choice points, that is, the critical alternatives, and then indicating how to choose between them. The demonstration of *where not to go* or *what not to do* is important to the extent that those alternatives are likely to mislead the child. In this light, it is possible to understand the finding of Herbert and Harsh, mentioned earlier, that the cats who saw the error-filled performance learned more than those who saw the error-free performance. The latter performance deleted what the critical choice points or critical alternatives were. A final skilled performance does not render observable the critical alternatives; hence, the observer does not detect the information required to choose between them.

Good instruction through modelling depends upon the sensitivity of the instructor to the alternatives likely to be entertained by the child. Modelling or providing demonstrations is, therefore a skill to which most pedagogic theories are blind. I.A. Richards provides an illustration of the pedagogic implications of such a theory:

> *A teacher should know how to demonstrate the meanings of sentences and other things in ways which are at once unambiguous, memorable, and easily imitated... For instance, with a ball and a table, a skilled teacher can in two minutes make the primal opposition of* on-off *evident... A careless teacher in the same minutes can generate potential confusions with other distinctions to be handled with* to *and* from *and* up *and* over, *confusions which may later on make the learner's tasks far harder than they need be.*

Just as providing clear demonstrations involves skill, it seems possible *that learning from demonstrations itself demands a skill;* depending upon its generality and utility, it may be a skill worth including in our educational aims (aside from the knowledge conveyed by that means). Elsewhere it has been argued that learning through modelling depends precisely on the capacity not so much to imitate directly as to construct behaviour from already mastered constituent acts in order to match selected features of the model—a procedure more like paraphrasing than imitating.

To summarise, any skilled performance, be it doing, saying, or making something, requires perceptual information for the guidance of each component of the act, that is, for selecting between all possible alternatives at each choice point in the performance. Modelling as an instructional technique is successful to the extent that it creates an awareness both of the critical alternatives and of how to choose between them. To this extent a good demonstration is different from skilled performance.

Verbal Instruction

Finally, consider language as an instructional medium. It is an instructional device *par excellence,* by virtue of the fact that a word indicates not only a perceived referent but also an excluded set of alternatives. Words function contrastively—they differentiate alternatives. The ordinary claim that 'words name things' overlooks the fact that words indicate or point to objects or events *in the implied context of the excluded alternatives.* This point may be grasped by noting that the name or the description of an event is determined by the contrasting alternatives. Thus, a large white block in the context of a small white block is called 'the large one,' while the same block in the context of a large black block is called 'the white one.' Reciprocally, hearing such a sentence, or any other instructional sentence, the listener knows about both the intended referent *and the likely alternatives.* That is, language is structured precisely in the way that is required for instructional purposes in general. For this reason, the instruction of literate subjects almost always involves language; when experimentally tested, such instruction competes favourably with that making use of reinforcement and ordinary demonstrations; language coding is less ambiguous, that is, it conveys more information than those other media of instruction. (This, too, accords with the results obtained by Masters and Branch and with those of many of the discovery-expository studies reported in the literature.)

But there are many ways in which language can specify an intended referent, and these ways provide a microcosm for examining the major premises of the instructional model presented in this paper. The point is that certain very different sentences covey the same information and hence are generally called paraphrases of each other, or synonymous sentences. Consider these simple examples:

1. (a) George is here.
   (b) My father's brother is here.
   (c) My uncle is here.
2. (a) The stick is too short.
   (b) The stick is not long enough.

The sentences in (1) all designate the same intended referent and in some contexts are informationally equivalent. The specific sentences in each case differ, however, in the way the information is coded and in the specific mental processes involved in arriving at their meaning. They also differ in the assumptions they make about the listener; the first could be used only if the listener already knew who George was, and so on. This picture is complicated by the fact that different sentences frequently appear to arrive at a common effect without having a common meaning.

Thus, Sheila Jones gave subjects sheets of paper filled with the randomly ordered digits *1* through *8*. Some subjects were given the instruction in (3a) while others were given that in (3b).

3a. Mark the numbers 3, 4, 7, and 8.

3b. Mark all the numbers except 1, 2, 5, and 6.

Subjects found the latter more difficult, a result implying that information is more easily processed when coded one way than when coded another way. This example raises the question of the nature of the equivalence of sentences which are superficially different. It may be noted that in the context in which they were given, both of these sentences convey the same information: it is the *3*, *4*, *7*, and *8* that are to be marked. Hence, in this specific context they are paraphrases of each other, as may be a very dissimilar sentence such as (3c).

3c. Beginning at the right side of the sheet, mark the first, third, seventh...numbers.

These sentences are paraphrases of each other only in this immediate context, however. A new context would render them non-equivalent. Given the choice between two equivalent instructional sentences, one would choose between them on the same basis as between two instructional forms in general, that is, in terms of the complexity of the demands they make upon the learner and their generalizability to new but related problems.

The last point warrants an additional comment. In teaching children to find the perimeter of a particular rectangle, two instructional sentences which would convey the same information are the following :

4a. Add the 7 to the 5 and multiply by 2.

4b. Add the length to the width and multiply by 2.

Yet these two statements differ radically in their demands upon the listener, the latter statement being more complex than the former, and, in terms of their generality, the latter being more generalizable than the former. Generalizability refers to the fact that the second statement could apply to many different rectangles while the first could apply only to the particular given rectangle. It is interesting to note that the greater the generalizability of an instructional sentence (roughly, its instructional value), the greater the intellectual demand it makes (roughly, its difficulty or comprehension).

The teaching of rules and strategies falls into a similar position; they are difficult to comprehend but they have wide generality. There is always a trade-off between these two factors, a trade-off that is reflected in an instructional rule of thumb formulated by Carl Bereiter (personal communication) to the effect that if the rules are easily stated and have few exceptions, teach the rule and let the learners practice applying it to various problems if the rules are not easily stated or have many exceptions, simply give practice on the problems and let the learners extract what rules they can for themselves.

The major limitation of language as an instructional medium, along with all cultural media such as graphs, diagrams, numbers, mime, and so on, is that the information is conveyed through a symbolic system that places high demands upon literacy in that medium. Further, the meaning extracted from those symbolic systems will be limited to the meaning acquired by the use of that symbol in the referential or experiential world. Stated generally, this limitation of language implies an ancient point that no new information can be conveyed through language. If the information intended by the speaker falls outside the listener's competence' the listener will interpret that sentence in terms of the knowledge he already possesses. It follows that instruction through language is limited to rearranging, ordering, and differentiating knowledge or information that the listener already has available from other sources, such as modelling, or through his own direct experiences. Parker has illustrated this point by showing the impossibility of verbally explaining perspective to the blind. In spite of this dependence of language upon perception, perception does come to be shaped in a way to permit easier comment, for reasons examined in the remainder of this essay.

On the Acquisition of Skills and Abilities

Having said that knowledge from different forms of experience can map onto a common deep structure, we must now make plain that there are also differences. The most important non-equivalence among experiences of events in the three forms is manifest not so much in the knowledge acquired, but in the skills involved in extracting or utilizing that knowledge. It is true that common knowledge of zebras may be obtained from actual experience and from appropriate sentences, but the skills involved in the two cases are entirely different; it is obviously a skill to extract symbolically coded knowledge from a sentence, but it is no less a skill to discriminate zebras from horses, albeit a skill so overlearned that we fail to recognize it as such until we are faced with a subtler but equally 'obvious' discrimination such as that between Grant's gazelle and an impale. However combinable the outcomes, the skill of obtaining information by perceptual discrimination is a radically different skill from that of extracting the same information from language. The crucial issue for instruction, then, becomes one of deciding which skill one wishes to cultivate.

What of these skills ? As we pointed out earlier, they are frequently rendered invisible by our habitual focus on the knowledge specified through the activity. As we examine a rock by turning it over in our hand we are aware of the fact that we acquire knowledge about the rock, but the skilled manipulation that gave rise to the knowledge of the rock is transparent to us. Our earlier example suggested that in carrying out any activity, such as kicking a ball, we are learning not only about the ball, but about the act of kicking. Carrying out that act across widely divergent objects or events would be responsible for the development of a skill of wide applicability. But if we look at the general skills that make up our cognitive or intellectual ability, we see that they are marked by the same property. Verbal, numerical, and spatial abilities reflect skills in such cultural activities as speaking and writing counting, and manipulating Euclidean space.

Consider these skills in more detail. It is enormously to Piaget's credit to have insisted and demonstrated that the structure of any ability must be conceptualized in some major part in terms of 'internalized activity'. Activities one carries out in the physical world—rotating an object in space, lining up objects to form a straight line, ordering objects serially—come to be internalized or carried out mentally. There is not only an internalization of operations, but an increasingly economical representation of diverse events operated upon. A face looked at from various angles comes to be represented as a single face. Even more important are the temporal ordering operations, which permit an appreciation first of physical order and then of logical relations. Once we can convert back from a changed state to our original one, we come to appreciate that such reversibility is a logical possibility or property of events and not simply an act one performs. In turn, such operations make it possible to transform a novel event into a standard or base event or to convert some base event into a new structure more appropriate to novel contexts.

The operations specified by Piaget were largely those appropriate to the manipulation of real objects in the physical environment. His basic premise is that their internalization not only produces the groundwork for logic, but assures that logic will be appropriate to the state of the world one experiences. Such operations, consequently, have a wide range of applicability and appear to be almost universally relevant to problem-solving.

But internalized activity related to the physical environment does not begin to describe the range of activities of the human mind. Specifically, it leaves out of account how we learn to cope with the cultural or symbolic environment. 'Learning from the culture,' like learning from physical activities, involves the act of picking up information to decide among alternatives; it also involves skills, and it also results, finally, in a biased knowledge of reality. Sentences, for example, to the extent that they are about something, carry information common to the other forms of experiencing and are comprehended and spoken in terms of those general underlying structures of knowledge we discussed earlier. But the skills involved in using sentences are unique to the particular mode of expression and communication. The skilful use of a symbolic system involves the mastery of both its structure and its rules for transformation. Once mastered, these skills may be considered to be 'intelligence,' primarily because the range of their applicability is virtually open.

This wide and expanding range of applicability is further indicated in the arts, which may be viewed in part as creative attempts to expand the limitations of a particular medium or symbolic system. These expanded symbolic systems may then be applied to nature, if appropriate, much as the binomial distribution was found to be an appropriate description of the range of human variability. In this way, our use of symbolic systems, like our practical activities, results in a version of 'reality' appropriate to the activity. There is no objective reality to 'copy' or to 'imitate', but only a selection from that reality, expressed in terms of the kinds of practical and symbolic activities in which we engage. Thus, Nelson Goodman is led to say that 'the world is as many ways as there are correct descriptions of it.' Similarly, Cezanne pointed out that the artist does not copy the word in his medium but, rather, recreates it in terms of the structure of that medium. So too with the ordinary man operating in the various symbolic systems of his culture. Whorf was among the first to argue that we 'dissect nature along lines laid down by our native language.' But the process probably goes even beyond that, to something comparable to Gide's advising young poets to follow the rhymes and not their thoughts. For the child, as for the creative artist, the uses of the culture involve processes of expanding and refining the code, of defining 'lawful' or 'comprehensible' or 'possible' options as he defining 'lawful' or 'comprehensible' or 'possible' options as he goes. This is the heart of skill in the use of symbolic codes. Even our failures in understanding new media, as McLuhan has pointed out, come from a failure to recognize that they require different skills than does the medium they replace—as in going from an oral to a written code, or in going from print to television.

Man in culture, like the artist, is in continual search for ways of applying symbolic systems to his ordinary experience. Translation into a symbolic code such as logic or mathematics is even taken as the criterion for 'understanding' a phenomenon; to express the relation between temperatures, pressure, and volume in the form of an equation is to explain that relation. Hansen goes so far as to say that scientific knowledge consists of statements known to be true.

But can one affirm that translation of experience into any one medium has more validity than translation into any other ? A historical account of the intellectual roots of the industrial revolution may be of a different symbolic system but not necessarily of greater validity than Yeat's famous epigram:

- Locke sank into a swoon;
- The garden died;
- God took the spinning jenny
- Out of his side.

Yet a scientific and technological culture like our own has put a premium on translation into a few symbolic systems—written language as in literature and explanations, in logical and mathematical statements, and in spatial systems such as maps, models, graphs, and geometry.

We would argue that it is not only scholars, poets, and scientists who seek constantly to cast experience into symbolic codes. Our conjecture is that there is a form of metaprocessing that involves the constant reorganization of what we know so that it may be translated into symbolic systems. It is a matter of 'going over one's past experiences to see what they yield' both for the purpose of facilitating the communication that is required for the survival of the culture and for the purposes of rendering one's own personal experience comprehensible. We may label this form of activity as 'deuteropraxis,' or second-order information processing. Deuteropraxis is elicited not only by failed communication but also by a conflict and difficulties in attempting to carry out an action or solve a problem. It occurs whenever there is information-processing capacity available not demanded by the task in hand. Deuteropraxis is involved in all translations of specific experience into general accounts. It can occur in any mode but it is clearly represented both by the poet's or essayist's search for the appropriate phrase or the summarizing aphorism and by the scientist's search for the most general mathematical statement. Merleau-Ponty has this in mind when he suggests that all intention wants to complete itself in saying. It is deuteropraxis that is responsible for the radical economization of the experience of the tribe or nation in a few great myths and, more generally, for the world view implicit in one's native language. It should not, however, be assumed that this process is simply one of translation. It more generally requires that the creator have more information available than was required for the ordinary experience of the event. This can easily be seen in the difficulties one encounters in an attempt to draw a map of a well-known territory or to give a description of a friend's appearance. New requirements, new purposes, or new activities alter our perceptions of events; this is no less true when these activities involve those that have shaped or evolved by the culture, as in the arts, than when they involve various practical or physical acts. It follows that such symbolic activities as drawing an object, describing an object, or photographing an object require somewhat different information about that object than does the manipulation of the object. To the extent that these new forms of cultural or symbolic activity require previously undetected information about the world, the media of expression and communication are *exploratory devices*—a point of immense importance to an understanding of the child's acquisition of knowledge.

Finally, deuteropraxis makes possible the organization of information into a form that is particularly appropriate for cultural transmission to the young. Since it is often difficult for the child (or an adult for that matter) to link an action with the consequences that follow, he is greatly aided by the deuteropraxis account of the event. Such accounts, whether in the form of an abstract equation, a principle, a noiseless exemplar, or an appropriate model, have the effect of 'time-binding' or virtually simultanizing temporal events and thereby surpassing ordinary experience.

It is such deuteropraxis accounts that are examined in more detail in other chapters of this volume in terms of their instructional potential. The very accounts that render experience comprehensible render it inscrutable. But there are limits in the degree to which such representations, whether in language or other symbolic systems, can substitute for or extend ordinary experience. As summary of experience they are indeed powerful; as an alternative to experience they are sometimes woefully inadequate. One can learn or memorize the summary without having grasp of the information summarized. In *Portrait of the Artist as a Young Man,* Joyce tells how his teachers taught the young the aphorism 'Zeal without prudence is like a ship adrift' to show how instruction often falls wide of the mark. To some adult no doubt such a statement has meaning; it summarizes his own experience in a simple code. To the young it summarizes nothing. In large measure, the same is true of the great myths; to the extent that they summarize no experience, they convey little or no information. On the other hand, it is also true that aphorisms, like new vocabulary items, may serve as pointers from which experience is progressively assimilated. At an appropriate level, such instruction may be successful in aiding the assimilation of experience. Experience in this case instantiates the categories created through the symbolic code. Frye makes a parallel point in regard to literature: 'criticism.... is designed to reconstruct the kind of experience we could and should have had, and thereby *to bring us into line with that experience*.

Technological Realizations

The column headed 'Technological Realizations' indicates, in a rough manner, the media appropriate to each of the modes of experiencing the world. Learning through contingent experience may be facilitated through rearranging the environment to render the consequences of activity more obvious. Laboratory experiments are prototypic attempts to simplify direct experience. Structured environments, simulations, toys, and authomatizing devices of various sorts have the advantages of both extending the range of a child's experience and making the relations between events observable or otherwise comprehensible.

Observational learning is realized through the provision of a model—'This is how you break out a spinnaker.' As we pointed out earlier, carrying out a performance for its own sake and carrying it out so as to instruct another are not identical. A good demonstration makes explicit the decisions made in the course of the activity—thus a good demonstration shows the student what not to do as well as what to do; a skilled performance makes these same decisions invisible. Technological media can greatly facilitate these processes by highlighting in various ways the critical points in the performance; slow motion or stopped action as well as descriptions and drawings (including caricatures) may have this effect. Such instruction, while it may convey some of the same information that would be apprehended through direct contingent experience (by virtue of its shared deep structure), is never complete in itself but, rather, specifies some of the major features to be looked for when actual performances are attempted. That is, these forms of instruction rely heavily on prior or subsequent experience to instantiate the information.

The instructional effects of a model are greatly increased by tying that demonstration to an appropriate symbolic representation as in the provision of a few mnemonic rules. The words 'keep your weight on the downhill ski' coupled with a demonstration will render the demonstration more comprehensible—the observer knows what to look for. But even this will not perfect the novice's performance; direct contingent experience is required to 'instantiate' the instruction. Indeed, it is probably not until such instantiation occurs that the proposition is fully comprehended. One says (after the first fall), 'So that's what he meant.' Hence, all modes of instructing are in some sense incomplete or inadequate for achieving full performatory power or efficiency, and knowledge in the last analysis is tied to one's own experience.

Learning through the various symbolic systems, including language, graphs, mathematics, and the various systems of visual representation, is realized through books, graphs, maps, models, and so on. These media make strong assumptions about the literacy of the learner. The properties of a 'good' explanation, description, or portrayal are complex subjects worthy of study in their own right. But to untangle the educational effects of these symbolic systems we again have to differentiate the knowledge of the world conveyed through the system from the skills involved in the mastery of the structure of the medium itself. Recall our aphorism: instructional means converge as to the knowledge conveyed but they diverge as to the skills they assume and develop. As to the knowledge conveyed, different systems are useful for the partitioning of alternatives or the conveying of information in a way that is fundamentally compatible with the information picked up from other types of experiences. You may learn that the stove is hot by touching it, by seeing someone recoil from touching it, and by being told that it is hot. Granted some level of literacy and granted that the learner has had some experience to instantiate the experience, the three forms are essentially equivalent, as we pointed out in the first part of this essay.

However, as to the skills they develop, each form of experience, including the various symbolic systems tied to the media, produces a unique pattern of skills for dealing with or thinking about the world. It is the skills in these systems that we call intelligence. The choice of a means of instruction, then, must not depend solely upon the effectiveness of the means for conveying and developing knowledge; it must depend as well upon its effects on the mental skills that are developed in the course of acquiring that knowledge.

We return, then, to our point of departure. The acquisition of knowledge as the primary goal of education can be seriously questioned. The analysis we have developed points to the contingent relationship between the knowledge acquired and the intellectual skills developed. To neglect the skills is to forget that they are the primary tools for acquiring and using knowledge—tolls that are critical for the child's further self-education.

The Use of Visual Media

Many of us desire to employ the visual media in the teaching of psychology (we, as teachers who are audio-visually perceived by our students anyway, not included...) The typical reasoning behind this desire, which is more frequently expressed than practised, is, however, not well throughout. Is it indeed the case that a picture is worth a thousand words ? Is a graph necessarily better comprehended than a verbal description ? Why is *Clockwork Orange* more revealing than, say, a scientific analysis of brutality ? Why bother to teach group processes through *Twelve Angry Men* rather than read the transcript ? Why view *Equus* in film or the play on stage ? Why not just read the play at home ?

It appears to me that we should attempt to answer such and similar questions in the same way we teach our students to do it. Namely, to begin with a *theory*. Specifically, we need a theory that sorts out the relevant elements, that differentiates between fact and fiction, and which is sufficiently general to guide future questions. This article is devoted to such an attempt. The rather common answer to the kinds of questions that I have raised is frequently as follows: (a) A-V materials can reveal unique and helpful contents, and (b) they offer that content through concrete, vivid experiences which are (for some unclear reason) superior to texts, lectures or discussions. Similar potentialities are often attributed to the technology associated with certain media (e.g. the ease of transmission through CCTV) or to the didactics associated with them (e.g. immediate feedback or better structuring of the materials).

Such answers confuse quite a number of issues. For example, contents are by and large transferable: You do not have to watch *Equus* in a film, you can read it: you do not have to observe an interview with Karl Jung on video-tape as one can read its content to you aloud. Thus, we confuse some unique attributes of visual media with non-unique ones. Similarly, we implicitly assume that different media offer different experiences, and yet we see them as alternative means to the *same* ends, particularly the acquisition of factual knowledge (Olson, 1976).

Uniqueness in Media

First, then, let me raise the question of what is unique to each medium and what is the *essential* difference, i.e. neither trivial nor accidental correlate, between them ? Once I have dealt with this, I will turn to my second question, namely—in what ways do such essential differences make a difference in learning ?

To make a very long story short—(more on this issue can be found in Gordon (1969), Olson (1974) and Salomon (1979)—we have reason to argue that the essential difference between media is neither their contents (which itself is an outcome of a more fundamental difference), nor the available didactics, but rather *their modes of gathering, packaging and presenting information, that is: their symbol systems*. To presently avoid unnecessary philosophical debate and in the service of brevity, let us speak of media's 'modes of presentation' and symbol system as equivalent. Indeed, remove cartography from maps, language from texts, pictoriality from film, movement from ballet, what are you left with? Not much.

Quite clearly media's symbol systems, or modes of presentation, owe much of their development to technological innovations. More detail and finer depth presentation became available through copper engravings, new 'statements' could be made once the zoom lens was developed, and a new 'language' becomes possible now with the development of holographs. Yet, let me remind you that it is not any technology *per se* that affects learning. Rather, the new symbol systems and the new combinations of old ones that become possible with new technological inventions, enable us to gather, package and present new aspects of knowledge. Thus, media's unique symbol systems and the unique combinations thereof are the very essence of media: they develop with the advent of new technologies and make new kinds of content available.

If media's symbol systems would be only mediators between technology and presentable content, then we would not have to dwell on their psychological import at all. We would concentrate on what media's contents could do for us. However, following Olson and Bruner (1974), Olson (1976) and my own work, I want to argue that *media's symbol systems have their own important effects on people's minds.* And it is these effects that, once understood, can lead us to develop novel ways of using the visual media to serve new educational functions.

The Differential Employment of Skills

Let me begin with the assumption that while the contents of messages address our structures of knowledge, the means of conveying the knowledge, the symbol systems, address our mental skills (Olson and Bruner, 1974). Thus, one can speak of intelligence as skill in a medium. When you read a book, see a play, watch a film or examine a painting, you may gain knowledge. However, the very *activity* of reading, film-viewing, map-reading or listening, *taps different kinds of mental skills.* As Olson (1978) writes: 'Skills are frequently rendered invisible by our habitual focus on the knowledge specified through the activity'. And as Gombrich (1974) shows, numerous skills, often 'automatic' ones (LaBerge and Samuels, 1974) are involved even in reading a regular black and white photograph. We do not read it as representing a gray, flat and framed world.

Salomon and Cohen (1977) have shown that different coding elements within the filmic symbol systems, such as spatial editing, zooms, logical gaps and close-up-long shots, call upon different kinds of mental skills. Hence, film-viewing is a skilled activity, and the specific kinds of coding elements it uses tap differential abilities. Spatially able students extract more knowledge from elements that distort known conceptions of space, while students with better mastery of temporal abilities extract more knowledge when time is being distorted. As Snow *et al*. (1965) have shown long ago, there are more general aptitudes which are called upon when all kinds of film are shown, and these aptitudes are less relevant when face-to-face instruction takes place.

Meringoff (1978) has shown that aside from the above, televiewing leads small children to extract different kinds of knowledge than listening to the same story when read aloud. Listening also calls for the generation of more personal inferences than televiewing.

Two implications seem to follow. First, as different coding elements within a symbol system call upon different skills, so do whole symbol systems, only on a larger scale. We would expect students with different clusters of aptitudes to benefit differentially from different symbol systems (provided our media presentations employ their unique symbolic potentialities). This, of course, is much in line with the known conceptions of aptitude—treatment interactions (ATI), as formulated by Cronbach (1957), Salomon (1971) and Cronbach and Snow (1977). I will relate to this as a *first order interaction* between symbol systems and learners' aptitudes.

The second implication is somewhat more complex. Traditionally, we attribute to some symbol systems characteristics of 'concreteness' and 'iconicity,' and to others 'abstractness' and 'arbitrariness,'. However, following the philosophical works of Goodman (1968, 1978) and my own analyses (Salomon, 1979a), it appears that symbol systems are 'iconic' or not relative to the way one represents the depicted or described entity *mentally*.

I argue this on the basis of the assumption that we use different kinds of symbol systems *mentally* to represent the world to ourselves and to manipulate it in thought (Paivio, 1971: Kosslyn and Pomerantz, 1977). External modes of representation can thus be closer or farther away from the internally used once.

A verbal description of an activity or process which you, for many cultural, developmental, situational and personal reasons, represent to yourself as visual images, is remote from its cognitive counterpart. Similarly, if I should try to present the ideas of this article through, say, a pictorial symbol system, I would be using a rather remote (i.e. non-iconic) 'language', because many people prefer to think about such issues in terms of internal propositions.

It follows, then, that 'iconicity' is *not* an inherent attribute of a symbol system but a function of the 'distance' between it and one's internal mode of representation. And as such modes differ with content, maturation, preference, etc., also 'iconicity' or 'abstractness' are flexible, relative, quantities. Statistical formulae are neither 'abstract' nor 'arbitrary' for one who thinks in terms of statistical formulae.

When the 'distance' between external and internal modes of representation is large one needs to activate processes of *recoding,* that is, invest mental effort in translating the external symbolic mode into the internal, preferred one. When, then, the information is new, its quantity large, and the recoder not well skilled, much of the information gets lost. But, barring extreme cases, the more one needs to recode (and is capable in doing so), not only does he/she learn more, but he/she also draws more heavily on his/her own mental schemata.

This brings me back to my second implication. Television and film may often be easier for processing (not only for children) because one often represents certain entities through imagery. Pictorial symbol systems thus as much of the recoding effort required by, say, language. But if pictorial systems require (or rather, *allow)* less recoding, then they may lead to less learning. They also often allow us to draw less upon our own mental schemata, as Meringoff's (1978) study shows.

Such would not be the results for learners who think of the same entities in terms of internal propositions. For them, pictorial systems may address a less preferred internal symbol system, require more recoding, and thus lead to more learning.

I would label this implication—*a second order interaction*. That is, an interaction between external and internal modes of representation which results in more or in less skilled reocding, in more or in less learning, and in heavier or lighter reliance on one's own mental schemata. Unlike the first order one, the second order interaction is highly variable, depending on the content presented, the task to the performed, one's preferred cognitive systems, etc.

The Cultivation of Skills

Thus far I have dealt with the different kinds of mental skills that symbol systems call upon and the different amounts of mental recoding they seem to require. But media's symbol systems appear to have other, far more pervasive effects on learners. I will mention here two such effects: the cultivation of mental skills and the cultivation of new internal modes of representation.

If mental skills are involved in extracting knowledge from symbolically coded messages then such skills can and do develop as a result of media's requirements. From watching the film *The Phoenix* you not only acquire knowledge about the emergence of leadership, but also exercise certain film-related mental skills.

The fact that we are often unaware that skills are needed only suggests that they are already well developed and can be used 'automatically'. Yet, as Kintscha (1977) points out: 'Novels or movies are easier when the natural order of events is maintained than when they are full of flash-backs and reversals, but since the latter invite deeper processing, they are more interesting to read or watch'. They are indeed more interesting, and may render also more unique information because they call upon not yet 'automatic' skills.

In a series of experiments and field studies (Salomon, 1979b) we could show that when specific coding elements of film—such as close-up—long-shot, varying spatial positions or changing points-of-view—are used under common learning conditions, they lead to improved mastery of relevant skills. Quite clearly, when coding elements call upon certain skills, they can cultivate those best in learners with a modest initial mastery of the skills. Skill-cultivation by activation cannot benefit a learner with no, or very poor, initial mastery of the skills.

When skills such as relating-parts-to-wholes, spatial imagery, changing-points-of-view and possibly others, show improvement through activation, they may also transfer as *mental tools* to new instances. We do not know as yet which skills transfer more widely and which ones begin as, say, film-literacy and stay untransferable to other symbol systems. The well-known rules of transfer-of-learning seem to apply here, as elsewhere. Transferability would depend not only on the nature of the skill but also on the nature and availability of other instances to which the skill can be transferred, and on one's awareness that a skill—such as changing spatial perspectives—is applicable to totally new instances. While we know that the filmic symbol system can be made to cultivate skills, we do not as yet know their potential transferability.

Let us turn now to the effects of symbol systems on the development of internal modes of representation. If we are willing to accept the assumption that people represent the world to themselves and manipulate it mentally through a number of internal symbol systems, we cannot avoid the possibility of interdependence between external-communicational and internal-cognitive symbol systems.

Numerous psychologists, aestheticism and philosophers have argued time and again that internal symbolism develops, in part at least, as a counterpart of external-communicational symbol systems. There is little disagreement that language serves prominently in thought.

Even without going as far as Whorf or even Vygotsky (1978), one could agree with Schlesinger (1977) that thinking emerges from interactions with a language community. Ultimately although not initially, one learns to 'compute' thoughts in those linguistic structures which serve in the production and comprehension of speech.

In short, the linguistic symbol system serves as a system of mental tolls which operates in internal manipulations of the world. And it does this apparently in two ways. It summarises, labels and internally represents already acquired knowledge, thus it serves a *representational function* (Olson, 1978). For example, acquiring new concepts such as 'intrinsic' and 'extrinsic' motivation allows the student to go over, so to speak, his or her past experiences and subsume them under these concepts. The concepts come now to represent in the student's mind a vast array of past experiences, observations and bits of knowledge.

But a symbol system such as the linguistic one serves also to guide and direct our exploratory and data-gathering behaviour, thus—to accomplish an exploratory function as *epistemological devices* (Olson, 1978). Once the student in the above example has learned about the two sources of motivation he or she can now start noticing events and behaviours to which he/she attributes hidden causes he/she would not have attributed before. Furthermore, he/she begins to notice things which he/she did not notice before.

Let me embed these arguments into Neisser's (1976) spiral model of perception and cognition. According to this model, one's mental schemata—including different kinds of symbolic representations—direct our perceptual exploration. Exploration, in turn, samples, constructs and provides meaning to external stimuli which are then incorporated into the schemata and change them accordingly.

Note that the acquisition of externally-provided concepts, labels, and other symbolic representations (e.g., a graph, a picture) changes one's relevant schemata. In this sense they serve in what we called a representational capacity of knowledge already stored in the schemata. But, once acquired, such symbolic representations begin to guide perception, information-gathering and comprehension, thus to serve in a epistemological capacity.

How then is it transformed from a communicational symbol system into an internal, mediational one? Vygotsky (1962) and later Luria (1976), working within a Marxian inter-actionist framework, suggest that language is interiorized, or internalized, by the child. Luria writes: 'Children assimilate language—a ready-made product of socio-historical development—and use it to analyse, generalize and encode experience'. Not only words but also grammatical structures are interiorized: thus, 'humans have at their disposal a powerful objective tool that permits them not only to reflect individual objects or situations but to create objective logical codes'.

Vygotsky does not claim that thought is *created* by language, as Whorf would have it. The internalization of language results in a *reorganization* of thinking into higher order functional systems. Still, *internalization* serves as the key process. Even Fodder (1975), the opponent of such views, find sit necessary to qualify his general argument by stating that though it might be admitted that the initial computations involved in first language learning cannot themselves be run in the language being learned, it could nevertheless still be claimed that a foothold in the language having once been gained, the child then proceeds by extrapolating his boot straps: the fragment of the language first internalized is itself somehow essentially employed to learn the part that's left. This process eventually leads to the construction of a representational system more elaborate than the one the child started with and this richer system mediates the having of thoughts the child could not otherwise have entertained.

But language is not the *only* symbol system that participates in thinking. Miller *et al.* (1970) have tried to replicate one of Luria's studies concerning the use of externally provided verbal instructions for self-regulation by three and four-year-olds. Although they failed to replicate Luria's findings, Flavell (1977) did not reject the internalization conception. Rather, he interpreted the failure as resulting from the assumptions that only internalized *language* can serve for self regulation. Other, non-linguistic modes could serve equally well, or even better, for some children. Shepard (for example, 1978) has shown how important non-linguistic internal codes are in solving spatial problems. The work of Furth (1966) with deaf children shows that, even in the absence of a well-mastered language, thinking can be relatively well developed, suggesting that language is only one of many ways whereby thought is carried out.

Could other, non-linguistic symbol systems become part of our cognitive apparatus in a way that resembles that of language? Could a child learn to think in, say, *graphical codes* as he does with language ? Hatano *et al.* (1977) have shown that expert abacus users seem to have internalized the operations of the abacus. This is suggested by the observation that users at intermediate levels still need to use visible finger movements to accompany mental computations. When prevented from using their fingers, such uses perform significantly less well. Experimental intervention of this kind has no appreciable effect on expert users. The finger movements of intermediate users of the abacus appear to be very much like egocentric speech, which, according to Vygotsky, is 'overt thought preceding inner speech'. Both are overt activities in the process of becoming totally internalized and covert.

Here, however, we face a possible pitfall. The analogy between the internalization of language and non-linguistic systems may be misleading inasmuch as language is acquired through active *interaction* while most non-linguistic systems are only *observed.* Only a few people interact through pictures, filmic-codes or cartography. Could the latter be acquired through observational learning?

Observational learning of modelled behaviours is a learning procedure that 'enables people to acquire large, integrated patterns of behaviour without having to form them gradually by tedious trial and error' (Bandura, 1977). However, modelling is not limited to overt physical acts. Observational learning also occurs with linguistic skills, conservation of liquids, attitudes, and emotional responses (Bandura, 1977). Underlying *all* these, according to Bandura, are common processes of attention, internal coding, rehearsal, and reinforcement by self or others.

The teaching potential of modelling need not be limited to observational learning of behaviours of humans nor to the informative contents of 'symbolic modelling'. *One should be able to learn by observing the symbolic code itself as well.* Indeed, this is very much in line with Bandura's explanation of the role of observational learning in language acquisition.

However, lest we oversimplify the case by arguing that all symbol systems encountered in the media can be internalized and used as coding elements in thought, we must at least show *why* they are learned. The internalizability of codes must surely depend on their function. Once we have a plausible (if speculative) explanation, we should be able to generate specific hypotheses pertaining to the conditions in which specific coding elements are internalized.

A verbal construction or spatial depiction, to be learned and used in perception and thought, needs to accomplish some useful function for the learner. It must promise a solution for a perceived difficulty. As Cole and Scribner (1974) theorize with respect to cognition and cultural differences, a skill is evoked and potentially cultivated within the context of functional demands. Thus, for a coding element to become a tool of thought, it must accomplish some useful cognitive function. It needs to accomplish for the learner something that the learner cannot perform on his own yet needs to perform.

Indeed, this is precisely what we have found in our experiments (Salomon, 1974, 1979b). When subjects are shown a filmic operation which *overtly models* an operation—such as rotations in space, changing points of view, zooming, or laying-out objects—the ones with poorer mastery of such operations seem to imitate and internalize the operations. Thus, the overt model seems to *supplant* a mental activity which can then be internalized, provided it has not been well-mastered beforehand.

The modelled operation seems to accomplish for the students an operation they cannot yet perform themselves and which does not easily translate into another, say, linguistic code. Our students have learned to use these new symbolic operations in their cognitive representational system and to transfer them to new instances. They have learned to think in terms of filmic codes. (Note that while better skilled students showed improved skill mastery when specific filmic codes *activated* skills, those with poorer initial mastery showed evidence of code-internalization when the latter overtly *supplanted* the skill: a perfect ATI, or first order interaction.

As we have found similar evidence also in field and cross-cultural studies *outside* the laboratory (Salomon, 1976; Salomon, 1979a), we feel quite confident in arguing that the symbol system of a medium such as film can serve as a cultivator of mental abilities and internal modes of representation. Quite clearly, though, media's symbol systems can cultivate mental skill only if (1) they are sufficiently unique, i.e. do not easily map upon alternative systems (as does the Morse Code with respect to language), and (2) they provide an organization of knowledge not provided by an alternative system (note that uniqueness of a flowchart).

A Third Order Interaction

Equipped with these theoretical arguments and empirical evidence I can suggest that audiovisual media, when examined through their symbol systems, serve as good or poor conveyors of information in interactions with learners' aptitudes and specific modes of internal representation. But it is also warranted to argue that, apart from the above, media's symbol systems, which can cultivate cognition, enter into another far more pervasive interaction with learners.

We tend often to speak of learners as rather passive recipients of knowledge and as claylike subjects whose skills are being moulded. But once we entertain the possibility that they do something *active* with the skills they acquire and particularly with the symbolic codes they internalize from the media, we will have to look at them as individuals who actively gather information and structure it in terms of what they have acquired. Thus, to quote Bowers (1973): 'The situation is a function of the observer in the sense that the observer's cognitive schemes filter and organize the environment in a fashion that makes it impossible ever to completely separate the environment from the person observing it'.

The learner who has internalized the filmic code of, say, changing spatial points of view into his/her imagery can now turn to his/her world of experience and represent it in ways that he/she was less able to do before. Here is the testimony of a student of mine:

> *I am fascinated by how my daydreaming is influenced by movies. Processes and techniques of presenting events by this Hollywood symbol system are powerfully implanted within my cognitive system. I have observed third person narration, flashbacks, zooms, slow-motion emphasis of action, audience viewing, re-takes, 'voice of conscience', multi-personality dialogue, background music, and many other movie means of expression in my head. I fear that there is very little original style to my daydreaming. It is all influenced by celluloid... There are scenes where I am climbing steps to address a large audience, and television shots in slow motion symbolize the slow and hard road to significant others and flashbacks to significant moments.*

While that student seems to be using filmic structures, in a representational capacity, it would make sense to hypothesize that he also examines other people's behaviour in similar terms. His mental, film-like schemata guide his perception and understanding of the world. This I call a *third order interaction.* It can be imagined as a spiral in which one's mental apparatus guides perception and interpretation, which in turn establishes contact with new symbolic forms. The latter can be internalized, and when they are—they enrich the mental apparatus. I think that this third order interaction should serve as our major justification for using audiovisual materials. It is a justification for audiovisual usage because we want our students to use rich and alternative modes of internal representations, not just the verbal one, and we want them to examine the world through more than one symbol system. After all, insights of many scientists did not start with propositions. On the contrary, it was imagery—often adapted from the world of art—which served as the initial key hole through which phenomena were examined.

But such third order interactions, whose nature we know only in skeletal form, need also to serve as a focus for research. We know too little which symbol systems are, or can be internalized, how they guide thinking and perception and how the latter are externalized for communication purposes.

Effects on Children's Attention Comprehension and Social Behaviour

Representational Codes of Television: Verbal and nonverbal forms are the representational codes of television. Because children view television at a very early age, it is tempting to assume that these representational codes are simple and of little interest. However, television is a medium that can be processed at differing levels of complexity. There is a difference between superficial consumption of interesting audiovisual events and mental extraction of information from coded messages, a distinction formulated by *Salomon* (1979). He used the term 'literate viewing' to refer to a process of information extraction by the active negotiation of the coding elements of the message'. The notion of 'literate viewing' is closely related to the more informal term 'media literacy.' With age and viewing experience, children's attention to, and comprehension of, television programmes change. It is presumed that these developmental changes reflect increasing facility with television's conventions and content, i.e., the beginning television viewer is not 'media literate' but instead gradually acquires such competence as a function of experience with the medium and the attainment of certain minimal cognitive abilities.

Just because one can become a literate viewer at an early age and without conscious effort does not demonstrate that the task is simple. The representational codes of television range in complexity from literal visual depiction to the most abstract and arbitrary symbols, including verbal language and audiovisual metaphor. The child's task is not an easy one. The change from infants' sensory-motor awareness of alternations in patterns of visual and verbal stimuli (*Hollenbeck* and *Slaby,* 1979) to the literate viewing skills of elementary school-age children involves a major qualitative advance, accompanied by developmental growth in related perceptual and cognitive skills.

Levels of Representation

The simplest level of representation is literal visual and/or auditory portrayal of real-world information, e.g., a shot of a car moving on the highway. A child's ability to process this level is presumably dependent primarily on perceptual and cognitive skills used in interpreting real-world stimuli. But even at this literal level, object recognition at unusual angles of viewing, lighting, and distance requires perceptual generalization and constituencies not yet fully developed in the youngest viewers.

On the second level of representation are media forms and conventions that do not have an exact real-world counterpart, some of these, such as cuts and zooms, are analogs of perceptual experience. For example, a zoom-in is a perceptual analog of moving close to an object. Other media conventions are more distinct from real-world experience. Dissolves, slow motion, musical accompaniments, sound effects, and electronically generated visual special effects are relatively specific to film and television. These features provide a structure for the presentation of content in a manner analogous to syntax in language. A literate viewer must be able to decode the structural meanings of formal features. For example, fades and dissolves often indicate major transitions in time, place, or content; cuts are more often used for minor shifts from one character or viewing angle to another. In American children's programmes, distinctive visual 'markers' are used to separate programmes from commercials; the literate viewer must understand their function. This understanding is not automatic. For example, 5-and 6-year-olds did not understand the meaning of separators between programmes and commercials in one recent study (*Palmer* and *McDowell, 1979*).

Media codes can also serve as models for mental representation or mental skills. That is, the child can adopt the media forms as modes of representations in her own thinking. *Salomon* (1979) has demonstrated, for example, that children can learn to analyse a complex stimulus into small parts by observing camera zooms in and out. Apparently, the camera provided a model of the mental process of focusing on specific parts of the stimulus. Media codes can be internalized as forms of mental representation, as suggested by *McLuhan* (1964), so that people can think in moving pictures with flashbacks, fast and slow motion, changes from colour to black and white, and other media conventions (*Salomon,* 1979).

The forms of television can also take on connotative meaning, either because of their repeated association with certain content themes or because of their metaphorical similarity to real-world objects and symbols. For example, rapid action, loud music, and sound effects are often associated with violence in children's programmes (*Huston* et al., 1981). Commercials for masculine sex-typed toys are made with high action, rapid cuts, and loud noise, whereas feminine sex-typed toys are advertised with fades, dissolves, and soft music. The forms themselves may come to signal violence or sex typing to children, even when the content cues are minimal or nonexistent. Two studies demonstrated that children as young as five or six understand that productions using loud noise, fast pace, and high action have masculine connotations while soft music, frequent fades and dissolves connote femininity. This is evident for content-reduced synthetic ads and for professionally produced naturalistic ads (*Leary* and *Huston,* 1983).

The third level of representation consists of symbolic forms not unique to the medium. Such forms may be nonlinguistic (e.g., a red stoplight) or linguistic. It is also possible for verbal language to encode forms at the other two levels. For example, dialogue can encode the literal representation of reality (the first level), as when a speaker describes on-screen objects or events, or dialogue can encode the conventional significance of a production feature (the second level), as when a fade is accompanied by the line 'Once upon a time, long, ago...' In this sense of double encoding, it is possible for the first two levels to nested in the linguistic codes. Such piggybacking of representational means could aid children in understanding the message and also, by association, facilitate their mastery of the codes themselves (cf. *Rice* and *Wartella,* 1981).

It is apparent that the second and third levels of representational codes found in children's television programmes not only have different surface characteristics but also are derived from different sources or experiences. The second level of representation, specific knowledge, is probably acquired largely as a function of experience with the medium. That is not the case with the third level, where symbols are shared by the wider culture.

By definition, these codes have currency outside the medium of television and can be learned without viewing television. They also have a different utility in the world, leading to slightly different reasons for investigating them. The media-specific codes are important insofar as they reveal what is involved in a child's processing of televised information. The verbal language of television is of special interest insofar as it contributes to a child's processing of televised messages and other media codes and also, perhaps more importantly, as it serves to facilitate a child's mastery of the general linguistic code (cf. *Rice,* in press, a; in press, b). While the representational functions of the linguistic system have been described by linguists in a long research tradition, the production conventions, or codes, of television have only recently come to the attention of behavioural scientists. The first step in understanding these codes and their functions is to develop descriptive taxonomies for formal features and to describe the ways in which they are used in television productions.

Most descriptions of formal features have been developed for the purpose of studying television's influence on children. This is not to imply that formal features are without relevance for adults or that studies conducted with adult subjects are without implications for understanding children's television viewing experiences. A general discussion of how formal features may influence adult viewers is, however, beyond the scope of this review; only those studies immediately pertinent to child-directed issues and investigations are presented. Readers interested in the effects of television forms on adult audiences may wish to refer to television and film broadcasting and production publications, where issues of form are often discussed in regard to editing techniques.

For example, *Messaris* et al. (1979) argue that editing techniques (the sequence and composition of visual shots) influenced how adult audiences perceived the nature of the interchanges between Carter and Ford during the televised 1976 presidential debates [....] Formal features of children's television programmes have been analysed in our work (*Huston* et al., 1981) to determine what features co-occur, what features characterize animated and live programmes, and how formal features differ as a function of target audience or production goals.

In two samples of children's programmes selected from Saturday morning, prime time, and daytime educational programming (primarily PBS), action (physical activity of characters), variability of scenes (number of different scenes), and tempo (rate of scene and character change) were grouped with visual special effects, rapid cuts, loud music, and sound effects. This package of features was labelled 'perceptually salient' because it was characterized by high intensity, rapid change, and rapid motion.

Commercial programmes for young children are packed with these perceptually salient forms. Although such formal features are more frequent in animated than in live shows, Saturday morning live programmes have higher rates of perceptually salient features than prime time or educational programmes.

This pattern of heavy reliance on perceptual salience suggests an image of the child in the minds of producers as a being whose attention must be captured and held by constant action, change, noise, and visual onslaught. Although much of what children watch is family adult programming, these children's programmes may be particularly important developmentally because they constitute the child's earliest experience with the medium. They may set the standard for what the child expects from television. In addition, they are less likely that adult programmes to be mediated or buffered by parents' or adults' viewing with the child. We co not know what effects early experience with heavily saturated television 'hype' and violence has on later development, later viewing patterns or on taste and preferences in the medium, but these questions are critically important for future research.

Educational programmes for young children use some perceptually salient visual features that characterize Saturday morning programmes, though at more moderate levels. They combine these features, however, with other forms that have considerable potential for helping children to understand, rehearse, and remember a message.

These include child dialogue—probably the best form of speech to gain and hold children's attention—as well as songs, long zooms, and moderate levels of physical activity. All of these features provide opportunities for reflection, rehearsal, and review of content.

Songs are frequently used to repeat themes and as a device for helping children to rehearse. Long zooms involve slow presentation and/or emphasis of important content. Because young children often understand content that is demonstrated in action, the moderate levels of action may be a particularly important means of conveying information in a form that is interesting and comprehensible to a young child. Educational programmes package their content in a set of forms that is quite different from commercial programming for children, and they appear to be designing programmes that have good potential to hold attention *and* to communicate a message effectively.

The findings concerning forms in children's programmes can also be seen from the perspective of media literacy and its antecedents (*Wright* and *Huston,* 1981). Recall that Saturday morning cartoons were characterized by high levels of action, variability, and tempo. These clusters consist of perceptually salient events, such as physical activity, music, sound effects, scene changes, and visual special effects.

The conspicuous nature of these features may allow the forms themselves to become the message. That is, the child may pay more attention to *how* the information is conveyed then to *what* the message is, especially when the plot lines are thin to begin with. Unnoticed in the entertainment value of the features is the tutorial nature of the experience. The child is receiving explicit cues about how messages are communicated on television. In this case, the relationship between form and content is the opposite of the usual assumption. That is, the forms overpower the content (from the young viewer's perspective), whereas the problem is usually regarded as a matter of the content controlling the form (from the producer's perspective).

Linguistic Codes

The coding systems inherent in verbal language constitute another component of the forms of television. In television programmes, verbal language is a code within a code. Descriptive studies of the language of children's television can provide information for two purposes: (1) Knowing the nature of television's linguistic conventions or codes and how they interact with other forms of communication in children's programmes is a critical part of any attempt to understand how children process televised information; and (2) analysis of television's linguistic codes may show how they are adjusted in different programmes to different levels of linguistic competence in the viewer and therefore how they may, under certain conditions, play an important role in furthering language acquisition itself.

In a pilot study of the linguistic structure of children's programming in relation to formal feature use, *Rice* (1979) analysed 25 categories of linguistic coding in six programmes. The programmes represented animated stories with high, low, and no dialogue; a live programme representing situation comedy; and educational programmes differing in age of intended audience and format (*Mister Rogers' Neighbourhood* and *The Electric Company).*

Three sets of linguistic descriptors were scored: (1) 'Communication flow' consisted of measures of length, variability, rate, and repetition of utterances; (2) 'language structure' contained measures of grammatical completeness, descriptive qualifiers, and stressed single words; (3) 'meaning/content' variables included focusing (i.e., giving selective prominence to a particular linguistic constituent), nonliteral meanings, explicit instructions, novel words, and immediacy of reference.

Distinctive patterns of language usage were evident in the two educational programmes. *Mister Rogers' Neighbourhood,* the educational programme for preschools, presented a moderate pattern of verbal communication: a moderate amount of dialogue, without the use of nonliteral meanings or novel words, combined with moderate amounts of focusing and some use of stressed single words. *The Electric Company,* an educational programme designed for early school-age children, used the most dialogue of all the shows sampled and incorporated techniques for drawing attention and interest to dialogue (e.g., focusing, stressed single words, novel words, nonliteral meanings) while at the same time adjusting for easier comprehension of grammatical forms (e.g., short comments, partial grammatical units, low variability in length) and content (e.g., reference to immediately present events). While it is widely recognized that the purpose of *The Electric Company* is to enhance children's reading skills, the fact that it does so by means of intensive verbal presentation is generally overlooked. Both *Mister Rogers' Neighbourhood* and *The Electric Company* used techniques that are likely to facilitate children's comprehension of language (stressed single words, focusing), but the latter also used a more complex pattern of verbal presentation designed to challenge the more linguistically competent school-age viewer.

Unlike the educational programmes, the commercial programmes containing dialogue showed little evidence that language codes were adjusted to the level of the child viewer. Some contained frequent nonliteral meanings and little focusing. The situation comedy was particularly high in descriptive qualifiers and nonreferential content, and it did not share any distinctive language features with the other shows.

Comparison of the linguistic features with the formal production features of the six programmes revealed that the shows with low amounts of dialogue were high in action, pace, cuts, fades, zooms, visual special effects, vocalizations, sound effects, and music. All of these production features are perceptually salient ones that attract and hold visual attention in young viewers. The two verbally complex shows contained some distinctive uses of salient formal features: one had very high pace, frequent cuts, pans, and background music; the other had a high number of vocalizations.

Such findings suggest a continuum of difficulty of representational coding in this range of children's programmes. We would expect linguistic coding to be more difficult for young viewers than the perceptually salient visual and auditory nonverbal codes. The packaging of American cartoons seems well suited to young children of limited media or linguistic competence. Similarly, the simple, comprehensible speech in *Mister Rogers' Neighbourhood* is well suited to a preschool audience. More complex packaging in shows aimed at an older audience requires considerable linguistic sophistication and comprehension of distinctive uses of formal features. In some cases, the codes are judiciously mixed in packages of information presentation well suited to the communicative competencies of the intended audience. A moderate level of complexity may be important to maintain interest among older relatively sophisticated viewers.

Just as the conventional meanings of production features can be suggested by exaggerated, perceptually salient presentations used to convey redundant content, so there is evidence of adjustments of the linguistic and production codes that are designed to draw attention to and clarify language forms themselves. For example, the frequent focusing operations and stressed single words on *Mister Rogers' Neighbourhood* and *The Electric Company* serve to draw attention to the language codes. Furthermore, in these two programmes, the meanings of the linguistic forms are often explicitly depicted. Frequently, the content is a visual representation of the verbal meaning, sometimes highlighted by attention-maintaining visual production techniques, such as cuts to a closer focus or different perspective. At least some children's programmes appear to combine language adjustments with selective and supportive use of nonlinguistic salient features, at first to supplement and later to challenge the emerging cognitive competencies of the child viewer.

The language of commercials aimed at children warrants explicit attention from research insofar as the intent goes beyond the communication of messages to the selling of products. Presumably, the effectiveness of commercials is dependent upon the nature of the linguistic codes presented (i.e., their basic understandability), their referential accuracy, and their use within the social context. *Bloome* and *Ripich* (1979) analysed the social message units of commercials and how the messages related to plot or social context and/or the product. They found that many of the product-tied references were ambiguous in regard to certain features of products, such as the use of flavourings. Also, there was a subtle shift within commercials from using language in a social context to using language to promote products. Language served to establish the social occasion and then to lead the child to a product and its role in enhancing the social occasion.

The Influence of Television Forms on Children's Mental Processes

When children watch television, they can just sit passively and stare at the set if they choose, but a growing body of empirical evidence suggests that this is not the usual level of response. Instead, children are more likely to become involved in the viewing experience, to work at extracting information from coded messages, to respond cognitively, effectively, and socially to programme content. They are mentally and socially active viewers. At least some (if not most) of their mental responses are influenced by how the information is packaged, i.e., the media-specific and general representational codes employed (*Rice* and *Wartella,* 1981). The ones for which there is empirical evidence are discussed here: children's visual attention while viewing, and their understanding of television forms, programme events, and relationships among characters.

Visual Attention to Television Forms

Studies using different types of programmes found that certain production features or programme attributes attract and hold children's visual attention while viewing television. Even though different systems of scoring production features have been used, there is consistency in the findings:

1. Auditory features, such as lively music, sound effects, children's voices (but not adult dialogue), peculiar voices, nonspeech vocalizations, and frequent changes of speaker attract and hold children's attention.
2. Conventional visual features, such as cuts, zooms, and pans have less influence, but visual special effects do attract children's attention.
3. In most studies, high levels of physical activity or action elicit and maintain children's attention.
4. Changes in scene, characters, themes, or auditory events are especially effective in eliciting attention, though they are less important for maintaining it once the child is looking.
5. Features that lose children's attention include long complex speeches, long zooms, song and dance, men's voices, and live animals.

Auditory Attention. The finding that auditory events, action, and change elicit and hold children's visual attention, while visual features have less influence, serves to remind us that audition and vision interact in a complex manner during information processing. While there is considerable evidence describing visual attention, little information is available describing auditory attention (or the interaction of the two modalities) while viewing television. Any general conceptual model of how children attend to television (including the factors that are proposed as controlling attention) must take into account both visual and auditory attention.

The measurement of auditory attention while maintaining a naturalistic viewing situation has been a challenging experimental problem. Looking behaviour can be recorded directly in a reliable and unobstrusive manner; listening is a private mental event without easily observable indicators. We have devised a promising method for measuring auditory attention independently of visual attention. The procedure involves an intermittent degrade of the television picture or sound. As the child views, she can press a lever to restore the picture or sound track when it degrades. The child's responses are automatically recorded and time-referenced to the programme. Initial findings with preschool children suggest a close, relationship between looking and listening (*Rolandelli, Wright,* and *Huston,* 1982).

In addition to direct measures, auditory attention can be inferred by testing comprehension of material presented in the auditory modality or material presented when the child is not looking at television. Repeated findings that children receive and understand fairly complex messages from exposure to *Mister Rogers' Neighbourhood,* despite low rates of visual attention, have led to speculation that children were often listening even when they were not looking (*Tower* et al., 1979).

Obviously, auditory attention can facilitate comprehension only for material that is presented in an auditory modality, usually speech. Studies in our laboratory, involving microanalysis of short time intervals within a programme, indicate close connections among visual presentation of content, visual attending, and recall (*Calvert* et al., 1982). Similar precision in specifying the mode through which content is presented would be required to infer that auditory attention mediated comprehension.

Auditory attention can also be inferred by observing visual attention to the screen (or lack thereof) and by observing what children talk about while viewing. If they are talking about things unrelated to the television content, they are probably not listening. Even if they are looking at the set, their attention may be only at the level of monitoring instead of active processing. On the other hand, auditory features, such as foreground music and children's speech, recruit visual attention for children who are looking away from the screen—evidence that some form of auditory processing is taking place.

Form and Content Interactions

One of the original reasons for our interest in television form was the hypothesis that formal features in children's television were more important determinants of attention that violent content. The relative contributions of form and violent content are difficult to disentangle because conventions of production lead to correlations of certain forms with violence. Violence in children's programmes is usually portrayed with high levels of action and salient auditory and visual features (*Huston* et al., 1981).

Yet, formal features can be separated conceptually and operationally from violent content. In two studies of preschoolers, we selected programmes that were high in both action and violence, or high in action and low in violence, low in action and high in violence or low in both action and violence. Children's total attention differed as a function of action, not of violence. That is, they were as attentive to high action without violence as they were when it accompanied violence, and less attentive to low action.

A more molecular analysis was performed for these three programmes and for four other cartoons by dividing each programme into 15-second intervals and correlating attention with formal features and violent content.

Multiple regressions were performed to determine which features were the best predictors of attention in each programme. Violence did not enter any of the seven multiple regressions as a predictor that contributed significant variance independently of formal features, but considerably more data on different programmes and different age groups are needed to establish the generality of this null conclusion (*Huston-Stein*, 1977).

Form, Content and Viewership Ratings

The relation of form and content to children's interest in television programmes has also been studied by analysing features occurrence rates in nationally broadcast television programmes in relation to national audience ratings for different ages, sexes, and regions of the country. For a sample of 34 Saturday morning programmes, high action and violent content were predictors of viewership for preschool children. Each made an independent contribution. Among children from age 6 to 11, variability and tempo were the bet predictors of viewership (*Wright* et al., 1980). In a similar analysis of general adult audience ratings in relation to violent content of prime time adventure programmes, violence accounted for a minuscule and non-significant portion of the variance in viewership (*Dienier* and *DeFour*, 1978).

How Formal Features Influence Attention

Salience and Informativeness. Basic research on young children's attention indicates that perceptual salience of the stimulus environment is one determinant of attention. The attributes of a stimulus that make it salient include intensity, movement, contrast, change, novelty, unexpectedness, and incongruity (*Berlyne,* 1960). Many of the production features that attract and hold young children's attention fit these criteria defining perceptual salience. We have proposed a developmental model hypothesizing that perceptual salience is a particularly important determinant of attention for very young viewers and/or for viewers with little media experience.

The theory guiding our work was derived from the more general theoretical work of *Wright* and *Vlietstra (1975)* concerning developmental change from 'exploration' to 'search' in children's modes of information getting. Exploration as a mode of response is governed by the most salient features of the stimulus environment. It involves short duration, discontinuous, and impulsive responding to whatever features of the environment are perceptually dominant from moment to moment. Habituation to the salient features of a particular stimulus environment occurs as one becomes more familiar with it. Application of this model to television experience leads to the hypothesis that, among the youngest and least experienced viewers, the viewing experience consists of the consumption of perceptually salient events as entertainment in their own right. The child's attention is controlled primarily by feature salience. Until the powerful effects of salience have partially habituated, the child is essentially a passive consumer of audiovisual thrills and does not engage in deeper levels of processing (*Wright* and *Huston,* 1981).

Consummatory stimulus-controlled exploration gives way in familiar contexts to perceptual search, a kind of information getting in which the activity is instrumental, rather than consummatory, active rather than passive, and guided by the child's desire to abstract information, rather than by just entertainment, from perceived events.

The child's progress from perceptual exploration to perceptual search is believed to be as much or more a function of familiarization through experience and habituation as it is a consequence of cognitive maturation, though, of course, the two are usually confounded. Thus, the older and more experienced viewers are more interested in the content of programme and its meaning and less responsive to salient formal features. When older children do attend to formal features, they may use them as syntactic markers to develop a structural framework in which to organize and integrate their comprehension of content meaning (*Huston* and *Wright,* 1983).

Singer (1980) also proposed that high rates of salient audiovisual events on television absorb children's attention, not only because they are perceptually interesting, but because they are affectively involving. His theory does not, however, contain the proposition that developmental shifts will occur as consequences of cognitive development and familiarity with the medium. Instead, he seems to imply that extensive exposure to salient features in the medium will inhibit other forms of interest (e.g., books and verbal media) and will leave the child focused on the absorbing stimulus features of the moving picture on the screen.

Studies comparing attention patterns of preschool children (age 4-6) with those of children in middle childhood (age 8-10) have provided minimal support for the hypothesis that younger children are more attentive to salient formal features than are older children (*Calvert* et al., 1982; *Wartella* and *Ettema,* 1974; *Wright* et al., in press). Both age groups attend to high levels of action and audiovisual 'tricks' (visual special effects, sound effects, and unfamiliar scenes). Although these studies are consistent with the notion that younger children's attention is affected by the perceptual salience of television's formal features, they suggest that many of these features serve other functions as well in the child's processing of televised information.

The complementary hypothesis is that older children's attention is guided more by the informativeness of features. Informativeness depends on the programme context and the child's level of processing. For example, in a study comparing high and low pace programmes, 8 to 10-year-old children patterned their attention according to the length of scenes so that their average duration per look at the screen was longer in low pace programmes (with long scenes) than during high paced programmes (with short scenes). Younger children (5-to 7-yer-olds) did not show this pattern (*Wright, Huston, Ross, Calvert, Rolandelli, Weeks, Raeissi,* and *Potts,* in press). These findings suggested that the older children used the formal cues in the programme to determine natural breaks between scenes with more skill than the younger children did.

When children try to follow a plot or engage in a logical search for meaning, they probably attend to features that provide cues about time sequences, locations, characters, and events in the programme. Studies by *Krull* and *Husson* (1979), in fact, suggest that older children may attend to form cues that signal content and form changes during the upcoming 1 or 2 minutes. Preschool children did not show these anticipatory patterns of attention to formal cues. Media literate children may learn temporal associations so they can anticipate what will occur in a programme. Older children also attend differentially to informative action and signals associated with scene changes, bit changes, and changes to and from commercials.

Comprehensibility

A somewhat different perspective on the relationship between attention and formal features is proposed by Anderson and his associates, who link attention with the comprehensibility of programme content (e.g., *Anderson* and *Lorch,* 1983). They suggest that features such as animation or children's voices may serve as signals that the content is designed for children and is therefore likely to be comprehensible. Children may attend to such features not because of the inherent qualities of the features, but because their media experience leads them to expect meaningful and understandable programme content. The fundamental determinant of attention, according to this formulation, is the comprehensibility of the content. Two sets of data have been used to support this hypothesis. In one study (*Lorch* et.al., 1979), children's attention to *Sesame Street* was manipulated experimentally by varying the availability of toys and distractions during viewing. Despite the fact that the nondistraction treatment produced very high levels of attention, it did not produce improved comprehension. Within the distracted group, however, the children who attended more comprehended more of the content. This finding was interpreted as demonstrating that comprehensibility guided attention rather than attention determining comprehension. In a subsequent study (*Anderson, Lorch, Field,* and *Sanders,* 1981), children attended less to a television programme in which the speech was incomprehensible because it was backwards or in a foreign language than to a programme with under-standable speech.

Although the influence of comprehensibility on attention has been tested thus far only by varying language features of programmes, the hypothesis suggests that the comprehensibility of nonlinguistic formal features should affect attention through a similar mechanism.

This line of research provides important evidence that very young children are actively processing content when they watch television rather than merely passively consuming audio-video thrills.

It does not, however, establish that feature salience and other noncontent aspects of television programmes are unimportant influences on children's attention. In the studies varying comprehensibility, feature salience has ben held constant (and fairly high).

If salience were low, would comprehensibility alone hold children's attention? Again, the relatively low rates of attention usually found for *Mister Rogers' Neighbourhood* suggest not, despite its outstanding comprehensibility. Second, the full range of comprehensibility has not been systematically explored. In a study recently completed in our Centre, these issues were addressed.

Form and comprehensibility were varied independently. Short educational bits were constructed with identical content in animated, child-format versions and live, adult-format versions. Each format was used to produce bits varying in difficulty or comprehensibility but all were within the range of children's ability to understand. Children attended to the child-format versions more than to the adult-format versions, but they did not attend differently to the bits that were easy or difficult to understand (*Campbell,* 1982). It appears that there are many reasons why animated child formats may be attractive to children.

Further, although complex, incompre-hensible material loses children's attention in comparisons to moderately easy, comprehensible material, one cannot extrapolate that finding to conclude that very easy material would produce more attention than moderately difficult but still comprehensible content. In fact, the model to be proposed here suggests that both extremes of comprehensibility will be less likely to maintain attention than material in the middle range. Moreover, the model explicitly cautions against trying to define moderate comprehensibility as a stimulus feature without taking into account both the cognitive level and the viewing experience of the child.

An Integrative Model of Attention and Development.

These seemingly divergent explanations of the determinants of attention can be integrated in the framework of one established model for attention and interest as a function of familiarity and complexity (*Hunt,* 1961).

The abscissa is a compound of familiarity and complexity of both form and content. On the left end are highly familiar and oft-repeated bits, like the standard introductions and closings of familiar programme series, whose informative content is minimal, and whose formal features have become habituated and no longer elicit attention among habitual viewers. The joint processes of habituation and familiarization (*Wright,* 1977) serve continually to depress attention on the left side of the inverted U-shaped function.

By contrast, the forms and content at the high end of the abscissa are unfamiliar, complex, and incomprehensible to the child viewer. They, too, elicit little interest and attention because the child is incapable of understanding their meaning and their relation to other parts of the programme. Their decoding requires comprehension of standards the child has not yet acquired and logical integration for which the child is not yet cognitively ready.

They also often make reference to outside information and contextual knowledge that only adult viewers possess. Thus, attention on the right side of the curve is also low, owing to incomprehensibility. But cognitive development and the child's growing store of background information will, over time, tend to raise attention on the right, just as familiarization and habituation tend to reduce it on the left. The result is a developmental migration of the curve describing a child's attention from left to right as a function of cognitive development and viewing experience. What was interesting for its perceptual salience or simple content becomes boring by its redundancy, and what was incomprehensible or formally complex, and therefore ignored, gradually becomes meaningful and informative in the decoding process and, therefore, of greater interest. If the abscissa is defined in terms of the form and content of a televised stimulus, the location of the curve for a particular child along that gradient is a function of cognitive level and viewing history.

How Formal Features Influence Comprehension

As children attend to television, their immediate task is how to interpret the information they receive, what to make of the messages. The medium's representational codes influence this process of comprehension in a number of ways. The media-specific codes themselves require some interpretation, as do the general representational codes, such as language. The coding systems also interact with content in ways that can enhance or interfere with how easily the content can be understood.

Media-Specific Codes and Mental Skills. Recall our opening remarks about how television does not literally present events as we perceive them in the real world. Instead, the representational codes package messages in a manner that requires mental transformations in order to interpret them. The linkage between forms and mental processes can be quite specific and intimate. *Salomon* (1979) proposed that some production features may be viewed as representing certain mental skills or mental operations. For example, zooming in and out literally portrays the mental operation of relating parts to a whole. Camera cuts that make the image jump from one part of a physical space to another, or from one view of an object to another, correspond to the mental operations of coordinating spaces and taking different perspectives.

Salomon (1979) distinguishes two different ways in which production features can function in relationships to mental processes, at two different levels of interpretative difficulty. One is the function of 'supplanting' the skill. That is, the camera essentially performs the operation for the viewer; presumably, the viewer can learn the skill from watching through the eye of the camera. A zoom-in is an example of a camera operation that supplants the skill of analysing a complex array into subparts or isolating one small part at a time.

The second function of media codes is to 'call upon' an already existing skill in the viewer. For example, a cut to close-up shot presumes that the viewer can already relate small parts to a larger whole; it does not perform the operation as a zoom does. Data on both Israeli and American children support the hypothesis that the understanding of and ability to use common media codes increase with age and, in some cases, with media experience. Younger and less experienced viewers benefit more from media formats or formal features that supplant the intellectual skills to which they relate. Older and more experienced viewers understand recurring formats that call upon related mental skills better than do younger and less experienced viewers (*Salomon, 1979; Palmer,* 1978).

For example, children who were skilled at visual analysis performed better when shown a 'cut to close up' format than when shown zooms (*Salomon,* 1974). *Salomon* (1979) argues that the relationship between media codes and children's mental processing is not just a one-way process of using mental skills to interpret media codes. Instead, the influence is reciprocal: Experience with media codes actually cultivates the existing mental skills to which they relate; the media codes can become part of children's mental schemata, resulting in their ability to think in terms of such codes as zooms and camera cuts. *Salomon* cautions, however, that the media-specific codes are not the only messages to affect cognition, and not all of television's codes function in this capacity. He suggests that those codes that are unique to television and have a wide potential field of reference are those most likely to contribute to viewers' mental schemata.

The supplanting function of media form was tested in our laboratory in two studies designed to teach conservation of number by showing children animated television sequences demonstrating that the number of objects was independent of their spatial configuration. Pairs of white and black squares separated into designs, danced around one another, and played games; then they returned to their original arrangement with a narrator's reminder that there were still the same number of blacks and whites. Training improved conservation on a televised post-test of number conservation, but did not generalize to a live test, in the first study. In the second, training influenced performance on both televised and live post-tests.

Children's understanding of how media-specific forms mark temporal relationships was investigated in two studies of instant replays. Two factors were varied: The content of the replay and the presence or absence of an accompanying special effect (opening and closing geometric shape). We were interested in when children noticed that a replay had been inserted and how they interpreted what it depicted. It was not until around age seven years that children noticed a majority of the replays. The most likely context for noticing the replay was that of simple, everyday events (such as phone calls).

Younger children (ages four to seven) interpreted replays as repetitions, as if there had been no cut back to the start of the sequence and the actor had simply repeated their actions or another actor had duplicated the actions of the first. Older children gave media-related explanations that were most likely for sports contexts, i.e. baseball games.

Language Codes

There are several aspects of verbal language that have relevance for how children comprehend the messages of television. The first is how children comprehend the verbal dialogue itself. This question has yet to be the subject of explicit empirical investigation (beyond a few observations of how children interpret disclaimer phrases in commercials). We can presume however, that children interpret televised verbal information according to the same linguistic processing strategies and contraints that they draw upon the presence of live speakers. In other words, insofar as the general representational codes of television are like their real-world counterparts, children probably interpret them in much the same way as they do in other social contexts.

The second aspect of verbal language with relevance for comprehension is the fact that, unlike the media-specific representational codes, viewers can produce the general codes themselves to communicate their reactions to and understanding of television. Viewers can process the messages of television and then respond in some of the same codes; indeed, they can literally imitate and rehearse the verbal messages, if they choose to do so.

In one study, we explored what children talk about when they watch television as a function of the amount of dialogue present in the programmes. Preschool and third-grade children watched four shows that differed in the amount of dialogue (one show with none, two with moderate amounts, and one with a high frequency of dialogue). The children watched in pairs, and they were free to pursue other play activities.

Their comments while viewing were transcribed and coded for content categories. The children made the most comments about the television programme when viewing the programme with no dialogue. This trend was more pronounced among the third-graders than the preschoolers. Furthermore, the television-related comments fell in a distinctive pattern: more descriptions of actions and events, more emotional and self-referenced comments (e.g., 'I like this part'), more questions about programme content, and more statements of knowledge of recurrent programme themes for the no-dialogue programme than for any of the other three. There were very few directly imitative responses (*Rice,* 1980).

The most obvious interpretation of these findings—that children listen when there is dialogue and talk when there is no dialogue—does not completely account for the results. The total amount of talking was highest in the no-dialogue show, but second highest in the high-dialogue show. Children talked to one another extensively during a programme with frequent dialogue, but they more often talked about topics that were irrelevant to the programme.

In the programme without dialogue, the absence of dialogue, as well as the fact that the programme was familiar and repetitive, appeared to stimulate children to talk about the programme. Whether or not similar effects would occur for programmes that were less repetitive or familiar is not yet clear, but in a programme that is interesting, familiar, and simple to understand, it appears that he absence of dialogue may elicit comments about aspects of a programme that are of interest to children.

Verbal Mediation of Content

Another aspect of verbal language with relevance for television viewing is that it can be used to mediate and direct more general mental processes, such as attention, comprehension, and recall. Verbal labels and explanations have been used in a number of experiments to clarify children's understanding of programme content. In one study, preschool children imitated sharing from a television programme more when the programme included verbal labelling of the characters' behaviour than when the behaviour was not labelled (*Susman,* 1976). In another investigation, verbal explanations of programme themes inserted in a cartoon with a moderately complex plot were relatively ineffective in improving comprehension, but the same explanations provided by an adult viewing with the child aided comprehension considerably. In particular, children who received the adult explanations recalled the temporal order of events in the programme and were able to make inferences about implicit content better than controls. They also attended more to the programme. Temporal integration and inferential processing of televised informations are skills that are difficult for third-graders, yet even 4 to 6-year-olds were able to do them better than chance after the adult explanations *(Watkins* et al., 1980). Other studies have demonstrated similar benefits for kindergarten-age children from verbal labelling of central programme themes (*Friederich* and *Stein*, 1975).

Television Form and Plot-relevant Content

Many television programmes are narratives; that is, they tell a story consisting of interrelated events. The content of such stories can be distinguished as plot-relevant (central content) or irrelevant to the plot (incidental content). Developmental changes in comprehension of such content have been explored in some detail (*Collins,* 1979). Through second grade, children have limited and fragmented comprehension of story material, fifth-graders do better, and eighth-graders comprehended most of the story. In particular, younger children tend to recall material that is incidental and irrelevant to the plot, whereas older children appear better able to select central content messages. Younger children also have difficulty in integrating facts of the story that are separated in time (e.g., connecting an action with its motives and consequences), and they have difficulty inferring content that is implicit in the story but is not explicitly shown. All of these findings are based on children's responses to adult prime time dramas (*Collins,* 1979; 1982). The specific ages at which changes in comprehension occur may be slightly different for other types of programmes, such as those made for children, but the direction of developmental trends is probably the same.

While developmental differences in children's understanding of television content undoubtedly reflect cognitive developmental changes, they may also vary, depending on the form in which content is communicated. In general, children understand information presented visually, so that character actions can be observed, better than they understand information presented in verbal form without accompanying visual cues. In addition, high action and other perceptually salient features maintain children's attention better than dialogue and narrations of children may retain the content presented with salient features better than content conveyed primarily through dialogue. Obviously, the combination of visual and verbal cues is likely to be most effective (*Friedlander* et al., 1974).

In one study (*Calvert* et al., 1982), children's recall of a televised story was measured for four types of content: central or incidental content was presented with formal features that were either high or low in perceptual salience. High salience features included visual features and moderately high action; low salience features included adult and child dialogue. Central content questions often involved inferences; incidental content usually consisted of isolated factual events. Children remembered central, theme-relevant content better when it was presented with highly salient formal features than when it was presented with low salience techniques.

Some parallels appear in a study of commercials in which visual cues and words in the form of slogans or labels actually conflicted with the more abstract verbal message. Visual cues and word slogans suggested that the advertised products contained fruit, although the 'higher level' abstract verbal message indicated no fruit content. Children from kindergarten through sixth grade accepted the false message conveyed by the visual and associative word cues. Apparently they did not understand the abstract implied message that there was no real fruit in the products (*Ross* et al., 1981).

Salomon's work (1979) also indicates that children understand content messages better when they understand the formats used to present the content. For instance, children who were good at relating parts to a whole, and who could, therefore, understand a close-up format, learned more content from a film using cuts to close-ups than did children who were less skilled in understanding that format.

This prediction is upheld in an investigation of the effect of media-specific forms on children's comprehension of nutritional announcements. Nutritional messages containing identical visual and verbal content were produced with two types of formal features selected to represent the forms typically used in adult and child programming respectively. The adult versions were made from live footage with an adult male narrator and sedate background music, while the child versions were animated with peculiar 'character' voices, and sprightly, whimsical music. Children comprehended nutritional messages better in the child-format presentation that in the adult format (*Compbell,* 1982).

These findings suggest that associating content with certain media codes may increase comprehension of the content, if the production feature is familiar and understood by the child and if it focuses attention on central rather than incidental content. If the child does not understand the code represented by the feature or if the feature focus attention away from the central content, it may interfere with comprehension. These conclusions may apply to the verbal codes of television as well as to the media-specific production features.

To conclude this section on how children's comprehension of television is influenced by the representational codes, we can offer some general observations. The child viewer has the job of making sense of the medium at several different levels: the codes themselves, the immediate content, and more abstract interrelations relevant to story lines. The representational codes are implicated at each of these levels. Children learn to interpret the media-specific codes as a function of age and viewing experience. Furthermore, certain media codes may come to be incorporated in children's general mental schemata. The general representational code of verbal language has a two-fold relevance for increasing our understanding of how children comprehend television: (1) We need to be aware of the particular interpretative demands presented by the verbal dialogue as a linguistic code; and (2) children's own verbal comments while viewing can provide further cues about how they comprehend television's messages (cf. *Rice* and *Wartella,* 1981). The psychological dimensions of television codes can be used to enhance children's comprehension of plot-relevant content: the association of attention-getting features or codes that are readily understood with content central to the story should contribute positively to children's ability to understand the plot.

2

Trends and Issues in Information Science

The Emergence of 'Information Science' as a Field of Research

The average person probably has little awareness of the terms information science and information research. They are related to the activities of a particular professional group (or, given the propensity to schism, particular groups); literature on the subject is found in specialized journals and rarely in the popular press; and it is written, at times, in a professional jargon that deters readers.

Things may become clearly, however, if the word 'librarianship' is used. The word is appropriate because information science has developed out of librarianship and many of its research concerns are held in common with library research. The Institute of Information Scientists in the UK has approximately 2,000 members and half of these are also members of the Library Association. In 1985 a conference of all professional bodies in the fields of information science, librarianship, archives management, and records management was held: an event which indicates the essential unity of the issues and problems faced by the different groups.

The branch of librarianship out of which information science has developed is generally known as 'special librarianship'. This term covers the activities of those working in specialized libraries and information units in business, industry, scientific research, government and local government. Its origins lie in the growth of industrial research activity during and following the First World War. Aslib, originally the Association of Special Libraries and Information Bureaux, was founded in 1924 and an American organization concerned with similar areas of work, the American Documentation Institute (now the American Society for Information Science) was founded in 1937.

Special librarianship and 'documentation' received a boost during and after the Second World War, partly as a result of the regeneration of industry, partly out a need to deal with vast quantities of industrial research and development documentation found in Germany, and partly as a result of the development of a new industry based on nuclear energy. That development resulted in such an increase in published reports and papers that a major new journal of summaries, *Nuclear Science Abstracts*, was established by the US Atomic Energy (USAEA) to disseminate information about information.

Fresh impetus to the generation of scientific and technical information was given by the launch of the first Russian sputnik in 1957. The effect in the USA in particular was galvanic, leading to an upsurge in research activity and publication.

In both the nuclear energy field and in space technology research one feature caused problems for librarians in government and industry. This was the emergence of a relatively new form of publication, the research report. This form was not unknown in industry where internal research reports had always been produced by those firms with research and development departments. The new feature was the wider publication of such material. Sometimes the 'publication' was limited; for example, the United Kingdom Atomic Energy Authority restricted some reports to contractors in the industry. Both UKAEA and the USAEA, however, maintained depository collections in major public libraries.

The main problem in handling the vastly increased output of scientific and technical information was how to identify the subject content for effective retrieval of the material from storage. What in libraries had been known as 'cataloguing and classification' became known as 'information storage and retrieval' and a new field of information research arrived. In continues to thrive.

More recently, during the Johnson administration in the USA (1963-1969), there was a great upsurge of social research associated with many aspects of social welfare and other issues. Much of this took the form of evaluation research on social programmes in the cities and, while not equal in scale to the volume of scientific information, the consequent growth of the literature was considerable and the semi-published report made its appearance in the social sciences. Both developments and related events in the United Kingdom and in the agencies of the United Nations resulted in an interest in research into similar problems of information use and information storage and retrieval as in science and technology.

Today, however, the systems that are created and used to control and disseminate information in industry, in government and in education make use of yet another force for change—the computer. This is not the place for a complete account of the role of the computer in information science. The aim here is simply to draw attention to its impact and to that of 'information technology'—a term which embraces computers, telecommunication systems, new means of storing information such as compact discs, and of communicating information such as teletext and view data systems.

Since the Second World War, therefore, there has been a series of continuing pressures on libraries and information systems as a result of the developments noted above. The field of information science has evolved as a consequence of these pressures and research in the field aims to help in adapting systems to the pressures.

The Phenomena Studied—What is 'Information'?

'Information' is such a widely used word, such a common-sensical word, that it may seem surprising that it has given 'information scientists' so much trouble over the years. The problem stems from seeking to discriminate among related words such as 'data', or 'knowledge' or even 'wisdom'! In dictionary definitions these terms are associated as these extracts from the Random House Dictionary show :

1. Knowledge communicated or received concerning a particular fact or circumstance; news...
2. (In communication theory) an indication of the number of possible choices of messages...
3. Computer Technology any data that can be coded for processing by a computer or similar device.

The same dictionary suggests data, facts, intelligence, advice as synonyms for information.

The definition used in this paper, then, will be that 'information' is an abstract noun, signifying some single fact or datum, or set of facts or data, which may be organized or not. Sometimes the abstract noun is used to signify concrete things which may be said to 'carry' information, such as books, journals, tape recordings, and visual media such as video recordings, maps, photographs, etc.

Some writers in information science, however, have not been satisfied to treat 'information' as a noun but have tried to define it as a *process*—the process whereby facts and data are integrated into existing knowledge or transformed into organized bodies of knowledge. This seems to do violence to the language. The processes whereby data and facts are transformed into knowledge are the processes of perception, cognition and understanding. They are almost entirely mysterious to us, having resisted the most serious scientific investigation. Indeed, consciousness itself is not yet clearly understood. To use the term 'information' to signify some cloudy set of terms in an attempt to give more solidity to the nature of information science hardly seems helpful.

Other writers have carefully defined what *they* mean by 'information' in carrying out their research. The most popular definitions of this kind relate information to decision-making in a form such as, 'Information is that which removes uncertainty'. Clearly, this is a *formal* definition because we all know that in the real world outside the experiment or the simulation we frequently receive communications of facts, data, news, or whatever which leave us more confused than ever. Under the formal definition these communications contain *no* information—party political broadcasts, perhaps.

Information Science and its Changing Scope

What constitutes 'information science' is as much of a problem as the nature of information—naturally, since one depends upon the other. The definition used here is based on that given above:

> *Information science is the study of the generation, organization, transfer, and utilization of information. It is concerned with the nature of information in general, with the channels or 'carriers' of information, and with the information user. It is concerned with all aspects of the design and evaluation of information systems and services, from public libraries to computer-based information retrieval systems.*

As noted earlier, information science emerged originally out of the pressures placed on libraries and information services by the explosion of scientific and technical information. That bias exists to this day. Although research in information retrieval may now be concerned with such things as how children ask questions in libraries (Wanting, 1984) or how to devise a computer-based online catalogue for fiction (Pejtersen, 1984) there is a tendency for the literature to be very much concerned with scientific and technical information problems. This is partly a consequence of the dominance of scientific research over social science research in the scale of funding and in consequent publication. Some problems in scientific information have also been of continual interest, particularly those having to do with chemistry where chemical formulae and chemical structures lend themselves to highly structured methods of retrieval.

The emergence of social science from its original neglect in favour of scientific information can be dated in the USA to 1950 and the University of Chicago (1950) report on bibliographical services in the social sciences. This beginning, however, was not followed immediately by research into problems of access to information, or different patterns of information-seeking behaviour. Interest in bibliographical aspects, that is, in the compilation of bibliographies and other guides to the social science literature, continued, however (for example, Boehm, 1965; de Gazia, 1965).

In the UK the beginnings can be dated to the start of the INFROSS (Information Requirements of Social Scientists) project in 1967. In the course of the INFROSS project Maurice Line and his colleagues surveyed the information-seeking behaviour of (chiefly) academic social scientists, and carried out a number of subsidiary studies (Bath University, 1971; Line, 1971).

INFROSS was followed in 1971 by DISISS (Design of Information Systems for the Social Sciences) which was concerned chiefly with the growth of social science literature in a variety of fields, with the coverage of this literature by the abstracting and indexing services, and with implications for the planning of services (Bath University, 1980; Line 1981).

During the INFROSS/DISISS period there were two major developments in bibliographic services to social scientists: the ERIC service (Marron, 1968) which covered information resources for education and drew upon the large volume of research commissioned by the US Government, and the extension of the Institute for Scientific Information's citation indexing into the social sciences (Garfield, 1972). In its early years the ERIC service attracted a good deal of comment, particularly on the quality of its indexing, and the entire service was subject to an intensive evaluation. The *Social Sciences Citation Index* built upon the strength of its predecessor in science, and both services were quick to take advantage of that other development of the period, the computer.

The terminology of the social sciences has always presented problems in information retrieval: not only does it use ordinary words in technical fashion (for example, 'class') but some of its technical terms, like 'bureaucracy', have changed their meaning subtly in common usage. As a result, a search may result in a set of documents which includes a large number of items which deal with, say, bureaucracy, but not in the sense anticipated by the user. An additional difficulty is that adherents of different philosophical or ideological schools use the same term in different ways or with different associations. These issues were raised in connection with the ERIC service (Eller and Panek, 1968), were reviewed by Foskett (1963) and were the subject of research in relation to the sociology of education (Swift, Winn and Bramer, 1979).

Since 1967, therefore, there has been a growing awareness that the social sciences have information problems which are related to those in science and technology, in that they are the result of a similar 'information explosion'. The problems differ, however, because social scientific research differs from that in pure science. For example, controlled experiment is difficult, if not impossible, in social research. Directions of research may be more directly influenced by political considerations (witness Sir Keith Joseph's attempt dispose of the Social Science Research Council). And society and its constituents are continually changing in character, whereas, generally, the phenomena studied by science are more stable in their structures—a molecule of hydrogen a century from now is likely to look very much the same as today's, while the nature of, say, the education system of the country could well be quite different.

Following the studies of the academic researcher in the social sciences, attention in the UK has focused upon the information problems of what might be called 'applied social sciences'. This era began with the study of local authority planning departments and planners in 1974 (White) and was followed by a major five-year project in the field of social services—Project INISS: Information Needs and Information Services in Local Authority Social Services Departments, and, simultaneously, by studies in education (Hounsell, *et al.* 1979). Subsequently, work was carried out in other local government departments. In the USA over the same period the major project was probably URBANDOC (Sessions, 1971).

During the same period as the increase in interest in the social sciences took place there was a similar movement in relation to the citizen-at-large. In the 1930s there has been an interest in 'library surveys' culminating in an extensive review of the subject by McDiarmid (1940). At the end of the Second World War a major report on the public library user was carried out and reported on by Berelson (1949). In an attempt to provide a sound conceptual base for the study of the general information user the US Department of Health, Education and Welfare funded a study in Baltimore—Information Needs of Urban Residents (1973). This laid the ground for other studies in Syracuse (Gee, 1974), Seattle (Dervin *et. al.* 1976/77), Maryland's Eastern Shore (Eidleman, 1979). South Carolina (Barron and Curran, 1979). California (Palmour *et. al.* 1979) and New England (Chen and Hernon, 1982). There has been no investigation in the UK approaching the scale of these studies.

It is important to note that virtually none of the work carried out in the UK could have been done without the existence of the Office for Scientific and Technical Information and its successor the British Library Research and Development Department, which has the status of a research council for the field. Its resources have always been very restricted compared with other councils such as the SERC and the ESRC but there has been quite a high return on its investment in the shape of actual innovation, particularly in the adoption of computers for library tasks, as well as publication.

Changing Research Perspectives

Whether one is concerned with the information behaviour of scientists or with that of social scientists it is clear that in either case social research methods will be employed. In the period immediately after the Second World War, the model of social research employed by those researching the information behaviour of scientists was based on the then prevailing idea of quantitative research in social science, that is, the use of large-scale surveys intended to collect large amounts of data from which generalizations amounting to 'laws' similar to those in science could be derived. This is understandable: those who carried out the work were likely to be scientists themselves and they saw their tasks as very much concerned with the description of identifiable aspects of behaviour. The work (such as that reported in the proceedings of the Royal Society Scientific Information Conference (Royal Society, 1948)) was also restricted almost entirely to a consideration of the sources and channels of communication used. There was little or nothing on the use made of information in scientific research or on the individual patterns of behaviour in information seeking.

The result of this methodological limitation was that progress towards some theoretical understanding of the concept of 'information need' was show. This fact was recognized by virtually every commentator on the subject from Menzel (1960) onwards. Generally, reviewers of the field have expressed disappointment in the results. The disappointment can be attributed in part to poorly chosen methods but also to:

— a failure to realize how expensive survey research is, if done properly;

— a consequent failure to do it properly because of insufficient funding;

— lack of adequate insight into user behaviour before devising research instruments;

— inappropriate choice of self-completed questionnaires as the data-collection method with resulting low response rates when the proper preparation and follow-up procedures (Robin, 1965) are not used;

— lack of adequate theoretical frameworks to guide research;

— lack of interviewer training and interview performance assessment resulting in data of unknown quality; and

— use of library or information system perspectives on information use which may not be held by the people under investigation. (Wilson, 1980b).

As long ago as 1965 William Paisley commented on the lack of case studies in the field in his review of the literature (Paisley, 1965). In other words, the need for a more qualitative approach, that is one which would recognize the subjectivity of information use and the need to generate hypotheses about behaviour rather than simply test other people's ideas about behaviour, was recognized early. Little was done in response to this call however, and the early researchers in the field of information studies in the social sciences followed the path set out by the earlier researchers in science information studies. Thus, although the INFROSS team carried out a small number of interviews, its approach was that of large-scale, quantitative data-collection using a lengthy self-completed questionnaire.

In the 1970s, however, reflecting the increased awareness of the value of qualitative approaches in sociology, other researchers began to adopt more 'naturalistic', 'ethnographic', or phenomenological approaches. Reports on some of these constituted part of a special issue of *Social Science Information Studies* in 1981. Lawrence Stenhouse discussed the use of case studies in a project concerned with library use and access in academic sixth-forms noting that: 'Researchers have turned to case-study in the face of the difficulties which have been encountered in attempting to apply a scientific paradigm of research to problems in which human behaviour, action or intention play a large part.' (Stenhouse, 1981 : 221)

Harris, in the same symposium, reported on an 'illuminative evaluation' strategy (Harris, 1981). This was employed in an action research project designed to produce teaching materials for the education of information users. Harris drew upon the work of Parlett and Hamilton (1976) and commented that: '[Illuminative evaluation] provided a convincing argument against the classic social science research model... It underlined the need to examine a wider range of contextual and environmental determinates of the success or otherwise of an education innovation.' (Harris, 1981: 251)

Earlier, in the same journal, Wilson and Streatfield had written on the use of structured observation in Project INISS and had noted that:

> *... all methods of investigation are ultimately based upon observation. Either the individual observes his own behaviour and his own perceptual states and reports upon them within more or less artificially constrained frameworks (interview schedules, questionnaires, diary record sheets) or records of his information-seeking behaviour are kept (e.g. book issue records) from which deductions about the underlying needs are made. (Wilson and Streatfield, 1981: 174)*

Wilson also contributed to the qualitative methods symposium and in his paper on Project INISS commented that: '...if anything is to be learned from the work, it is that a more sensitive approach to the collection of data and accounts will pay dividends in insights, theory, and practical ideas for improvements in information services'. (Wilson, 1981: 245)

In their concluding comments on the symposium the issue editors noted: 'It would be mistaken in our view, to see qualitative approaches as competing with quantitative ones. For many purposes indeed it would be both appropriate and desirable to use qualitative and quantitative approaches in combination so that each can compensate for the weaknesses of the other.' (Hounsell and Winn, 1981: 255)

This author heartily concurs in that view.

Relations with other Fields

The relationships between librarianship and information science has been discussed earlier and, in terms of the field of practice to which information science relates, this is probably the closest association. Nor would one wish to draw an artificial distinction between research and practice. However, it is possible to look at the relationships between information science and other fields of research.

We can begin by considering the definition quoted earlier and, hence, by dividing the discussion into three parts: the generation of information, the organization and handling of information, and the transfer and utilization of information. In an essay such as this it would be inappropriate to deal with the literature in detail but in the paragraphs below one or two references are given for those with specific interests.

In the case of the first of these there are strong links between information science issues and related issues in the sociology of knowledge, the sociology of science, and the sociology of various professional fields. One area of considerable interest is that which links 'bibliometrics' to research 'performance'. Bibliometrics is the study of statistical regularities in various aspects of information generation and use. It has its origins in a study by Bradford (1948) which revealed the statistical distribution of periodicals borrowed from the Science Museum Library. The so-called 'Bradford's Law of Scattering' was subsequently found to exist among citations to journals and with the advent of the *Science Citation Index* a great deal of work ensued on showing the universality of the 'law'. The idea has been misused (in this author's opinion) in seeking to show relationship between the quality of a journal or of a particular scientist and the extent to which that journal or scientist is cited by others.

The second area, that of the organization and handling of information, is closely related to computer science. Although early work in information retrieval was closely associated with library classification and cataloguing, more recently it has become strongly identified with the use of computer systems. Thus, most library 'housekeeping' functions, such as book ordering, cataloguing, book issue, and journal ordering and receipt systems, are now computer-based. In addition, the retrieval of information from large files of computer records is now a commonplace and an event such as the International Online Meeting in London can attract thousands of visitors to its exhibition to see the latest offerings from companies providing such services (Williams, 1979). The actual retrieval mechanisms used in such systems are relatively crude, compared with the present state of knowledge and research in the field, but changes are taking place continually and as order computers are replaced and as novel computer architectures become more commercially viable the changes are likely to increase apace. Part of the information retrieval problem has close associations also with linguistics and computational linguistics.

One continual problem has been the cost of 'indexing', that is, using human beings to select words and phrase to identify the subject content of documents. One solution has been so-called 'free-text searching', whereby the choice of words is made the responsibility of the searcher. The disadvantage here is that the words chosen by the searcher may not be a complete match for those used in the documents. One answer to this may be the development of more sophisticated computer systems based on the analysis of natural language.

As regards the transfer and utilization of information, the links with other fields are diverse. For example, early work in the field of public opinion which led to the idea of 'opinion leaders' in the community has been replicated in the study of communication networks in scientific research laboratories, leading to the analogous idea of 'gatekeepers' (Allen and Cohen, 1969). Project INISS also paid specific attention to the communication activities in organizations and drew on that literature, and related to the study of information use to other aspects of the ordinary day-to-day work of people in organizations. In doing so the researchers acknowledged debts to such as Schutz (1946; 1970) and Berger and Luckmann (1966) for the relevance of the phenomenological viewpoint in studying the subjective aspects of the role of information in organizational life. The subject of the utilization of information is clearly closely related to that of the diffusion of innovations and technology transfer and a number of studies have dealt with this area.

A special subset of problems relates to the economics of information. The emergence of this as a subject for research has had great deal to do with the economic recession. Libraries and information systems have been called upon more and more to justify their activities in economic terms and the idea of 'cost/benefit' equations applied to information services gained some currency in the 1970s (Martyn and Flowerdew, 1983). The problem has proved virtually intractable, however. The chief problem lies in the nature of information: there is no standard measure of information according to which we can say that a person has become 'informed' to such-and-such a degree. What informs one, fails to inform another—what is news to one is old news to another. Researchers have also failed at times to distinguish between the 'exchange value' of information and its 'value-in-use'. We may be able to evolve methods for determining, but quantifying the value-in-use is likely to be a more difficult problem.

For a useful set of papers which demonstrates the links between information science and many other fields the reader is referred to a double issue of *Social Science Information Studies* volume 4, numbers 2 and 3, 1984, which reprinted the papers of the seminar on the psychological aspects of information searching.

It may be seen from this essay information science is a very diverse, and very active area of research. Whether it can be called a discipline is another matter, and whether it will have the resilience of the true disciplines of science is yet another matter. It may certainly be called a multi-disciplinary field and there is room for many different approaches to the problems with which it deals. Certain areas of research, however, may disappear into what might be called 'parent disciplines'. It seems that as workers in a particular area of research gain maturity and deeper understanding of their subject they draw more and more upon the theories and methods of the parents. When those in the parent discipline also become aware of interesting research issues in the field of information science, to which they can apply their own models, theories and methods, there is a tendency for the subject to be acknowledged as part of the parent discipline.

The increased interest of those in computer science in the problems of information retrieval is a case in point. When information scientists first began to be involved in this area the number of computer scientists who were working in the field was very small. Today the subject is a standard part of many computer science curricula.

As yet, however, there has been not great tendency for the social sciences to take over parts of information science. The economics of information is regarded as a research topic in economics but many other areas discussed above appear to hold little interest for those in the parent disciplines. There are exceptions to the rule, of course, but their solitary appearance in their fields proves rather than contradicts the rule.

In fact most of the areas to which social scientific knowledge, theories, models and methods have been applied remain interesting research areas. Little is known about how information is used to help in the performance of research, or innovation in industry, or the performance of work in business, or many other areas. How information from sources such as books, journals and library systems fits into the general information environment of an individual is still open to investigation. More remains to be done on the effectiveness of methods of disseminating information. The problem of effective storage and retrieval of information requires more work. The relationship of indexing and classification to linguistics have been explored but answers which are useful in practice await further understanding of human linguistic processes. In other words, we are likely to see the field surviving and thriving for some time to come.

Scientific Communication: Five Sociological Themes

The recent upsurge of interest in the behavioural aspects of scientific and technical communication and information flow has two distinct sources, a theoretical one in the development of communication research, and a practical one in the concerns of policy makers in scientific organizations and information services.

For some time past, the attention of sociologists and social psychologists studying communication processes, once focused on so-called mass phenomena and mass public, has turned to the interplay of communication process with more and more definitely delineated and mapped aspects of social structure. One aspect of this shift in interest has been in the increasing attention paid by behavioural scientists to the systems supplying information of a specialized sort, and to the publics which are consumers of this specialized information. The scientific and applied professions have been most prominent among the publics so studied.

At the same time those concerned with the planning of science information policy have become increasingly interested in so-called 'user studies' as possible sources of guidance. For a decade or two, as the mushrooming of the scientific enterprise has led to a multifold increase in the supply of scientific information as well as in the demand for such information on the part of scientists and technologists, the adequacy of the science information system whose task it is to link this supply and this demand has become a matter of increasing concern. A multitude of astonishing new services has been introduced into the system, alleviating some of the concerns, but also generating new questions of optimal allocation of resources and even giving rise to some additional strains in the information system itself. Concerns have led to attempts at planning and these have, after some lag, more recently led to demands in some quarters that the information needs of science be ascertained as a basis for wise planning. While some have asked that the scientist users of scientific information be studied in order to ascertain these needs, others have countered that these needs can better be estimated by those who are experts in information handling. Both proponents and critics of the so-called 'user study' approach have often confused it with opinion polling—that is, with quizzing scientists on what should be done.

Actually, studies of the information-gathering behaviour and experiences of scientists have been going on, in one form or another, for at least 20 years (reviewed in Paisley, 1965). Behavioural scientists have taken some part in this work for about 10 years. Many of the studies have been quite primitive in the techniques of data gathering, simplistic in the conceptualization of variables and research goals, poor in comparability, and questionable in generalizability. But although many of the shortcomings remain, sounder and more sophisticated approaches have increasingly been used, with an especially gratifying concentration in the last 3 years or so (Menzel, 1966c). Outstanding among these most recent accomplishments is the Project on Scientific Information Exchange in Psychology of the American Psychological Association (1963, 1965), which has refined and innovated research techniques and has used them in battery of studies giving comprehensive coverage to the communication situation in a discipline. It has drawn together the results in a process model which has suggested several policy changes and has aided in the choice between them. Recent highlights from this work are reported in other articles in this issue of the *American Psychologist*.

Enough of this work has now accumulated to make it possible to discern certain themes which emerge with increasing insistence as the sophistication of the studies advances. A discussion of five of these interrelated themes will constitute the bulk of this paper. The selection of these particular themes was, no doubt, influenced by the author's sociological bias, but it is believed that they warrant special attention in the interest of both practical and theoretical advances in the field of science communication research.

The first of these themes is that of the desirability of taking a systematic view of the scientific communication in any discipline. It is necessary to look upon any one arrangement, institution, facility, or policy for scientific and professional communication as a component of the total system of scientific communication for a profession, a system which includes *all* the provisions, *all* the publications, *all* the facilities, *all* the occasions and arrangements, and *all* the customs in the discipline that determine how scientific messages are transmitted.

The systematic view, however, means more than comprehensiveness with regard to the channels and mechanisms encompassed. Thus, for example, it also seems useful to conceive of the flow of scientific information as a set of interaction processes in a social system. The information-receiving actions of any one individual often involve several of his roles (as researcher, teacher, consultant, editorial referee, etc.) and approaches to several different channels, including individuals standing in diverse relationships to him and serving now as source, now as relays, of information. The scientists who generate and use the information in a given discipline can therefore be usefully looked upon as interconnected publics.

Furthermore, it is necessary to be comprehensive with regard to the varied functions served by the science information system. And finally, it is necessary to be comprehensive in the delineation of transactions of scientific information, for these frequently involve much more than a single encounter between a scientist and someone communication channel.

The systematic view is urged upon us by a number of considerations. One cannot obtain a true picture of what the functions of the science communication system are, how often the need for each function arises, and how well each is performed, unless one considers and the channels through which scientific information travels. Conversely, one cannot obtain a true picture of the significance of any particular channel or arrangement unless one considers all the information functions that it may perform. Changes and innovations introduced in any one component of the system will have their consequences on the utilization and efficacy of other components. Numerous transactions of scientific information within a public of scientists may have to be considered before aggregate regularities and patterns are revealed behind what appears to be accidental and idiosyncratic in the individual case (Menzel, 1959b). And finally, even the effective transmission of a single message to an individual scientist may involve a multitude of contacts with diverse channels extending over a period of time—a topic to which we now turn.

Several Channels may act Synergistically to bring about the Effective Transmission of a Message

Any given transaction between a scientist as a receiver of information and the channel that brings him that information usually has a history behind it and a future ahead of it that may be very relevant to the evaluation of the success of that transaction and to the prognosis of whether this kind of transaction will happen again with similar results.

Often one channel of communication calls attention to a message to be found in another; sometimes a third channel is required to locate the precise document in which the message is contained; frequently one or more persons serve as relays between the source of a message and its ultimate consumer; and contacts at each intervening step may be initiated now by the receiver, now by the bringer of the message. The events which thus interplay are often distributed over a period of time. The possible relevance of a message to a man's work may not become apparent at the time it is first received, but only when that same message is repeated, sometimes more than once, or when it is put together with other information yet to be received, or when changes occur and needs come up in the course of the scientist's own future work.

In fact, not only an individual scientist, but an entire scientific community may for years turn its back on some already published and significant piece of work, until it is 'brought home' by repetition, appearance in new media, rediscovery in new contexts, or other supplementary messages. Information must often be publicized repeatedly or through diverse channels before it will enter the stream of communications which will lead it to its ultimate user; and from the point of view of the consumer of information, it is frequently necessary to be exposed to the information repeatedly before it will make an impact. Much of this crucial multiple exposure is brought about informal ways, largely through contacts between individual scientists. This phenomenon will be discussed in the next section.

Informal and Unplanned Communication Plays A Crucial Role in the Science Information System

There is by now a fair amount of documentation for the great role played by informal, unplanned, person-to-person communication in the experiences of scientific investigators, often in ways that affect their work quite vitally. This comes as no surprise to communications researchers familiar with the 'multistep flow of communications' that prevails in so-called mass communications. However, the situation in the sciences differs from 'mass communication' in fundamental ways. The mass communication audience is typically apathetic, while the scientific audience is highly motivated; the familiar multistep flow serves to diffuse messages already contained in the mass media, while informal transmission of messages among scientists often antecedes their appearance in print; in mass communication, interpersonal links play their role primarily in persuasion, while in the sciences they seem to be crucial even in mere cognitive transmission. (For an example of persuasive communication in an applied profession). For these reasons, the importance of interpersonal communication in the sciences cannot simply be explained by the same factors as in mass communication, but will have to be accounted for through the specific characteristics of the scientific public.

While informal communication in the sciences is largely unplanned, and sometimes appears accidental, there is actually a good bit of regularity to it. Certain individuals, for example, tend to be the most frequent carriers of information from one place to another, the recipients of correspondence, the hosts of visiting scientists, the visitors to other institutions—largely due to the positions or obligations that researchers assume in addition to their primary activity as researchers. It is the people who serve as editors of journals, who serve on grant-application review committees, who go to summer laboratories, and so on, that play the role of 'the scientific troubadour', as it has been called.

There is also some regularity in the kinds of occasions, places, and times at which these information exchanges the place: at summer laboratories, in the corridors of scientific meetings, during and after colloquial and conferences. There is some regularity as to the patterns of initiative on the part of the conveyor and of the recipient of information through which unplanned communication comes about: seeking one kind of information and obtaining another; informing a colleague of current work and being rewarded with a relevant item of information; information brought up spontaneously by a colleague with whom one is together for another purpose; being sought out deliberately by a colleague who has information to convey; and so on (Menzel, 1959b).

And finally, there is some regularity as to the content of the information that seems preferentially to flow through these kinds of channels rather than through the more regular and systematized mechanisms of the printed word and the attendant bibliographic control devices. For example, there is a certain level of know-how information about the use and setting up of scientific apparatus that seems to go by preference through the word-of-mouth channels, perhaps because this kind of information is regarded as unworthy of being handled in detail in the printed word, and does not find a ready place under the subject terms of indexing procedures. Information that helps interpret results and information that helps a person become acquainted with a new field also seem to make their way differentially, often through the personal channels.

The regularities inherent in the apparently accidental and unplanned ways to communicating hold out the hope of planned improvements in the system. On the one hand, as more is learned of the kinds of information that seem to go through these kinds of communication-switching devices, needs for better and more effective sources on the part of the formal devices become clear. On the other hand, as it is realized that some kinds of information will continue to be carried primarily through interpersonal interchanges, formal devices for making these informal interchanges more effective may be developed-planned mechanisms to make the so-called lucky accidents happen more often. These mechanisms may range from directories and newsletters that tell scientists who is doing what to the scheduling of working hours and the location of new institutes in such a way as to facilitate visits.

Scientists Constitute Publics

The populations which are served by the science information systems—scientific researchers, practitioners in various disciplines and professions—can be usefully looked upon as publics, and described under the same categories that one uses when describing the more familiar publics of the mass media. These publics, can, for example, be described in terms of size, in terms of turnover, and in terms of the interaction that exists within them. They can also be described in terms of their interests in a range of topics, in terms of the fidelity with which they attend to given channels and in terms of the norms that they have created with regard to exposure to various channels.

Yet, while the scientific publics share certain characteristics with the mass publics, in certain other respects they are very different from the public of the newspapers, of the TV programme, or the neighbourhood public library. Number one, the scientists have a very high motivation to obtain the information that is channelled in their direction through the system that is designed to serve them. They go out of their way to reach out for this information. Second, they want this information to help in very specific activities—activities that form very essential parts of their professional roles and therefore of their lives. Third, because of both of these facts, they have very well-developed and very well-structured behaviour patterns with regard to professional communication. In more concrete language, these professions have, in the course of their development, worked out a rich set of customs, habits, traditions, mechanisms, tricks, and devices as to how one goes about obtaining information, what one does by way of screening and listening for information, and what one need not listen or attend to. Planners of information policies must take into account this body of behaviour patterns, of traditions, customs, and learned behaviour. The members of these specialized publics have developed communication institutions and learned ways of interacting with them and with one another to a much higher degree than is true, for example, for the public of a newspaper. Furthermore, scientists themselves look upon the communications services and systems as instruments, and take an interest in their improvement as technologies.

Of course, the several scientific publics also differ from one another in many of these aspects (Menzel, 1966d). All of these aspects have implications for the wise planning of information services for these publics.

Science Information Systems Serve Multiple Functions

The last theme to be taken up here is that it is rather important to draw qualitative distinctions between the several kinds of things that the science information systems are called upon to perform, especially in this current age of streamlining, of great technological strides, of great advances in logical systems. The reason is that these advances bring with them some risk that they may make some of these functions be served more efficiently and satisfactorily, while neglecting or even hampering others. Most of the great innovations have been instituted under the guiding themes of speed, efficiency, and comprehensiveness. The overriding aim has been to bring information to scientists promptly, to bring all the information that is relevant to the scientist's specific query, and to do so with a minimum of waste motion. The prototype of that activity is the exhaustive search. But this is only one of several types of services that are required of the science information system. To give but one example of another type, with characteristics almost the opposite of those of the exhaustive search, there is the requirement to call the scientist's attention to relevant developments in fields which he has not recognized as pertinent to his own work.

Can policies designed to satisfy some of these requirements really work to the detriment of others? If search and retrieval services and selected distribution arrangements were working optimally, they would bring to each scientist exactly that which he has asked for and nothing else. But, by that very fact they would eliminate browsing, and would thereby put and to the occasions when a scientist's attention is called to information which he had not appreciated as relevant to his own interests. This is just one example of perhaps the crudest kind of optimizing one science information function to the detriment of others.

But what actually are all the various kinds of functions that these information systems must perform; how many of them is it worth distinguishing? Distinctions along a number of axes have been suggested. The most basic criterion of classification is probably that of the scope and permanence with which the information needed by a particular scientist can be described in advance.

Along this dimension one can distinguish the exhaustive search; the reference function (to give the scientist the single best answer to a specific question); the current awareness function (to keep the person abreast of developments in his predetermined area of attention); a function which consists of stimulating researchers from time to time to seek information outside of their predesigned areas of attention: and a function which consists of enabling a scientist to follow through on this stimulation by 'brushing up' or familiarizing himself with a well-defined field of inquiry which he had not previously included in his attention area. The two last-mentioned functions, it should be noted, transcend the informational requirements that each scientist can define for himself.

The themes enumerated above have implications for science information policy, but the translation of these implications into concrete steps requires that the themes be specified through a considerable amount of empirical research. As indicated in the opening paragraphs, much research on the use of information and information sources by scientists has been carried out, but until very recently great variety and subtlety of potentially useful research questions and approaches was not realized. Discussions of 'methodology' in this field all too often are confined to a consideration of data-gathering techniques. Insufficient attention has been paid to the more fundamental questions of the conceptualization of units of observation, the choice of variables to be considered, the causal models to be employed, and the analytic designs to be used.

The Supply and Demand for Information about Education

Any attempt to survey the literature of education is fraught with formidable difficulties. Education can be variously defined as (i) 'the total processes developing human ability and behaviour'; (ii) a 'social process in which one achieves social competence and individual growth, carried on in a selected, controlled setting which can be institutionalized as a school or college'; (iii) 'in the sense of theory of education or disciplines of education' (Page and Thomas, 1977). Most definitions also embody a distinction customarily made in Britain between education and training, with the latter defined as 'systematic practice in the performance of a skill' as in industrial training or teacher education (Page and Thomas, 1977), but this distinction has less to do with aims and purposes (Which clearly have much in common) than within a history of separate organization and development. Furthermore, whether education is a discipline in its own right is often challenged. Storer's argument that education is best regarded as a 'conjunctive domain' whose focus is 'a socially relevant whole rather than a natural cluster of abstract phenomena' (Storer, 1970), reflects the uneasy status of a field of study which draws much of its strength from perspectives rooted in the so-called 'parent disciplines' of philosophy, history, sociology, psychology and, more recently, politics, economics and operational research. While this conceptual and methodological eclecticism alone would provide a daunting challenge for the documentalist, the diversity of professional and other interest-groups concerned adds a further dimension of complexity to an already tangled web.

For the purposes of this paper a working definition is adopted which takes as its focus published literature concerned with the theory or practice of education and produced by or intended for those professionally* involved in the education and training services and/or those with a commitment to or an interest in educational issues, problems and practices. Circular though this definition is, it would be fertile to attempt precision.

Supply

Gauging the size of the literature provides an illustration of these problems. Statistics published annually in the *Library Association Record* give total numbers of education volumes published as 634 (in 1976), 539 (1977), and 536 (1978), but these figures are based on Dewey classes and exclude monographs on the teaching of specific subjects and relevant literature in the parent disciplines. The volume of journal articles can be gleaned from the coverage of the *British Education Index*, which has included references to approximately 3,000 articles annually since the early 1970s and draws on nearly 200 journals, chiefly of UK origin (Hounsell, Payne and Willett, 1978). These figures however mask a considerably larger corpus of documents. First, alongside commercially published monographs and nationally indexed articles is a large body of material in such forms as pamphlets, booklets, manuals and reports produced by educational and training institutions and organizations. Such documents often go unrecorded in the *British National Bibliography* and reliable statistics of them are difficult to come by. Second, the literature of the USA and of Commonwealth countries is extensively used in some quarters (particularly by educational researchers and teachers of education as a field of study, and much more strongly in some area—e.g. educational psychology, economics of education—than in others). The coverage of the American Current Index to Journals in Education gives some indication of scale here: references to 22,866 articles were included in the 1978 volume (bringing the cumulative total since January 1969 to 186,217), and a total of 775 journals were being covered by May 1979 (Brandhorst, personal communication). Third, in looking at aspects of supply in education, the *kind* of documents produced is at least as important a factor as their volume. There is a richly varied mass of material which appears to have few common elements. My observation on the literature of higher education;

> *Specialist research monographs and sober institutional self-studies rub shoulders with works of opinion and polemic, heady accounts of curricular innovations, journalistic 'analyses' of student unrest, weighty reflections of former presidents, and a mass of conference proceedings, anthologies and readings. (Hounsell, 1977).*

applies with equal facility to the literature of education as a whole. Similarly, convenient labels such as 'journals' or 'periodical' must by viewed with circumspection, since the terms are widely used in education to include such diverse publications as highly specialized research journals, the magazines of professional associations and trade union newspapers. Indeed, a ranking of periodicals contributing references to the *British Education Index* between 1973 and 1975 (Hounsell, Payne and Willett, 1978) showed that none of the first five items in the list (which together contributed almost one-fifth of all references) could be considered a scientific or scholarly journal when the usual criteria (such as refereeing by peers) are applied.

While the literature of education is abundant, diverse and diffuse, the level of availability in general terms is quite high. Several cooperative schemes have been established by the Librarians of Institutes and Schools of Education (LISE) to improve services to users in the geographical areas of England and Wales for which they are responsible (Humby, 1975); these include union catalogues of books and periodicals, cooperation in the storage of obsolescent books and the acquisition of overseas material, and union lists of stock on particular countries. And there have been similar cooperative efforts by the Annual Conference of Librarians in Scottish Colleges of Education. Foskett and Humby (1969) noted that 72% of requests made through the LISE scheme were satisfied.

This regional network is complemented by other national sources, the largest of which is the Department of Education and Science Library. This Library, which is open for reference and research enquiries, has a stock of 183,000 volumes and subscribes to 800 journals. Many other national organizations (the National Foundation for Education Research, the National Union of Teachers and the National Institute of Adult Education are only three such examples) have their own library and information services, while there is a small number of more specialist libraries such as the Language Teaching Library of the Centre for Information on Language Teaching and the English Teaching Information Centre.

Not all kinds of material are widely available since some collections exclude specific categories of information, for example the DES collection does not include school textbooks, and documents such as curriculum materials, policy documents and progress reports on research are often difficult to trace. An interesting initiative has been the introduction of *CORE*, a new microfiche journal which publishes full-length versions of material such as conference proceedings and full-length versions of material such as conference proceedings and full-length research reports which may not be readily available elsewhere.

Cooperation and a readiness to link stock to bibliographical sources have helped to establish good inter-library loan services. For example, the Inter-Library Loans Service at Boston Spa has the entire collection of microfiche represented in the American *Resources in Education*, and has been willing to extend its holdings of journals to cover material appearing in the companion ERIC journal, the *Current Index to Journals in Education*, as comprehensively as possible. At the same time, a tradition of treating comparative education as one of the subjects studied in most teacher training courses has made a considerable contribution to the general availability of foreign-language material, further aided by the publication by LISE of union lists of stock on education in specific countries. This favourable picture should be qualified in two ways. Firstly, ease of availability is closely related to status and institutional affiliation; those working in academic institutions are likely to perceive the inter-library loans service as rapid, efficient and extensive, but others (such as schoolteachers) to whom use of these institutions' libraries has been extended, may find their access to inter-library loan facilities tightly constrained. Similarly, users of public libraries will in many cases be at a considerable disadvantage compared to those in academic institutions. Second, while the availability of foreign-language material is at least satisfactory, there has been no major effort to translate, summarize or synthesize this literature in any systematic way, and in those few instances which are the exception, the driving-force has tended to be the influence of a particular school of thought (e.g. French sociology of education) rather than an interest *per se* in the perspectives of other nations and cultures.

Demand

The potential market for educational information in the United Kingdom is large and varied. One detailed study (Hounsell, Payne and Willett, 1977) indicated that in excess of three-quarters of a million people are professionally employed in the education and training services. Breaking this figure down into the broad categories adopted by Mersel, Donohue and Morris (1966), by far the largest professional grouping is *teaching* (with over 700,000 staff employed) followed by *administration and ancillary services* (almost 50,000) and *research and scholarship* (4,000). Though often used, a tripartite categorization of this kind serves to conceal differences both within and across categories. An example of the first kind is the administrative category, which embraces professional sub-groups as diverse as local education authority advisers, central government administrators, teachers centre wardens and educational correspondents. And an important across-category difference is that of employer or employing institution: as far as demand for documents is concerned, the university teacher seems likely to have more in common with the university-based researcher than with the schoolteacher, the adult education lecturer, the teacher in the Prison Education Service or the industrial training officer.

Differences in the kinds of demands made by these various subgroups is in part a function of the diversity of the education and training services. While some questions (e.g. teaching method, models of course design) are manifestly of interest across a broad spectrum of groups, others tend to be viewed largely within the framework of specific parts of the system. On the one hand, differences in the age of ability levels of the students are inevitably one distinguishing factor in interest (clearly the educational concerns of the primary teacher are significantly different for those of the tutor of undergraduates); on the other, primary education, secondary education, higher education, adult education, further education and industrial training comprise more or less discrete organizational sub-systems each with its own characteristic rationals, procedures, etc. Subject affiliations are also a strong source of demand differences, since for many (if not most) teachers their subject or discipline is a more powerful reference-point than the kind of institution in which they are employed or the age of ability-level of the pupils or students for which they are responsible.

But if these differences make for variations in the direction of demand, perhaps the greatest single area of difference is in *intensity* of demand.

It is generally accepted that the highest level of demand is from researchers and that here, as in the United States, the journal article is the chief medium of communication between researchers. Since as we have seen, the number of educational journals in the English language alone is very high, monitoring through bibliographical sources is especially important for the researcher, and British sources include not only the *British Education Index* but three abstracting journals and over thirty current-awareness services (Hounsell, Payne and Willett, 1978), many of which have specialized interests and audiences which extend beyond the narrow confines of research. Brittain (1970) has suggested that education 'is perhaps better covered by bibliographical tools and information services than any other social science', but the value of this wealth of information sources to those other than researchers is questionable, if not largely irrelevant. Indeed it can be argued that while the myriad assortment of documents which make up the primary literature generally represent responses to a host of different users' needs, the secondary literature is directed almost overwhelmingly towards an academic audience. And while the needs of teaching and administrative groups have been little researched and are often poorly understood.

Of those two groups, administrators are by far the most neglected. There is limited evidence from a recent study (Hounsell, Payne and Willett, 1979) that topics of interest change rapidly and that administrators have little time to look for information or to read it. The needs of teachers have been better documented though the studies undertaken have tended to focus on research and development information rather than on subject-based curriculum and teaching materials. Cane and Schroeder concluded that:

> *Teachers felt that reading research was a small part of their professional life but they nevertheless attached importance to it. Some of those interviewed said that these writings were often incomprehensible, too long, phrased in tactless language, biased in their presentation or of limited applicability. While some were enthusiastic about research publications that spoke directly to the classroom teacher, many complained of inadequate reporting in the more popular journals. They believed that research findings ought to be disseminated through some system of regular comprehensive research summaries. (Cane and Schroeder, 1970)*

The Lancaster enquiry (Hounsell *et al.*, 1980) yielded similar findings. Four out of five of the teachers surveyed felt that a gulf existed between themselves and researchers, chiefly because of the tediousness of research reports, research jargon and poor dissemination of findings to schools. And while almost all of the teachers thought that being well-informed about educational research and development was important, there was a division of opinion on whether teachers were well-informed. The main obstacles to keeping up-to-date were a lack of time, both to read and to look for information, and a lack of advice. However one-third of the teachers had made a specific enquiry for information in the recent past, and more than half of the teachers had been influenced by research which they had read or heard about. There was also evidence that communication was by no means predominantly informal; books and reports (together with teaching colleagues) emerged as the most popular sources of information, and main-steam periodicals (such as the Times Educational Supplement) were widely read.

Two other findings are of interest here. The first of these is that information was more likely to be found useful it rooted in the experiences of individual teachers or specific schools. This provides an interesting contrast to the perspective of Allison (1974), writing as a scholar-researcher, who criticizes the educational literature for the very reason that 'personal experience seems to be the touchstone of truth'. The second is that there was a significant relationship between length of teaching experience and use of information: the more experienced teachers were more likely to have been influenced by research, to have made specific enquiries for information, to look for information beyond the immediate confines of the school, and to make greater use of periodicals and libraries.

Artistry and Teaching: The Teacher as Focus of Research and Development

Experience tells me that if I am not to be misunderstood I must begin this chapter by offering you a brief sketch of my views on the relation of research to education action. These views are set out at a greater length in other works (Stenhouse 1979, 1980, 1983). There is in England a strong doctrine that the study of education is fed by the contributory disciplines of history, philosophy, and sociology. I agree that these disciplines do contribute to our understanding of education. In my own personal experience I can say that in the curriculum project with which I am most closely associated, the Humanities Curriculum Project, my own contribution was substantially influenced by my knowledge of the history of elementary school readers (that is, text books), of the philosophical work of R S Peters, of the social psychology of groups, and of the sociology of knowledge. These disciplines, while they serve to stimulate education imagination and to define the conditions of educational action, do not serve to guide such action. They provide for education—as rules of the game and traditions of play do for a sport—a context in which to plan intelligent action. But they do not tell us how to act.

The yearing towards a form of research which might guide educational action led educational researchers to look enviously at agricultural research. Here, in a tradition associated with Ronald Fisher, researchers had conducted field trials which utilized random sampling in block and pot designs in order to recommend to farmers those strains of seed and crop treatments which would maximize yield. Both random sampling—which legitimized the deployment of the statistics of probability to estimate error and significance—and the measure of yield present problems in educational research. A number of classic papers, among which Campbell and Stanley's 'Experimental and Quasi-Experimental Designs for Research in Teaching' (1963) is prominent, have considered the robustness of various experimental designs and statistical procedures in terms of reliability and validity as sampling falls away from the desideratum of randomness. The doctrine of behavioural objectiveness allied to the development of criterion-referenced testing was developed to give a measure of educational yield.

Personality, I am satisfied that the application of this so-called 'psycho-statistical paradigm' (Fienberg 1977) in education research provides no reliable guide to action (though it may contribute a little to theory). It has to assume, as agriculturalists assume in treating a crop in a field, consistency of treatment throughout the treatment group; but it is the teacher's job to work like a gardener rather than a farmer, differentiating the treatment of each subject and each learner as the gardener does each flower bed and each plant. The variability of educational situations is grossly underestimated: sampling procedure cannot be related to educational action except on a survey basis rather than an experimental basis. Further, behavioural objectives are quite inappropriate to education except in the case of skill learning. They are a monument to the philosophical naivete of a psychological tradition which simplifies intentionality and purpose to 'having a goal'. Purpose in education is about having an agenda.

Now, if I am right about this—and you will not readily persuade me that I am not—then the question arises: if experimental research based on sampling cannot tell us how to act in education, how are we as teachers to know what to do?

One answer to this question is that instructions shall be laid down for us in the form of curricula and specifications of teaching methods. I reject this. Education is learning in the context of a search for truth. Truth cannot be defined by the state even through democratic processes: close control of curricula and teaching methods in schools is to be likened to the totalitarian control of art. Reaching towards the truth through education is a matter of situational professional judgement; and professors of education or administrators cannot tell us what we should be doing. Prescriptions will very according to cases. We do not need doctors if all they are going to give us is a treatment laid down by the state or suggested by their professor without bothering to examine us and make a diagnosis.

Educational action is concerned with varying according to case and to context the pursuit of truth through learning. In this subtle and complicated process, how is the teacher to conceive the problem: what shall I do? This riddle provides the context and occasion of my chapter.

The student who, during the course of ten years in school, meets two or three outstanding and congenial teachers has had a fortunate educational experience. Many are not so lucky.

The improvement of schooling hinges on increasing the numbers of outstanding teachers, on serving their needs, and on trying to ensure that their virtues are not frustrated by the system. The basic institutional framework of the educational enterprise—the neighbourhood elementary school and the comprehensive high school—are for the moment stably established or well on the way. Within these framework it is the outstanding teachers who transmute the process of instruction into the adventure of education. Others, it is true, may teach us; but it is *they* who teach us to delight in learning and to exult in the extension of powers that learning gives. [...]

Good teachers are necessarily autonomous in professional judgement. They do not need to be told what to do. They are not professionally the dependents of researchers or superintendents, of innovators or supervisors. This does not mean that they do not welcome access to ideas created by other people at other places or in other times. Nor do they reject advice, consultancy or support. But they do know that ideas and people are not of much real use until they are digested to the point where they are subject to the teacher's own judgement. In short, it is the task of all educationalists outside the classroom to serve the teachers; for only teachers are in the position to create good teaching.

Let me restate my case by saying that I am declaring teaching an art; and then elaborate on that. By an art I mean an exercise of skill expressive of meaning. The painter, the poet, the musician, the actor and the dancer all express meaning through skill. Some artists fly so high that we designate them geniuses, and that may be true of some teachers. But a claim as ambitious as that does not need to be made on behalf of the excellent teachers I have spoken of. It is enough that they have assiduously cultivated modest but worthwhile talents like those of the innumerable stonemasons who adorned the English parish churches or those sound repertory actors who exceed in number the jobs the theatre has to offer. In short I am not elevating teachers inordinately. Rather I am diagnosing the nature of their job in order to discern how performances may be improved. I am suggesting that just as dramatists, theater school staff, producers, stage managers, front of house managers and even booking agencies need to understand to some degree the players' art, so curriculum developers, educational researchers, teacher educators, supervisors and administrators need to understand the art of the teacher.

Teaching is the art which expresses in a form accessible to learners an understanding of the nature of that which is to be learned. Thus, teaching music is about understanding the nature of music and having the skill to teach it true to one's understanding. Teaching tennis is about understanding the logic and psychology and techniques of the game and about expressing that understanding through skill in teaching. Similarly, the teaching of French expresses an understanding of the nature of language and culture and of that particular language and culture; the teaching of wrought ironwork, as a craft expresses the relationship of material to fitness for use and to concepts of beauty; and so forth. And one mainstream tradition of teaching is an expression of knowledge of a discipline or field of knowledge; it is always to 'teach' the epistemology of that discipline, the nature of its tenure on knowledge.

My own belief, as I have said, is that whether teaching is concerned with that knowledge we associate with the disciplines or with the arts or with practical skills, it should aspire to express a view of knowledge or of a field of activity. This epistemological desideratum might be expressed by saying that the teacher should aspire to give learners access to insight into the status of what they learn. The way towards this is that a view of knowledge comes to infuse the teacher's perception of subject matter and judgement of the performance of students, and that this view and its status becomes revealed, by teaching, to the student. Such a perception of knowledge develops and deepens throughout the career of a good teacher and it is the product of the teacher's personal construction or reconstruction of knowledge. It can be assisted by reading and instruction, but it is essentially a personal construction created from socially available resources and it cannot be imparted by others or to others in a straightforward manner.

Now, the construction of a personal perception of our world from the knowledge and traditions that our culture makes available to us is a task faces not only the teacher, but also the student; and teaching rests on both partners in the process being at different stages of the same enterprise. This is clear to us when we watch a great musician teaching a master class, but it tends to be obscured in schools in the ordinary classroom. The technical clap-trap of learning systems and behavioural objectives is much to blame for this. Good learning is about making, not mere doing. It is about constructing a view of the world. It is not about showing that, although you have failed in that construction, you are capable of all the performances that would appear to make the construction possible. Education is for real: it is not about practice shots.

Let me sum up so far an analogy (which is not to be pursued too far). The art of social comedy expresses a view of manners and morals as people live them: the art of education expresses a view of knowledge as people live it. The medium of one is theatrical entertainment; of the other, schooling. Both are at their highest when the audience or learner is brought to reflect consciously on the message he or she receives. This fulfilment depends not only upon the quality of the play or the curriculum, but also upon the art of the actor or teacher.

And now let me take a second step. All good art is an inquiry and an experiment. It is by virtue of being an artist that the teacher is a researcher. The point appears to be difficult to grasp because education faculties have been invaded by the idea that research is scientific and concerned with general laws. This notion persists even though our universities teach music and literature and history and art and lay an obligation on their staff in these fields to conduct research. Why then should research in educational look only to science?

The artist is the researcher *par excellence*. So much so that prominent scientists are now arguing that, while routine consolidation in science can be achieved by following conventional scientific method, the big breakthroughs really show that science is an art. I am sceptical of that, but I am clear that all art rests upon research and the purpose of the artist's research is to improve the truth of his performance. Leonardo's sketchbooks, George Stubbs dissecting a horse in his studio, Nureyev working with a partner in a new ballet, Solti and the Chicago Symphony Orchestra tackling Beethoven, Derek Jacobi evolving his Hamlet, all are engaged in inquiry, in research and development of their work. And this development, though it involves improvement of technique, is not for the sake of technique: it is for the sake of the expression of a truth in a performance which challenges criticism in those terms. Thus, an elementary school teacher who wishes to improve his or her teaching of science will record teaching or invite a colleague in as an observer, and will, if possible, bring in an outsider to monitor the children's perceptions as a basis for 'triangulation'. From this the next aspiration is to drop the outsider and move towards open discourse between teacher and children about the teaching/learning process in the classroom and its 'meaning'. A crucial aspect of this meaning is the impression of science—always expressed in specific instances or episodes—that the children are acquiring. And this the teacher needs to criticize in the light of the philosophy of science. All teaching falsifies its subject as it shapes it into the form of teaching and learning: the art of pedagogy is to minimize the falsification of knowledge. It is the aspiration to do this, to shape understanding without distortion into pedgagoic forms that is the challenge to develop one's art. Now, if you say that most teachers are not like this, I shall reply that some are, and that it is the model of teaching that those teachers display to us that we need to disseminate. The way ahead is to disseminate the idea of teacher as artist with the implication that artists exercise autonomy of judgement founded upon research directed towards improvement in their art. The changes in school administration or curriculum or teaching arrangements which will be required are those which make it possible to implement that vision.

If I, as a teacher, absorb and accept the case I have just been putting, then it is clear to me that I am the focus of research and development. Who else could be? My problem then is how to get others to recognize it. That is not going to be easy. If teachers are at the bottom of the pile, there are bound to be lots of people who like it that way. So, though I can exercise my art in secret, or even in a small group of consenting adults, if I want the support of a movement, I need to make alliances and develop some political power.

Let me give you a short account of the kinds of support that have been developed round the teacher-as-researcher movement in Britain. There is an alliance between some universities or colleges of education and some teacher groups. What is required of the universities is that they break the stranglehold of the 'psycho-statistical and nomothetic paradigm' on educational research. The universities which have done this recognize forms of research alternative to the still dominant tradition of scientific positivism with its emphasis on experimental and survey procedures conducted on samples in field settings and giving rise to 'results'. Among these alternative forms are experimental or descriptive case studies which may be based upon the teacher's access either to the classroom as a laboratory or to the school or classroom as a setting for participant observation. In Britain standards for these research paradigms are now in process of being worked out at master's and doctoral levels, both through discussion at conferences and in the consultations between internal and external examiners.

This alliance with universities is important for the teachers because it gives access to a pattern of part-time study right up to the level of the doctorate which turns one towards one's professional work rather than away from it and offers a systematic training in the appropriate research skills as well as a grasp of the theoretical issues applicable to close-in, practitioner research. The tradition, once established at advanced levels, begins to influence patterns of in-service work.

Academic validation has drawn on alternative traditions which include the hermeneutic tradition and the neo-Marxist tradition from Germany, phenomenology and ethnomethodology. These theoretical currents are in harmony with reappraisals at present being conducted in the social science community whose interests lie outside education. This link is a source of validation and alliance. It turns the education faculty towards sociologists, anthropologists and historians as alternative allies to psychologists and philosophers. This shift of alliance has, of course, profound power implications in the academic community.

The academic endorsement of styles of research into schooling which are as accessible to practising school teachers as to university teachers and professional researchers can also, of course, create considerable hostility and fear among university faculties. In my view, this is misplaced. The universities can only thrive the more as a result of an extension of the boundaries of the research community. The shift is from lecturing on research results towards training researchers. There is room for both, of course, but the balance becomes different. The message is that the 'role' of universities is bound to be central in the development of a tradition that puts research at its heart.

Of course, teacher power expresses itself in unfamiliar ways within this tradition. The Schools Council for Curriculum and Examinations, the main funding agency for curriculum in Britain recently funded a conference of teachers on 'The Teacher as Researcher' (Nixon, 1981). The teachers who organized it did not invite anyone from a university. I guess we talk too much, and they wanted time to think over the issues in their own way. But they will need us; and we need them. In an age of accountability, educational research will be held accountable for its relevance to practice, and that relevance can only be validated by practitioners.

Enlightened administrators look benevolently on the teacher-researcher model of staff development, and one can gather support there. The idea has potential appeal for teacher unions, though that hasn't really been pressed home in Britain. One way or another there are the makings of a movement.

But what are the consequences to be expected of such a movement if it gathers momentum and power? May we expect teachers to demand schools fit for educational artist-researchers to live in? And what would those look like?

We can only guess. But I am suggesting that forms of schooling can best be seen as obsolescent when they constrict developments in teaching. I believe that the development of the teacher as artist means that some time in the future we are going to have to get rid of school principals. My own guess is that we shall need delegatory rather than legislative democracy. Committees will not decide what to do: artists grudge that use of time. They will delegate the power to decide to individuals for fixed periods and will hold them accountable. In the University in which I work professors who run departments or faculties are not different from those who teach or do research: their leadership role is more an award than an appointment. A capacity for intellectual leadership is appropriate, but the leadership role is not structured on the job. Perhaps we need such a concept in schools: persons appointed by their colleagues to a status which recognizes their distinctive capacity to contribute to the community of teachers.

A community of teachers whose attention is primarily focused on the art of teaching will require—as a company of actors does or as a university faculty does—an administrative support structure. It is important that the teacher who acts as president of the school faculty commands the highest salary in the institution, and below that the head of the administration has parity with the highest grade of teacher. It is vital that administrators service teaching not lead it.

However, we shall not change teaching by creating a school organized on that model. The reform of school organization needs to be an adjustment to the development of teaching. It is the teacher who is the focus of research and development: only the teacher can change the teacher. You can recognize schools yet teachers can still remain as they were. You can pull down the walls and make an open school; but open teaching remains an achievement of the teacher's art, and an achievement that is an expression of understanding.

What are the implications of all this for in-service development? My position is that in-service development must be the development of the teacher as artist. That means the development of understanding expressed in performance: understanding of the nature of knowledge expressed in the art form of teaching and learning. No skills unless they enhance understanding. What I am advocating is so radical that I may not be communicating it. Let me sharpen the message in the area of curriculum: I am saying that the purpose of any curriculum change, any curriculum research, any curriculum development is the enhancement of the art of teaching, of understanding expressed as performance. The idea that you want a change and the change is dependent on retraining teachers is a non-starter.

As a starting point teachers must want change, rather than others wanting to change them. That means that the option of professional development leading toward professional satisfaction of a kind that brings an enhancement of self must be made clear and open to teachers. Teachers have been taught that teaching is instrumental. When we say that teaching is an art,we are saying that the craft of teaching is inseparable from the understanding taught. In short, teaching is intrinsic. Improving education is not about improving teaching as a delivery system. Crucial is the desire of the artist to improve his or her art. This art is what the experienced teacher brings to in-service development. Good in-service education recognizes and strengthens the power and primacy of the art. If offer curricula to teachers as music in-service offers Beethoven or Stravinsky to musicians: to further the art. In-service is linked to curriculum because art is about change and only develops in change. If the art of teaching could develop without change, then there would be not need for change in education. It is art's appetite for change that makes educational change necessary to the virtue of schooling.

The artist is the researcher whose inquiry expresses itself in performance of his or her art rather than (or as well as) in a research report. In an essential practical art, like education, all the research and all the in-service education we offer should support that research towards performance on the part of the teacher. For there is in education no absolute and unperformed knowledge. In educational research scholarship the ivory towers where the truth is neglected are so many theatres without players, galleries without pictures, music without musicians. Educational knowledge exists in, and is verified or falsified in, its performance.

3

Analysis of Information Systems in Library

A dictionary definition of a system is "an assemblage of objects united by some form of regular *interaction* or *interdependence*." This definition implies dynamic processes consisting of interrelated functions that tend to become increasingly complex as the volume or requirements placed on a system grows.

Types of Library Systems

Broadly conceived the library functions in the framework of two major types of systems: the data processing and the informational. The data processing system may be defined as the organization and the methods involved to perform operations necessary to effect the form or content of information needed to satisfy the library's *management requirements* and goals.

The informational system may be defined as the organization and the methods followed in storing and retrieving information to satisfy the library's *service requirements* and goals.

Generalizing the distinction between the two major types of systems, the data processing system is concerned with the manipulation of data (clerical functions) and the informational system with the storage of information and its recovery.

On a more specific level six basic systems can be identified within the library. All contain the characteristics of the data processing and informational systems previously defined. Some of these belong almost completely in one category, while others consist of a combination of data processing and information storage and recovery. Considering its predominant function of ordering and receiving library materials and paying and accounting, the functions of the *acquisitions system* depend mainly on data processing operations. Likewise the *serials control* system is heavily concerned with data processing functions from which, however, an informational system evolves that permanently stores serials information for future reference.

The *circulation control* and the *library administration and planning* systems are examples of the combination of the data processing and the informational systems. The major function of the circulation system is the control of the flow and movement of library materials. The function of the administrative system is that of organizing and controlling the operation of the library as a whole, receiving the reports and statistics of each of the other systems and summarizing and analysing this information to make meaningful decisions and to determine whether management goals are being served.

The *cataloguing system,* with an appreciable amount of data processing, is primarily an informational system charged with classifying books and other library materials and providing the records essential for retrieving them. The *reference system* also may be regarded as an informational system, concerned as it is with retrieval and transfer of information required by the library user.

Elements of a System

In any type of system will be found four basic elements: the input, storage, processing and output components. That these four components are present in any system is demonstrated by a random illustration of input, storage, processing and output of the human "nervous system": *input,* finger touches a hot stove; *storage,* the impulse arrives at the brain where the previous experiences of the system as a whole are stored; *processing*, the brain sorts out the questions asked of it and transfers these to a pain signal; *output* the pain signal triggers the removal of the finger from the stove.

We can consider the data processing and informational systems referred to as the two major types in a library. The data processing system contains these four elements: the *input element;* the *memory element* (storage), or unit, where information is stored until it is ready to be processed; the *processing element* where the various calculations necessary to transactions are made; and finally the *output element* where the desired results are obtained or action occurs. It will be recognized that these four elements in data processing are identical to those found in a computer system.

The informational system is almost identical to the data processing system in the generalized view. It too contains the *input* unit or clement by which information is received; the *memory* unit (storage) where the information is held until desired; and the *output* unit. There is no need for the *processing* unit. The information is required with no manipulation or change.

The formation and use of the traditional library card catalogue illustrate the operation of an informational system. The inputs are the cards prepared and field by the cataloguing department and the memory and storage unit is the file in which the catalogue cards are stored. In this example the output element (the catalogue card) is not activated until a reader approaches the system, the card catalogue, with a need for information on a specified subject, thus generating an input that is his need for information.

The informational system cycle is continued: the reader locates in the catalogue the desired information—output—that the book wanted is in the library and that it carries a specific location number.

Subsystems

The model of an acquisition system serves as an example for analyses of interrelated functions within a system. Within this or any other system there is always a group of interrelated subsystems, each of which is designed for the performance of a particular task. This acquisitions system model

consists of the subsystems *preorder search*, *ordering, receiving, checking, accounting* and *reporting*. The sub-systems depend one on the other for input and output to fulfil specified requirements. For example, the order subsystem could not operate alone; it requires the verified information (output) supplied by the preorder search subsystem.

The operation of checking in books carries with it the function of comparing the on-order slip with the book when it is received. A decision is made on whether or not the book and the on-order slip correspond. If they do not, action is taken so that the slip and the book are referred to the order subsystem for review and follow-up. If the two do correspond, the resulting action is the property stamping of the book and its being forwarded to the cataloguing system for further processing.

Operations of a System

Each subsystem consists of a group of logically interrelated operations. Each operation is concerned with the performance of certain functions, or certain decisions, or both, as the bases of action. For example, the preorder search subsystem may consist of the following illustrative elements:

Operations

Searching library records

Searching trade bibliographies and other sources of title verification.

(*a*) *Functions*

Verification of title

Provision of order information

(*b*) *Decisions and Actions*

Decision : Is item in collection? Yes...........No...........

Action : Duplicate...........Do not duplicate............

Decision : Is item available? Yes...........No..............

Action : Order..............Not order..................

Decision : Information sufficient to satisfy ordering subsystem? Yes................No................

Action : Order................

Refer to requestor for additional information..........

Thus we can see that the *operations,* which are the major elements of the subsystem, consist of specified *functions, decisions,* and *actions,* also known and referred to as *elements of operations*—the basic "building blocks" of a system and its subsystems. In an effort to clarify the meaning of and relationships among these elements the following explanations are offered: (*a*) *operations*—processing;(*b*) *functions*—the substance of processing, that is, the objectives; (*c*) *decisions*—the questions to be answered in the course of the processing; and (*d*) *action*—action taken as a result of the decision.

Consistency of approach in the study of each system based on these elements reveals the interaction among operations in all systems of the library organization.

Total Systems

There is no system in which the operations are isolated within a single subsystem. Characteristically, as illustrated, it will be found that there is a direct as well as an indirect effect on the operations of another system and its subsystems. It is the complexity of this interaction between and among systems that is causing libraries to investigate the concept of "total systems" before automating any operation when undertaking a systems study.

When synthesized and coordinated, the six basic library systems comprise what may be termed the "total library system" or the library functioning as an entity. It is the combination of these systems, with well–defined operational interrelationships and recognition of information transfer requirements among them, that assures effective and efficient operations directed toward achievement of the total system's, the library's overall established goals. Integration is necessary to facilitate exchange of significant information on a need-to-know basis among system comprising the total system. A total system is one in which traditional departmental boundaries tend to fade and artificial separations find no place.

The total systems concept is not new in library administration but its full application beyond acknowledgment of it through a broadly functional organizational structure has been hampered and, indeed, prevented by the absence and unavailability of technological aids for a job that has always been overwhelming—the storage and controlled use of the mass of "data" native to the library. The use of modern business methods for processing and storing the varied, accumulating and ever-changing data generated and used by the library would appear to be a requirement in the medium-to-large-sized library.

The total systems concept is more completely and successfully implemented in terms of preciseness and timeliness of needed information through machine methods, than by laborious, economically unjustified, and error-prone manual methods. To be sure, reference personnel in evaluating the library's collection can hand produce subject area lists for analysis. More probably such lists will be generated by merely scanning the shelf list under main classifications, resulting in an imprecise, generalized conclusion regarding the improvement of the collection. On the other hand by using data generated by the acquisitions and cataloguing departments and stored in computer memory the reference personnel can study this storage to obtain accurate and detailed information and then use their time applying the professional judgement necessary for valid collection evaluation. Examples of the high utility of the computer in applying the total systems principle can be multiplied. Circulation control based on the data stored in the computer by acquisitions and cataloguing becomes more precise and timely and can be programmed for ready analysis of collection use and reader characteristics. This can be done manually but the results are likely to be reported too late and at too great a cost to be useful in improving currently chronic service deficiencies.

Feedback

The principle that has led to the application of the total systems concept is that of monitoring and feedback. In a total system feedback is the relaying of information from one system to another, so that a given system can adjust to satisfy the requirements of the total system. For example if the demand for books in a particular subject area is increasing, this is evidenced in the circulation system's records. In a computer based system the information in these records would be monitored. When demand exceeds predetermined criteria, management would be notified for the purpose of taking appropriate action.

Therefore planning of individual systems is not done in isolation. Such planning should always be in the context of developing a total system giving maximum service to readers and eliminating duplication of staff effort.

The Library Data Processing System

The complexity of any data processing system prohibits analysis, evaluation and design as a one-step process. The job of the study staff in the analysis phase of the data processing system is that of identifying the major activities of the system, the *subsystems*. The subsystems together satisfy one or more secondary requirements or demands placed on the system and contribute to the satisfaction of the system's primary requirements. With the subsystems identified the operations occurring within the subsystem can be isolated and the functions and decisions associate with the manipulation of each input needed to prepare the desired output can be defined. Finally the required actions resulting from the various decisions also can be defined.

The functions and decisions are the basic elements of a data processing system. The evaluation of a system consists of determining how well the functions are organized and performed and how appropriate the decisions are in satisfying the requirements of the system. In addition the design of a new system should start with these basic "building blocks," the elements. The level of detail in such an analysis as this depends on the type of system being developed. If the design of a computer system is contemplated, the functions and decisions must be defined in sufficient detail to permit a programmer to programme the system.

The Total Systems Concept Reviewed

The total system operates within an environment dictated by the goals of its parent organization or governing body.

"The first consideration in the total systems concept is description of its objectives. They can be simply stated as : (*a*) to organize administrative work flow from the viewpoint of the [library] as a whole, without regard for barriers of organizational segments; and (*b*) to develop data processing systems whereby source data are recorded once and thereafter perpetuated in various summary forms to meet departmental operating and financial needs, without repetitive processing."

The realization of the total system concept occurs when the major operating systems have been so designed and integrated that the interaction and exchange of information are facilitated in a logical and systematic manner. The planning of individual systems is not an end in itself. Such planning must always be in the context of developing a total system of reciprocal relationships among individual systems. This requires the design of integrated procedures, taking into account all of the library's systems.

The cost of punched card equipment, or computer equipment, or both, and the extent to which this equipment can profitably be put to use for any library requires planning for the future. The total systems concept can be adapted to limited use of machines for appropriate operations within a system or for all operations in one or several systems. The urgency is that a systems study be oriented toward a future goal and that the six basic library systems be tested, reviewed, and designed to that all can perform as a whole. The decision to use machines is an administrative one and depends on all the factors that determine the role of any one library. Although a computer-based total systems goal may be a good administrative objective, the systems study could be hampered by the question of the administration's economic ability. It is now generally realized that computer use rarely saves money. It is more important to recognize that proper use of the special talents of professionally trained librarians is essential to handle the proliferating volume of literature to be controlled, so that the users can be more profitably served. If machines are not the answer for a small library, the study should result in the design of operations in order that clerical processing can be done by other than the professional staff members who will then be free to render the creative and imaginative service appropriate to their professional qualifications.

Planning and Conducting Systems Study

In the Introduction the causes of the increased complexity in libraries have been given in some detail. A systems study is indispensable when a library faces these problems and admits that it is no longer serving its community effectively.

"Systems study" is equated to the phrase "let's get organized." It is prerequisite to a well-designed and successful automated system but the results of such a study need not be an automated system. Study methods and techniques can and should be used in analysing, evaluating and designing all levels of data processing. The librarian familiar with the concepts and techniques of systems study should be able to increase the efficiency and productivity of the library even if the only available mechanical equipment is the typewriter.

Systems Study Concept

The systems study is defined as the logical analysis of the present systems; the evaluation of the efficiency, economy, accuracy, productivity, and timeliness of existing methods and procedures measured against the established goals of the library; and the design of new methods and procedures or modification of existing methods and procedures to improve the flow of information through the systems. The main distinction between the analysis and design phases is that analysis is a rigorously controlled inquiry into existing conditions, while design is the resulting, synthesizing process in which new ideas are generated and refined. Design is the final phase of a systems study involving creative thinking, coordination of the conclusions reached in the analysis and deductive reasoning directed toward realization of the stated objectives and goals of management.

The concept of systems study consists of three interdependent phases:

1. Analysis, which is the accurate delineation of the requirements placed on a system; the current procedures by which the requirements are met; the outputs of the system in satisfaction of the system's requirements; and the inputs used to generate the outputs. The four items under analysis represent concurrent identification of the areas of inquiry, coupled with the charting of all operations, functions, decisions and actions, the gathering of data produced and forms used, the listing and evaluation of available personnel and equipment, all synthesized into a report of existing conditions.
2. Evaluation, which is the detailed examination of current procedures with respect to their adequacy to implement the mission of the system.
3. Design, which is the action taken by validation of the existing systems, by modification of it, or by substitution of a newly designed system to satisfy the demands being placed on the system.

Definition of Terms

The use or terms in subsequent detailing of phases of a systems study can be a source of confusion. It is our intention here to avoid technical language as much as possible in order to serve better the understanding of the non-specialist.

The simple terms chosen are applicable to processing by any means, manual or machine and can be expanded or modified where appropriate. It is suggested that the following terms are commonly in use and therefore can be helpful in effective interchange of ideas with management specialists. The reader will note that the arrangement of the terms attempts to indicate their logical and hierarchial interrelationships.

Goals: The objectives of the total system that establish demands placed against each system and its subsystems.

Demands: The established requirements of a system and its subsystems.

Requirements: The supply of data, information, action taken resulting from a demand.

Input: The printed form, written record, oral information, instructions needed to satisfy a requirement.

Output: The answer to the requirement of a system in the form necessary to convey or transmit information.

Subsystem: A major part, component, or activity of a system.

Operations: The major, specific units of work.

Procedures: Used synonomously with operations.

Jobs: Used synonomously with operations and procedures.

Elements of operations: The functions, decisions, actions comprising operations.

Functions: The processing steps in operations.

Decisions: The determination of the steps to be taken to complete a function.

Action: The course taken as a result of the decision.

Librarians and the Systems Study

Intelligent staff participation and interest are essential to the success of any study to effect operating improvements in a system. In order to consolidate the gains that can come from a systems study the personnel must be capable of maintaining surveillance of the recommended operational structure and procedures.

A systems study is the beginning for a different administrative and organizational work pattern that must be monitored in order to maintain and improve the library's ability to achieve the goals set for it. Regular analysis and evaluation of current methods and procedures should ensure that the demands for information and action being placed on the systems are being met. If they are not, the design and modification of methods and procedures become necessary because of the changing requirements of the system. Thus the need for the "new breed in librarianship," as Paul Wasserman puts it in his monograph "The Librarian and the Machine." This "new breed" is the library systems analyst and the programming librarian. The presence of such personnel trained in the required managerial skills should release other professional librarians from processing functions to the areas of professional services to library users and to research in user requirements and improved methods of service.

Basic education in librarianship coupled with specialization in data processing, or computer programming, or both, is suggested, if not essential for the professionally oriented library systems analyst and programming librarian. As held by both Wasserman and Minder the problems to be solved are not simply tied to managerial technology also involve understanding of the professional objectives to be served. Librarians must be able to analyse, evaluate and design their own systems in terms of the requirements of librarianship. Otherwise the management and computer technologist, unaware or uncertain of the goals of librarianship, may adversely influence the organizational structure required for the attainment of the purposes of library service. Again, as Wasserman writes in discussing the use of technological expertise by libraries, "The responsibility of the data processing person must be subordinate to a management which is broader and more comprehensive in its approach to the programme of the library. Even when those who are trained or experienced in data processing begin to assume general and broader library management responsibility, it must be for the ability which those so chosen manifest in these broader problems of organization than simply those tied to its technology." Thus it seems advisable to look toward the library profession itself in the development of these new administrative positions in order to maintain balance in the composition of library administrative leadership.

It would appear composition of library to have on its administrative staff at least one full-time officer whose responsibility is that of improving the library's systems and procedures and constantly modifying processes and procedures as demands or requirements placed on the organization change. The size of a library is not a factor in the need for systems study. In the case of the "one-men" library it would be left for the librarian himself to acquire the requisite managerial skills. On the other hand the medium-to large–sized library organizations might well think in terms of full-time staff specialists.

Since the systems analyst or manager of systems and procedures is a staff officer, established and accepted as an agent of the library's director, his point of view and interest must be coterminous with those of the director. The responsibilities of this position, in cooperation with library department heads, include the following functions:

1. Assisting management in the review and evaluation of operations and services to meet the established goals of the library.
2. Designing and implementing in cooperation with supervisory staff new or improved operating systems for increasing effectiveness, strengthening operating or management controls and expediting performance of routine work.
3. Developing operating manuals and reviewing, improving and planning statistical and accounting reports for managerial control at all levels.
4. Evaluating existing forms and as necessary designing new or improved forms.

5. Conducting training programmes for staff management in the regular application of systems study techniques to daily operating problems and in the capabilities and use of the computer in operations and library services.
6. Directing the design and programming of computer–based systems and representing the library's interests in shared computer facilities.
7. Keeping abreast of new developments in data processing, together with associated equipment and their application in library operations.

Library systems analysis, evaluation and design will be ineffectual unless done by persons who are trained or formally educated in librarianship. Although without experience, the library school graduate is prepared to learn the nuances of library service that can only be gained through experience. At least his schooling has made him aware of this contingency and he is prepared to develop professional attitudes. This cannot be safely said of the one trained solely in managerial techniques.

Library schools in the main are beginning to recognize the need for an introduction to systems study and data processing. A recent sampling of some half dozen schools revealed thinking in this direction. This is corroborated by Hayes' table of university programmes. There is, however, a tendency to feel that the student librarian without sufficient prior knowledge of the components of a total library system would not properly profit from instruction in these phases of managerial science. Cannot this be said, too, of the student in such a course as "Library Administration" or "Library Organization," where the application of principles can only be inferred and likely misinterpreted in the case of the many students who have not even elementary exposure to the operation of a library?

Paul Wasserman suggests that the library school should offer programmes in data processing to the practicing librarian at an intermediate level, "not necessarily tied to any formal degree level resulting in some type of certificate midway between the master's and doctorate. Conversely it is suggested that programmes in the specific functions of the control systems of a library be offered to management degree holders. This can be done and is being done by some libraries through in-service study programmes. In institutions where both a library degree and a management degree are offered, an interdisciplinary programme could be profitable in making available to libraries management personal knowledgeable in library operations.

Modern library management, aware of the need for system study, has no recourse but to learn the techniques and tools of systems study and the skills to apply them—the basis of good management. If a library is to examine itself with the techniques of management science, the responsible personnel should be trained to do so. Because the systems study represents a demanding total library effort that may result in major operating changes, the entire library staff, under the strong leadership of the administration of the library, should be fully involved in planning and conducting the study. Here the guidance, direction and personal participation of the director of the library are critical. He is responsible for the proper execution of the study.

Study Staff

Having received governing administrative authorization to proceed, the first responsibility of the director of the library is to select and appoint the staff to make the study. There are two principles to be kept in mind here: (*a*) a good systems study cannot be done on a part–time basis; and (*b*) the person selected to direct the study preferably should possess a combination of education in librarianship and training in the methods of systems analysis as taught in modern management courses. Since satisfaction of the latter prerequisite probably is not possible in most instances, one of two courses is open: either to release a library staff member from other duties to prepare himself for the conduct of a study, or, to bring in a skilled systems analyst unfamiliar with library organization.

The outside analyst skilled in modern management techniques should become fully familiar with the library's problems and responsibilities and develop a rapport and identification particularly with the supervisory staff. It is probable that the analyst from outside the library organization will require at least six months of intensive study and orientation to become sufficiently familiar with the library's problems and responsibilities and to develop rapport with the staff. He should not approach the study with preconceived notions of the local problems to be solved, possibly arising from his work with another library or with what he feels is an analogous organization. Although the conditions he sees in a cursory inspection may appear to be the same as he has encountered before, the causes of the conditions to be studied frequently are completely different. The analyst's responsibility is to determine *what* problems exist, *how* and *where* they originated and *how* the conditions at hand can be corrected.

The composition of the study staff should be as follows:

1. A library officer possessing responsibility and authority within the library's organization, to take supervision of the study.
2. At least one member of the study staff fully trained and experienced in the application of management–analysis techniques, preferably a librarian.
3. At least one member of the staff skilled in electronic data processing (EDP) methods, particularly if an automated system is contemplated; and again this member preferably should be a librarian.

4. Clerical assistance sufficient to support the work of the study staff.

It is conceivable that the requirements in Items 1-3 could be met by one person. However, it is more likely that two persons will be needed to meet the indicated requirements in the case of the medium– or large-sized libraries. A major factor here, of course, is that the library must continue to operate during the study and the dual responsibility could impede the progress of the study if only one person undertakes the role.

Defining the Study Problems

The study staff is to develop with the library's management a detailed procedural plan and time schedule for the study, the first step of which is the general definition of the problems to be studied and the identification and description of the specific problems involved. It is the responsibility of the library's management to supply a clear and concise statement of these problems in the form of a *written report* such as would have been prepared for gaining governing administrative support and financing for the systems study originally. Problem definition must be in sufficient detail to serve as a guide to the study staff members and to inform the other members of the library's organization who are concerned with the activities named as areas to be covered by the study.

Long-Term Goals

The next step, critical in planning and conducting the study, is the definition of the library's overall goals, of which the systems study staff must be fully aware in relation to the problems to be studied. Goals are those factors that the management of the library determine to be important for accomplishment by the library. The statement of goals determines the major requirements resulting from demands that should be satisfied by the library through its data processing and informational systems. Goals are basic in evaluating the current system and in designing a new system. If the goals are not precisely and correctly defined and understood in detail, the results can only be an inaccurate evaluation of current operations and the design of a faulty system.

Therefore the study staff should verify the validity of the stated goals through discussion with library users, department heads in the library, department heads of the parent organization of the library and with the key administrative officers of the library's governing organization.

Long-term planning is implicit in defining the library's goals. Because most libraries are in a period of dynamic and persistent growth, systems to satisfy long-term goals should be designed with the capability of handing increased demands. Thus computer-based systems are suggested. Such systems have the capability of less costly and more efficient growth as demands on the library grow. Today's commonly applied manual systems often become more costly and less efficient under increasing demand and do not possess the "stand-by" qualities of the computer system in adjusting to growing requirements.

The following are some of the major goals of many libraries today : (*a*) to improve service to users; (*b*) to provide more prompt access and greater use of the library's resources; and (*c*) to participate in library network programmes of bibliographic data distribution and information transfer.

Scope

After the goals have been defined, the scope of the study must be established. Here the particular data processing systems within the library that are to be studied are identified as well as the organizational units in which the operations are performed and the activities involved in order to prevent wandering into other systems with which management is not concerned at this juncture; and within the system priorities are established for the components thought to need early attention by the library's administration. It is important in specifying scope and priorities that the systems study staff not be too rigidly restricted but rather allowed a degree of flexibility permitting recognition of other areas that might be affected by the particular system directly assigned for study.

Limits and Restrictions

Within the scope management also should define any limits or restrictions to be placed on the development of a system. It is important, obviously, for the study staff to know these parameters before the systems design phase. Illustrative of limits and restrictions are : (*a*) the type of system wanted: computer based or not computer based;(*b*) number and proportional distribution of personnel to be in the system; and (*c*) tolerable unit or total costs of operations of the system.

Methods Techniques

In further preparation the study staff members should decide on the methods and techniques to be used in the study for obtaining and recording the necessary information. These should be determined in order to assure a logical, systematic study and to permit comparison of findings within the systems. For example, if statistical work sampling is to be used, the confidence level to be accepted must be agreed on in advance with applicable sampling techniques being uniformly employed; survey forms must be designed for each of the surveys to be conducted; type and format of reports to be presented must be determined—that is, graphic reports such as organization charts, procedure flow charts, graphs, tables, and so forth; and written reports or other narrative materials must be agreed on.

Involved also in the methods used are designation of the persons to be interviewed, the records to be obtained and analysed, the equipment available and its use and a detailed outline of the specific types of information to be sought. Adoption of uniform methods and procedures assures that the results reported by each study staff member are consistent in content and format and allow uniform comparison and evaluation by the staff in consultation.

Work and Time Schedule

As terminal planning steps the organization of the work of the study staff should be set down and a time schedule prepared for completion of its assignment measured by man-days or man-months; the types of skills needed for each assignment have to be determined—that is, managerial analysis, clerical, programming and so forth; the responsibilities of each person in prosecuting and completing his study assignment should be explicitly defined based on a list of specific identifiable study stages, each with a target date for completion; target dates for interim reporting to the library's management and to the study group as a whole should be set as well as the target date for submission of the final study report. The time schedule is not only important to the orderly and expeditious prosecution of the study but also to administrative knowledge and acceptance of howlong current library operations will be slowed or otherwise adversely affected by the study's demands on the operating time.

Announcement of Study Plan

As the plan for the systems study is being formulated the director of the library should have introduced the idea to the library staff, indicating the reasons for the study and its objectives. Such announcement would include : (*a*) an indication of the reasons for the study; (*b*) a description of the principal goals of the study; (*c*) a description of the benefits expected; and (*d*) solicitation of the full cooperation of the members of the library staff, assuring them of their major roles and engendering their full support and interest in order that the study be successful.

When the planning is completed, the director should review the finished plan with the study staff and with other members of the library's administration. When he has approved the plan, the director of the library should make a formal announcement of the undertaking of the systems study to the community served by the library, indicating the reasons for the study and its objectives and anticipated benefits as well as explaining what problems the user of the library may temporarily encounter during the period of the study.

The library staff should be reassured at this time of the administration's awareness and sympathetic understanding of the disruption of each staff member's assigned duties and, further, be assured of the administration's firm support of the study. It should be demonstrated to the staff that without the cooperation and participation of each member the study cannot lead to results beneficial to the staff and to the library.

Staff Training Programme

Following the announcement of the starting date of the study, it would be well to conduct a short staff training programme detailing the techniques used in a systems study. Discussion of these techniques should bring a better understanding of the study, generate the very necessary staff interest in it and furnish knowledge of what information the analyst will be seeking in his contacts with individual library staff members. The training programme also might well include description of the potential use and contribution of computers in library data processing operations and library services. At the same time the library staff should be provided with selected references to the current literature on library automation.

It cannot be overstressed that staff understanding, perceptiveness and support are prerequisite to a systems study resulting in practicable systems design. Support in this phase of organizational improvement efforts will be carried over into the successful implementation of the study's recommendations. As in any activity staff cooperation, willingness, interest, desire and pride in work generally assures attainment of operating objectives.

Analysis Phase of the Systems Study—Determination and Survey of Requirements

In the analysis of systems, the initial phase of any study, the "analyst" or "analysts" on the study staff should acquire a complete understanding of the system to be surveyed and become thoroughly identified and conversant with all of its components. It is equally important that the analyst determine the interactions, the interrelations, existing between the system under investigation and all other systems that place demands on it. The analysis phase, as briefly consists of four distinct but interacting surveys :

1. *The Survey of Requirements* : The requirements of the system are the results of the *demands* (for information, reports, and action) placed on the system from all sources. The analyst should determine the demands in the light of stated goals and also where they originate and how they are satisfied by the system. Are there requirements that are not satisfied and if so, why not?
2. *The Survey of Current Operating Conditions* : The analyst should obtain a working knowledge of operations required in the system,

the sequence in which they are performed, the functions, decisions, and actions required for the performance of each operation, and of what the inputs and outputs of each operation are. He should make a survey of equipment to establish the utilization and capabilities of available equipment and make a detailed survey, including work measurement, of the individual jobs in the system to learn whether staff job descriptions match the functions required.

3. *The Survey of Outputs* : The outputs of a system consist of the reports, records, and actions that are prepared or performed in the system to satisfy the demands being placed against it. The analyst should determine why, how, when, and by whom the output is prepared, what information it contains, and what functions and actions are required for preparing this output.

4. *They Survey of Inputs* : An input to the system is the information that must be used in order to generate the necessary outputs needed to satisfy the system's requirements. The analyst should determine what inputs are received; how many, how often, and where they originate; what information they contain; and what functions, decisions, and actions are required in order to convert this information into the desired outputs.

Requirements Versus Demands

Requirements to be met by a system are based on requests or "demands" for specified information and action originating with management, the library, user, and other sources both within the outside of the library. The questions needing to be asked are: What is required of the system? What must it do to satisfy the demands and needs of the library user, of management, and of the library's other systems? Exogenous demands must be identified and evaluated for their necessity and impact on the system and for their possible elimination if they are unnecessary and hamper fulfilment of the system's operational objectives.

Until requirements are known in detail, it is impossible to proceed with the analysis phase of the systems study. Understanding of present procedures, considered cannot occur without knowledge of the precise requirements a system is supposed to meet. Although the outputs of a system are derived from requirements, the two should not be confused. The outputs of a system are considered. Outputs (information and action) flow from the demands with which the system is concerned.

We shall consider a few examples illustrating what requirements are in the operation of a system. Let us say that a fundamental demand of the serials system of the library is to provide the user with an accurate and current catalogue or listing of the library's serials holdings. This demand obviously places a requirement on the serials system. We shall assume further that the demand is placed on the serials system to provide, within a reasonable time, special listings or special reports concerning the serials holdings felt to be necessary by the library's users and by the library staff itself.

The complexity of this type of demand indicates that any serials system capable of handling it must be flexible enough to provide an analysis or report concerning the serials collection without prior knowledge of what specifically will be asked. This means that the serials system requires records that can be manipulated in various ways to satisfy multiple demands. Internal requirements of the serials system include the prompt claim of issues on a definite schedule, precise control of renewals of subscriptions when due, and improved accuracy and speed in the check-in of issues as received.

Another example of a demand is the preparation by the library's management of annual statistical reports for national data gathering agencies. This demand commits the director of the library to preparing the report and causes him to place demands on each system within the library to provide the data for this report. Thus this demand placed on the director causes the placement of multiple demands on systems throughout the library and the records required in each system must provide the information needed for the director's report.

Although the terms "demands" and "requirements" sometimes are used interchangeably, there is a difference in the meaning of these terms until the action taken translates a demand into a requirement. This fact may have become evident in the foregoing example of the demand for an annual statistical report placed against the library's management.

Whether demands originate from within the library or from outside, the reactive process explained above occurs. This complex of demands and requirements can be the source of a system's breakdown if it is not thoroughly controlled and analysed with respect to the need, duplication, or overlapping of each element of the set of demands leading to requirements placed on the systems.

Establishment of the need and correlation of demands and requirements is particularly important at the level of so-called "routine" operations. Here the library clerk with limited responsibility, an incomplete understanding of the process to which his work contributes, and no defined limitation of his own contribution may impose demands, or requirements, or both on a fellow worker resulting in a gradual deterioration of a process as it was originally designed.

The origin of the demand resulting in a requirement against a system has bearing on nay judgement of whether the demand is unnecessary or must be accepted as a bonafide requirement of the system. Again alluding to the annual statistical report "demanded" by a national agency, this represents a demand from outside of the library over which the library has no direct control.

The administration has two courses open. Either it can comply with all of the items of statistical information requested, placing additional requirements on the various systems of the library, or it can decide to comply partially using whatever statistical information is available. If this demand for a statistical report were an internal one and, for example, had originated with the library's administration itself, the management of the other systems of the library would be able to question elements of the demand with respect to the library's needs to be served and with respect to the applicability of the same information being made available in a different from that requested by the library's administration.

Some demand placed on the library from outside sources may be questioned as to their being legitimate requirements acceptable by a system. This is illustrated by the instance of a comptroller's office of a parent organization demanding the continuance of manual procedures in the clearance of book invoices by the acquisitions department whose operations are to be automated. It may be pointed out that the computer system could furnish and summarize payment and accounting information in almost any manner required by the comptroller. The comptroller's demand may be shown to be unnecessary and uneconomical in the operations of both the library's acquisitions system and the comptroller's system. The comptroller may take the position that the library would create an exception in his commonly applied procedures that he is not readily inclined to change. Whatever the resolution with the comptroller of this outside demand, it serves as an illustration of why it is necessary to examine the validity of each demand.

Some demands from outside the library are patently arbitrary and create requirements deleterious to a system's operation. In an university library, for example, a department chairman may demand that his record of the books he has requested for purchase be kept up to date with the acquisitions department's record of action and ordering—that is, when each book is ordered, reports of delay, date received, and date catalogued. This requirement obviously would hamper the efficiency of the acquisitions system and create added costs if indeed the total demand could be met. This demand represents an unreasonable extension of an acceptable requirement; that is, notification to the requestor when the book is available for his use. Thus demands coming from any and all sources must be critically reviewed and analysed in relation to the impact of the resulting requirements on the efficiency and mission of systems.

In analysing or designing any system requirements cannot be established by asking what is wanted and blindly accepting stated requirements. Intrinsic requirements in the operation of a system frequently are not recognized or identifiable by the personnel responsible for fulfilling the purposes of a system.

Explanation should be made of the *concept of requirements* if workers are to understand the meaning of their jobs and be able to identify for themselves the subsidiary requirements they fulfil in satisfying the primary demands of a system. A member of the acquisitions staff, if asked, might reply that the requirement of the acquisitions system is to order books, not realizing that many other requirements must be fulfilled to meet the basic demand of the ordering of books. Also a number of requirements are entailed if the serials system is to meet the primary demand of maintaining accurate and up-to-date records. Thus not only the primary demand of a system needs to be known but also all requirements contributing to the execution of the primary demand.

Determination of Requirements

The first step in the analysis of a system is that of determining what requirements are being placed on the system. The study staff must translate the stated goals of the library into the demands that the goals place on each system and, in addition, must identify all requirements and their sources as listed below :

1. From outside the local organization there are ALA rules for filing; rules for main entry; reports required by Governmental agencies and professional groups.
2. From outside the library locally accounting information is required by central purchasing; user requests are required for information and services.
3. From within the library there are systems depending on other systems for information; the director of libraries requiring certain reports and statistics. Illustrative of interdependence of systems the cataloguing department may wish to receive from the acquisitions system certain information contributing to the cataloguing of a book; in addition it may expect that he acquisitions department will have ordered the Library of Congress cards at the time the book was ordered; or that the acquisition department will supply the proof card or copy of the cataloguing information from the *National Union Catalogue* if available.

4. From within a system information is required by one subsystem from another; information required within a subsystem. For example, the ordering subsystem within the acquisitions department may place the requirement on the preorder search subsystem that it furnish the correct information about the availability of the publication, the publisher, the date of publication, edition, cost, author, and title.

The need for identifying sources arises in connection with the opportunities the study staff may or may not have in suggesting helpful modification, change, or elimination of existing requirements. Typical sources of requirements are represented by the following, whom the study staff should interview regarding the requirements each one places on the system:

(i) the director of libraries;

(ii) the users of the library;

(iii) the heads of departments within the parent organization affecting library operations, such as purchasing, accounting, and so on;

(iv) the head of each major operating system within the library;

(v) the head of the system being surveyed; and

(vi) the personnel within the system.

In analysing the requirements of the system it is necessary to sift out those invalid requirements arising from artificial organizational separations as well as those of a traditional character serving vestigial needs. The magnitude of the need served by the requirement should be observed. If, for example, a record is maintained to answer a need that may or may not arise, it will be necessary to prove that this record is necessary. In many instances requirements have been perpetuated in a system and with the growth of the system those that are obsolete have not been eliminated. When the "why" of a requirement is explored, it may be found to be sperious. A simple relocation of records can lead to the elimination of a so-called "requirement." For example, an "official catalogue," a main entry catalogue of each title in the library and on order, was deemed essential in a technical processing area because of the distance of the public card catalogue fro the cataloguing and acquisition personnel. This requirement to maintain an official catalogue, entailing a considerable drain on staff time, could be eliminated by relocating the public catalogue closer to the acquisitions and cataloguing departments and by filing open-order records directly into the public catalogue. Thus a primary phase of the preorder searching operations of the acquisitions department could be satisfied in one place—the public card catalogue.

In analysing requirements the analyst plays a rigorously objective role finding out how the system operates and inevitably in the process evaluating the validity of the requirements. If, for example, the library's management wants a report every month of every account maintained by the library, the question "why" arises : Is this report needed every month? Would a report simply on those accounts that are running low at a particular time be more pertinent? Just how much information does management need? How is this information going to be used? In the matter of reports it will be found many times that various reports will present the same information and that several records within the library will duplicate this information.

The obvious question is can one or more of these records/files be eliminated or combined? This is typical of what must be investigated in order to determine the practicability of retention of existing records and files. This point is belabored in order to emphasize that *no* requirement, formal or informal, is too small to investigate and evaluate. In addition no requirement can be retained for any reason except that it is necessary to meet the valid demands made on the system.

The analyst must probe and question until he knows why the information flowing from a given requirement is needed, how it is used and where, whether used elsewhere or filed, and if so, why, until he knows every use and disposition of the information being generated by each requirement. In order to do this he must learn the content of specific jobs in depth and the purpose each is intended to serve. It is not a question of his being able to do the job being analysed but rather to know what the job is about; to know the requirements the work is intended to meet; and to know the processes through which personnel attempt to satisfy the requirements.

Each system looked at in a cursory way may reveal apparent requirement but such requirements cannot actually be accepted unless sit is found what the demands are that cause these requirements. For example, the primary demand placed on the acquisitions system is the ordering of books. This, of course, could be done by simply accepting a request and ordering the item desired. However, all requirements of the acquisitions system would not be fulfilled by this action that satisfies the primary demand. Such action would not satisfy the requirement of "no duplication"; it would not satisfy the requirement that if a book is on order another copy should not be ordered; and it would not satisfy the requirement that before ordering a book verified bibliographic information should be supplied. Without identifying within a given system all requirements both modifying and enforcing established primary demands, the system cannot be properly analysed or designed.

Requirements are determined on the basis of actual need rather than on desire without any demonstrable reason. Otherwise an administrator who states his requirement as being the need for information about *all aspects* of an operation rather than for the *critical elements* of it will only find that his decisions affecting the maintenance of the effectiveness and efficiency of that operation are more difficult to make. Such a requirement ignores the principle of "management by exception," which is knowing what has not occurred as a planned in an operation rather than all that has occurred.

Knowledge of all requirement in specific detail is vital to determining the work force capable of satisfying these requirements. Awareness of the requirements will uncover the extent of duplication of work, multiplication of the same reports from various sources, and the actual need for the information being supplied. It is not infrequently the case that staff members receive reports serving no useful purpose to them but merely perpetuating a traditional referring of information based on defunct requirements. Such unnecessary requirements should be ferreted out and eliminated.

Survey of Requirements

In the beginning of this chapter were listed the people to be interviewed by the analyst, beginning with the director of the library, to determine the specific demands being placed on systems by the officers, workers, and users of the library and by those officers of the library's governing organization whose demands affect the library's operations.

The results of the interviews should be written if the analyst is to analyse systematically and to synthesize the information gathered. Availability of this information in a correlated condition is prerequisite and critical in the determination and survey of the "outputs" of systems, a step in the analysis phase of a systems study, subsequently treated.

As a guide in interviewing and in maintaining a record of the information given by each interviewee, the form Worksheet for the Survey of Requirements is used. Before considering the use of this worksheet in illustrative detail, it is used to record the answers to questions such as the following :

1. What bibliographic, statistical and account records or reports are needed?
2. What system(s) generates the requested records or reports?
3. What information must these reports and records contain?
4. Why and how is this information used?
5. Is the information received in usable or final form; if not, what functions must be performed to adapt it for use?

6. Is the proper information for making necessary decisions furnished; and what are these decisions and the basic of each?
7. What actions are normally taken as the result of these decisions?

Analysis and survey procedures can be somewhat confusing and overwhelming unless undertaken *seriatim,* proceeding gradually and systematically from the greater to the lesser factors being determined, analysed, and surveyed. This technique should be followed in the analysis of requirements as well as in the analysis and understanding of current procedures and in the determination of outputs and of the system under study.

The information obtained in the survey of requirements serves the purpose of supplying the basis for the analyst to arrive at the following determinations:

1. The information unconditionally required by each staff member at each level of the organization in order for him to meet his responsibilities; the origin of the stated requirements and their pertinence to the operation for which he is responsible;
2. The reports unconditionally needed by management, including their frequency and content;
3. The statistics that are unquestionably required for analysis of the workloads and efficiency of system;
4. The information generated at each level of operation actually required by management for the making of valid decisions and the taking of actions actually contributing to the objectives of the system's functions.

The first step is to analyse the system broadly in order to gain a general idea of the demands placed on it and the operations that the system must undertake if it is to satisfy its objectives. Having gained this general understanding and come to deductive conclusions, the analyst probes to a more specific level. This process is continued until he possesses sufficient detailed knowledge to allow him it evaluate the effectiveness and efficiency of the system and suggest an improved design that will best satisfy the overall requirements and goals of the library. With a knowledge of the system's primary demand and major functions, subsidiary or supporting requirements can now be sought and deduced. This step-building process continues until all of the operations, functions, decisions, and actions of the system are determined and synthesized in preparation for the factual systems' evaluation and design.

Referring to the Worksheet for the Survey of Requirements, the descriptions of requirements and of decisions, actions, and functions performed in satisfying each requirement are approached concurrently because of their close interdependence and are treated in this manner. The acquisitions system is taken as an example in an effort to clarify what information is being sought in the four sections of the form. Although an acquisitions system has many requirements placed on it, only one placed against the accounting and reporting subsystem is used in illustration.

The requirement placed on the accounting and reporting subsystem is that of maintaining accurate and current balances for each book fund including a record of actual expenditures from each fund, estimated outstanding encumbrances, and the supply of monthly reports of the status of each fund. There are many minor decisions entering into this requirement: What is the fund to which each book will be charged? Is the list price of the book correct? What is the estimated variance between the list and delivered price of each book? The major decision is has a given account balance fallen to or below the minimum established for administrative action. The action triggered by the affirmative may be the transfer of funds to bolster the account or the suspension of further purchasing.

The functions performed in satisfying the requirement of accurate and timely balances include the posting of estimated prices of books at the time of order, posting of the actual costs on receipt of invoices, calculating the variances between estimated and actual charges, and the posting of total expenditures and estimated outstanding charges against each fund. The preparation of the monthly financial report for each book account is based on the execution of these functions.

Referring to Part 2 of the Worksheet for the Survey of Requirements, the description of each record or report said to be needed for satisfying given requirements should be described and justified with respect to its actual need and application. Each person preparing and maintaining a record or a report should describe each record or report and the role each plays in satisfying specified requirements.

In determining requirements it is necessary to gain an understanding of a given system before moving to another. The analyst, however, will inevitably gain knowledge of relationships between the system under study and other systems in the library. In studying the acquisitions system, for example, it may become evident that demands are placed on the acquisitions system by the reference system as well as the cataloguing system. The detailing of such demands from other systems must be made in order to reach an understanding of the requirements placed on the acquisitions system. Thus in studying a system that analyst must determine factors outside of that system affecting or causing the requirements to be met by the system under study.

At whatever level in the organization requirements are being investigated much the same questions are asked: What is wanted? What is actually required? How is it used? In summary, the survey of requirements is intended to yield knowledge in the following areas: (i) information definitely required from each person at each level in order for him to fulfil his functions within the system; (ii) reports required by management—their frequency and content; (iii) statistics required about operations; (iv) information at each level clearly required for making decisions; (v) actions resulting from such decisions; (vi) relevant requirements; and (vii) unnecessary requirements.

In order to evaluate and correlate the findings of the survey of requirements of each system and its components, findings should be systematically summarized for study. The reports, information and records purported to be needed to satisfy the requirements placed against the system will have to be evaluated as valid or invalid *outputs* in fulfilling the system's requirements.

4

Current Procedures in Systems Study

With the stated requirements of the system identified and recorded, the analyst or study staff in a position in a to proceed with the three remaining portions of the analysis phase : the survey of current operating conditions (subsequently referred to as the "preliminary survey"), the survey of outputs, and the survey of inputs. Although each of these portions of the analysis phase is treated separately, as though autonomous, this is distinctly not the case. There is no alternative to performing the preliminary and the output and inputs surveys concurrently. The obviously interlocking character of the procedures applied in processing "inputs" to yield "outputs" satisfying the system's requirements calls for concurrent study of the three areas to arrive at a composite understanding and record of the system's operations. At the same time preliminary flow charts should be prepared in parallel with the understanding of the system's present procedures and be constantly revised until they picture the actual flow of work through the system. The technique of graphically representing the progression of work through a system.

Preliminary Survey—Premise

In the preliminary survey consisting of the analysis of current procedures everything about the system is closely scrutinized: its requirements, equipment, personnel, procedures and their applicability to stated outputs of the system; the effect of other systems and functions of the library upon the system's procedures; and the flow of work through the system. The system should be analysed in minute detail to make certain that all of its components together with their functions, decisions, and the actions taken, are isolated precisely understood.

It cannot be overstressed that the assigned analyst should work *within* the system—become immersed in it—so he will actually know which of the system's problems cannot be analysed in abstract fashion.

He should gain acceptance by the system's personnel in order to learn the content of their jobs and how each staff member performs his assigned work. He should exercise strict objectivity in approaching the system without preconceived notions of the system's effectiveness, value, or need in the total library system, nor of the effectiveness, value or need of any part of the system itself.

Although the entire analysis phase is concerned simply with observing and recording what exists and what is done presently, the analyst consciously identifies what does not exist and what is not done in the light of his understanding of the demands made of each system and his knowledge of the goals of the library. It is a cardinal principle at this stage that the analyst should make no suggestions of change in methods and procedures, however obvious the solution to a deficiency may be. Thus in the analysis phase preparation is made for the concluding major phases of a systems study—evaluation of the current system and design of a different system if required, where changes and adjustments felt to be necessary to improve present operations are incorporated. The continuation of the systems study to a successful conclusion depends entirely on the efficacy of the findings of the analysis phase.

Preliminary Survey—Worksheets

The tool of the preliminary survey is a methodical record of the present procedures being followed by a system. Preliminary survey worksheets are supplied for uniform approach and recording in the surveying of all systems under review.

Worksheet—General and Equipment Survey

Here also a brief description of the system and its major activities is set down. To clarify the form's use two systems are given illustration: an acquisition system of a central library and the cataloguing system of a branch. The described activities of the acquisitions system are to process book requests in accordance with selection policies, avoid duplication of library material prepare book orders, check in books received, maintain accounting and statistical reports for all acquisitions. This is a digest of the chief activities of this system. The next item on the form calls for a statement of primary requirement, which in the case of the acquisitions system is plainly the ordering of library materials within budgetary provision. The manual of procedures, if available, is obtained at this time for comparative reference in the study of observed versus stated processes.

Turning to the branch library cataloguing system, we find it is briefly described as processing and indexing library materials for the following files: periodical index, vertical file of clipping materials, public card catalogue, American Institute of Architects, file, slides, prints and art works, and theses. The primary requirements of the system is to provide timely and accurate updating of the library files and to process library materials for use as rapidly as possible.

A manual of procedures is available for this system and, if a valid manual, should facilitate the analyst's, comprehension of the system.

Special equipment may be typified by the keypunch, tape typewriter, punched-card reader, and card sorter. The questions to be answered in the equipment survey are exemplified by the following: (*a*) equipment used in present system; (*b*) other equipment available both in and outside the library; (*c*) location of each piece of equipment; (*d*) special features of any piece of equipment, such as tape typewriter with punched-card reader; (*e*) percentage use of each piece of equipment; (*f*) age and condition of each piece of equipment; and (*g*) authorization and procedure required for use of equipment outside of the library and its schedule of access, such as computer, centralized printing equipment, and services.

Worksheet—Personnel

This survey is an approach to two areas of long-standing interest to library manages. The first is the preparation of job descriptions to arrive at the content of the job and the skills required to do it properly. The second area is that of analysing the qualifications of staff members to determine whether they are capable of and sufficiently trained for doing the particular work to which each is assigned. An attempt is made in the personnel survey to find out as completely as possible the qualifications required to perform properly a given job but without evaluating present job performance of the surveyed personnel.

The personnel survey is conducted through a combination of personnel and organizational records and personal interviews with each worker in the system. Form organization charts, job descriptions, and personnel classification schedules, the analyst seeks the following information: (i) the titles of the positions found in the system; (ii) the job level or classification and grade of each position; (iii) the special skills called for in each position; (iv) the name of the incumbent of a each position, noting vacancies or additional personnel not reflected in the organization chart or the budgetary authorization; (v) the actual job level—classification and grade— of the incumbent in a given job (is the incumbent working in or out of classification?); (vi) the special skills possessed by the individual worker; and (vii) the accuracy and up to dateness of job descriptions (if outdated or inadequate, modification of job analysis to the degree judged necessary by the analyst at this stage of the survey.)

This study of the attributes and deficiencies of personnel and the relationship between job requirements and the ability of job incumbent to meet the those requirements is not an isolated exercise. In the course of the personnel survey the study staff or analyst has been accepting the prime responsibility for acquiring a knowledge of the major activities of the systems being studied. The analyst, further, in his interviews with personnel should have acquired sufficient awareness of details about elements of the jobs to grasp the interconnection between the major activities. Without this knowledge of the major activities and the details of the component operations, functions, decisions, and actions, the analyst is unable to proceed with the completion of the preliminary survey form or with the flow charting and analysis of the existing systems required in the next phase of the systems study:—evaluation of the competency of those systems.

Worksheet—System Components

The analyst in his gathering of details about how an operation is performed and the steps needed in a given operation supporting a subsystem's activities should have gained a generalized concept of the flow of work through a subsystem beginning with the first major activity triggered by an input into the overall system. The system components survey of each major activity or subsystem in work-step sequence furnishes a composite picture of the flow of work through the whole system consisting of its several subsystems. With the major activities and their component operations, functions, decisions, and actions, recorded, the path of work through the system can be followed and pictorially represented in a flow chart. The analysis should be sufficiently detailed to enable the analyst to spot the same function occurring at two or more points within the same subsystem, within a related, or within an administratively separate system.

The type of component is checked, which in this case is the subsystem preorder search. Its major requirements are described:—the avoidance of duplication of bok orders and verification of all bibliographic data. The first operation, checked in the second column under Type of Component, is the searching of the library's record and consists of operations of checking the official catalogue, Library of Congress proof card file, and the library's public card catalogue. The first function checked is the searching of the official catalogue by title. The first decision, checked in the Decision—Action column, is that of finding out whether the book is in the library or on order. The action taken, checked in the fourth column, depends on the decision reached on the question, "Is the book in the library or on order: 'yes' or 'no'?" If "no" as illustrated, the chain of activity continues with the next step in the search procedure to verify the information needed for ordering and cataloguing purposes.

The final decision that the information needed for ordering and cataloguing purposes is complete ends the chain of activity in the preorder search subsystem and releases the validated bok request to the order subsystem. There another chain of operations, functions, decisions, and actions are generated by this "output" of the preorder search subsystem.

The file is described as having the responsibility for indexing certain architectural journals to supplement the art index. The operation of reviewing these journals involves, as indicated, three regularly received journals. The first function checked is the receipt of an issue of the *Architectural Record*. This leads to a decision as to whether the issue has been indexed before or not, which necessitates a check of the work file. If the issue has not been indexed, the worker prepares draft slips for articles to be indexed. If it has been indexed, the issue is forwarded to the vertical file preparation subsystem.

It may be evident that these examples can be depicted in greater detail depending on the degree of detail desired or needed. For example, the "operation" of searching trade bibliographies to verify all bibliographic data necessary for maximum identification of a publication can be further detailed with respect to the sequential steps or functions that the searcher must go through in verification. This type of very detailed analysis is required for computer control of an operation in the absence of the heuristic capabilities exercised by the searcher in a manual system.

The matter of the degree of detail desired in the analysis of a manual operation can be illustrated by "typing a purchase order for a book." Within this operation are various functions, such as separating the manifold slips, filing one in the public catalogue and one in the open-order file, mailing two copies to the vendor, and sending one copy to the card division of the Library of Congress as an order for printed catalogue cards.

This illustration also makes clear the distinguishing characteristics of an "operation" and a "function". It also shows that an operation usually consists of multiple functions or of sequential steps taken to complete the operation. Functions, then, are supporting parts or steps in effecting the consummation of an operation.

The finally drawn detailing of the functions, decisions, and actions described above is not particularly material to the broad picture of the system's operation that the analyst is looking for in the preliminary survey.

Standard Rate

It is used to record the number of units of output per unit of time in the performance of those operations and functions, capable of such measurement. Although formal time-study techniques are applicable her, standard rates can be approximated with a high degree of validity simply by subjective observation. If it seems necessary to confirm the worker's rate of production a work sample can be taken. Records of production for a randomly selected hour daily for a period of a week will give a reasonably close approximation of standard rates of production or work output per man-hour. Anticipated daily or weekly rates then can be computed, setting quantity standards adjusted by a factor for worker fatigue, interruptions, and the making of decisions, to drive at a reasonable day's or week's work.

Determination of standard rates by work measurement, time study, work sampling, or by objective inquiry and observation clearly is needed for establishing work standards and recommending adequate staffing of an operation and a system. This determination is required not only in analysing and understanding current procedures but in evaluating the current operating system, the second phase of the systems study. If, for example, the library's management places on the circulation system the requirement of shelving a minimum of 400 books per day, the capacity of the staff to meet or not meet this requirement must be known.

When the number of books to be shelved and the number of books that presently can be shelved per unit of time is known, the system can be staffed accordingly. The grossness of this illustrative requirement is recognized, calling into play as it does a series of operations and functions of varying complexity, performed at varying rates of production or output. Thus the staffing of the entire circulation system must be analysed for production "bottlenecks" in the flow of work and relief given them with additional staff or work simplification in order to met the demand. Knowledge of the standard rates of all controlling functions permits identification of those functions likely to interrupt and retard the flow of work necessary for fulfilling the requirement place don the system. A standard rate should be calculated for each function if it is measurable by units processed; if it is not, the calculation of the standard rate for the operation should consist of a composite of all functions performed in that operation.

Questionnaires—Job Analysis and Job Description

Work standard with a satisfactory level of reliability can be set by a combination of job analyses and supporting job descriptions prepared by the workers themselves. The predesignation on this form of all possible functions in a system will serve to remind the worker of functions that otherwise would be overlooked. The executed job analysis form is intended to provide the raw data for preparation of a more nearly complete description of the worker's job than otherwise could be predicted. This job analysis form filled out by all staff members, both clerical and professional, should yield a significant by-product for management:—revelation of duplicating and overlapping functions and of too much time being spent on "low level" work by professional and skilled staff.

The worker's summarization in this form of specific activities, distribution of his time devoted to such activities, his responsibilities, manner of performing his work, his working conditions, machines used, and so forth finds application not only in the analysis and understanding of current procedures but in the subsequent evaluation of the suitability of the current procedures.

The techniques and procedures of time study, random sampling, setting of work standards rates or times, work simplification, and of job analysis through work sampling as related specifically to library task are fully treated by Dougherty and Heinritz.

Analysis Phase of the Systems Study—Determination and Survey of Inputs/Outputs

The third and fourth distinct but related portions of analysis phase of a systems study are those of determining and analysing the "inputs" and "outputs" of the system. Input means just what it says—information that is a matter of record within a system. Output also means what it says—information transmitted from the system. The flowchart symbol for an input or output is the same.

If confusion arises in distinguishing input/output from requirement or demand, it is helpful to remember that a requirement or a demand is a task assigned to or assumed by a system or subsystem to satisfy a segment of the overall goals of the total system. The input/output of the system results in the performance of the task. This performance is accomplished by means of information at hand that can be sorted to fulfil the requirement or the demand and the result of this sorting is output.

In this chapter the term "input/output" is used because of its duality of purpose. An output of one system or subsystem frequently becomes an input of another and it is the complex chain set up that needs to be analysed. One input—for example, a book request from a library users—sets up a chain that is obvious as we follow this request from acquisitions through cataloguing to circulation. Subsystems of each of these systems are involved and it is in the survey that the picture takes shape.

Each input/output should be followed through the system to its destination, finding out in its course the operations utilizing the input/output, the information added to it if this occurs, and how it is acted on to meet its primary purpose of contributing to the satisfaction of a stated requirement of the system. The questions to be answered are (i) is the input/output needed to meet the requirement and (ii) is the input/output information adequate with respect to content and form to permit efficient satisfaction of the requirement?

Input/Output Worksheets

In following either a specific input or output through the system the analyst should make use of an executed Worksheet for the Survey of Inputs and covering the handling of each input or a Worksheet for the Survey of Outputs and covering the handling of each output at each "level" as it progresses through the system, resulting in multiple records of the same input/output as it goes through transformation, modification, and change to achieve its objective. The term "level" can be equated to the individual worker who performs certain functions, makes decisions, and takes action in his manipulation of the input/output for referral to a fellow worker or to anther system. Here the analyst should make certain that the level at which an input, for example, enters the system is the level where it is used or the action is taken contributing to the processing of the input. It is not uncommon for a worker to receive data or requests for no other reason than that of referring them to someone else in the system who does the work the input calls for. Such interim handling, functionally wasteful, clearly, delays the processing of the input and slows the progress of the system's work in meeting its requirements. Hence the level at which the input entered the system is not proper and appropriate revision is necessary at the design stage of the study.

The handling of a book invoice exemplifies the processing of an input/output at different levels. The invoice is received by the package receiving clerk. He uses it in confirming that the items listed are in hand or that the invoice is incorrect in this respect. The invoice is either referred to the accounts clerk for recording and clearance for payment or its is referred to the acquisitions clerk for claiming the missing item. The three workers in this example each represent a level and from each a worksheet is obtained indicating the functions, decisions, and actions taken in processing one basic input/output—a book invoice.

Source and Type of Inputs/Outputs

As in the case of the requirements of a system the inputs/outputs of a system are received from many sources and in some instances the form and content of the input/output cannot be altered or controlled, however essential to improved operating efficiency and best results a change might be. The analyst should become cognizant of all sources of inputs/outputs to know whether or not opportunities exist for proposing redesign of the form and content of given inputs/outputs in the interests of efficiency, economy, and effectiveness. The sources may be : (i) from outside the governing, administration of the library; (ii) from outside the library but within the governing administration; (iii) from within the library; and (iv) from within the library's system being surveyed. With the inputs/outputs of a system being derived from the requirements placed on it the determination and survey of requirements unavoidably bring attention to the inputs/outputs of the system. This again illustrates the parallel, interconnecting character of the systems study in which information is gathered simultaneously in related areas to yield an interlocking picture of the system's activities.

Form of Input/Output

The form of the input/output of a system has bearing on the efficiency and economy of operations. Is it handwriting in an illogical fashion necessitating typing and rearrangement and addition of information before action can result from or be taken on the input/output? If it is a typed or photocopied request, does it have to be recast for processing in the established routine of the system? One of two courses is open: effect a change in the originator's method of producing the input/output including arrangement of the content of the form of adapt the system's procedures to the input/output in whatever form received. The later course usually can only result in continuation of operating problems and inefficiency.

For example, the book purchase request brings into play two factors: control of the source sand content of the input/output and the design of the form of the input/output. To illustrate, book purchase requests may be submitted in the form of handwritten scraps of paper, clippings, marked book review pages, and listings and may often lack critical elements of book identification. Such a situation materially slows the acquisition process, reduces personnel efficiency, and increase operating costs per title processed. To overcome these undesirable, inefficient, and uneconomical operating conditions a printed request from may be designed with the items of required information arranged in the format that is best for both the preorder search functions and the preparation of book orders. Control over the source of this input/output, the requestor, may be enforced by the library's not accepting the book requests unless each is submitted on the newly designed form. Because preorder search personnel would be able to use this input/output directly without the former recasting and typing of the request, this should improve their rate of output to the order subsystem where the order could now be typed directly from the original input/output.

This manner of adjustment is confined to sources of input/output within the province of the library. Libraries, in general, may lack the leverage to persuade sources outside their governing, administration to change the form of their inputs/outputs for best handling within the library's operational design. Libraries with extensive acquisitions' budgets, however, should be able to ask and receive the acquiescence of contracting vendors to use a suggested form of invoice and bibliographic data best fitting that system's design. If machine-produced records in the form of punched cards, paper tape, and magnetic type are received by a library employing computer controls, these forms of input/output should be evaluated with respect to direct incorporation into the library's computer system to avoid the additional step and expense of regenerating such records.

The question of control or influence over the source of such machine-produced records may be further exemplified. If an input/output comes from the comptroller of the governing administration of the library, it is conceivable that discussion with this local officer will result in the form and content of this input/output being modified ore changed to a more useful form for the library. If the library is accustomed to issuing invoices of charges made in its photocopying service, for collection by the comptroller, any change in the format of the library's invoice should be discussed with the comptroller. If the invoice being used requires a variety of signatures and other information manually added to this input/output, then a new invoice form utilizing automated billing techniques may be designed to take the currently accepted procedure into account or if viewed as an improvement, the requirement of the current procedure may be modified.

As another illustration the monthly statement of expenditures for library materials from the comptroller may be of minimal control significance to the accounting and reporting subsystem of acquisitions because it lacks indication of the encumbrances standing against the book funds. The elimination of this input/output and the assumption by the acquisitions system of up-to-date recording of expenditures and encumbrances might be more meaningful to both the library and comptroller's office which could be supplied this record at any time desired.

Another input/output considered is the "verbal communication" type. This form of input/output, especially in the fulfilling of requirements, should be eliminated to the fullest extent possible unless it can be reduced to recorded form. The proliferation of verbal inputs/outputs unrecorded at their entry into or exit from the system will likely result in repetitive handling of inquiries and unnecessary disruption of the planned flow of work. Should urgency or need for a book by a user require telephoning the vendor or publisher for a report on the delay of receipt of the item, the information obtained should be written on the open-order record. There is extensive verbal communication in reference work with many inquiries and answers that should be recorded. Wasteful repetition of the same search process at a later time may well be avoided if records are made and kept of these verbal inputs/outputs.

The variant types of inputs/outputs are (i) manual—for example, handwritten or typed information to beacted on clippings, lists, book charges, overdue notices; (ii) machine record—such as punched card circulation transaction card, magnetic tape (LC MARC, other machine-readable data); and (iii) verbal communication of information to be acted on—such as renewal of book charges by telephone.

Survey of Inputs/Outputs—Analytical Principles

Some indication of the procedure to be followed in the survey of inputs/outputs was given in the beginning of this chapter. The requirements are : (i) the isolation of each input/output to a system, including each variant of the same input/output as it is used at each functional level; (ii) identification of the level at which each input/output enters or leaves the system; and (iii) determination of the need, use, and path of each input/output as it progress through the system to its ultimate objective and disposal.

In order to satisfy the requirements of the detailed analysis in the input/output survey numerous questions about each input/output must be posed and answered.

What is the form of input/output? Is it necessary that the form be changed for use within the system? Keeping in mind the matter of control over the input/output, the analyst is mainly concerned with the processing needed to use the information supplied? Does the vendor's invoice have to be rewritten or recast for use? Do requests for books have to be rewritten or recast for efficiency in preorder search operations? Do other systems in the library generate requisitions for books in incomplete or variant form? These and similar situations are investigated for unnecessary data processing that can be eliminated to yield lower unit costs of operation and more purposeful utilization of personnel. The underlying question is can the format of the input/output be changed if needed to improve operations?

Where and how does the input/output originate? This question strikes at the critical problem of control over an input by the system. The design of a system or improved data processing methods and procedures is significantly influenced by the extent of control over the form and content of the inputs/outputs. An appreciable lack of control over key inputs/outputs can prevent the design of the most economical system, or the most effective or the most efficient system, or the design of a system possessing a combination of these attributes. This can be illustrated by the library that has applied the Dewey decimal classification through its several editions and has decided to continue with it in any event. Having to develop this classification data for each title and to reclassify and recatalogue material previously classified under earlier editions in order to maintain collection integrity may yield the most effective results but certainly not with the maximum possible economy and perhaps not with any degree of efficiency as measured in terms of units completed per unit of time against a cataloguing operation using the Library of Congress classification scheme without modifications.

At what level does the input/output enter or leave the system? At what levels is it used? These are leading questions with the objective of making certain that the level at which the input/output actually enters or leaves the system is the level at which it is first or last actually used or acted on. As mentioned earlier it is not uncommon to find improper referral or interception of incoming data at a level where the worker takes no more action than that of passing on the input/output to another level that may or may not be the proper level for use of the input/output. This illustrates the principle in the survey of inputs/outputs of establishing the path of each input/output from its entry through its progression and exit, from level to level or from worker to worker in the system.

What information from the input/output record is required by each level receiving it? This question keeps emphasis on the isolation of the needless entry and interception of an input/output at a given level or levels and at the same time seeks identification of the precise portion of the data of an input/output used or acted on at each level where the input/output is found. For example, a reference question about the library's annual review series holdings is properly addressed to a reference librarian at the information desk. The librarian may either check the serials catalogue or, this failing, refer the user to the serials system for more up-to-date information. Is systems analysis, however, it could be discovered that such reference questions (inputs) are being asked inadvertently of a student assistant who mistakenly is referring user to the acquisitions system which refers the users to the serials system which, in turn, refers the users to information desk, the normal entry point of these inputs.

Is information added to the input/output record for use at other levels or is a new input/output record created? The point being investigated is the actual need for adding information or for recasting the input/output in acceptable form in relation to the efficient use of the system's staff.

An example of a book invoice as an input/output illustrates the adding of the number of the library account to be charged, unquestionably needed at the accounts posting level. *Recasting* or creation of a new input/output record is typified by the book purchase request submitted in a form requiring it to rewritten in standardized format for efficient processing by the preorder search subsystem. This problem may be further typified by the "class reserve" reading list in an incomplete, inaccurate, and confused format received by the circulation system which is required to correct and recast it in the standard form needed for efficient processing.

What functions, decisions, and actions are triggered by the input/output? What workers are involved and what does each do in processing a given input/output through the system? For example, the "book" as an input has numerous levels of workers logically concerned with the processing of this one type of input. A Worksheet for the Survey of Inputs must be filled out for each manipulation of the book as an input for securing a correlative view of the functions, decisions, and actions entering into all aspects of processing it.

What is the final disposition of the input/output? What files and records does the input/output affect? Are there written procedures describing the functions in processing the input/output? The processed input/output may be disposed of by : (a) filing, (b) recording pertinent information from it and discarding the original input/output, (c) being discarded entirely, and (d) being transmitted as information for further action or manipulation at anther level. The effect of an input/output on files and records is illustrated by the book invoice that has a direct bearing on the updating of the book funds' accounting records. The book purchase request may be discarded after being transformed into a purchase order, one part of which may become a record of book on order in the public card catalogue. Another example of disposition of inputs/outputs is in a computer-based system where data are entered on punched cards that subsequently are discarded.

Types of Inputs

In the interests of an orderly and more detailed analysis and survey of inputs that vary in their importance to and effect on the operations of a system, inputs may be logically classified into four types: primary, functional, instructional, and informational.

***Primary Input* :** This type of input is characterized by its capacity to activate a major activity—a subsystem of a system. It usually calls for activity entailing major data processing functions, decisions, and actions. In the acquisitions system an approved book purchase request, a primary input, "triggers" the preorder search subsystem into activity; receipt of a book activates the receiving and checking subsystem. Similarly Library of Congress cataloguing data activates the card preparation subsystem of the cataloguing system. Another primary input, an interlibrary loan request, activates the interlibrary loan subsystem of the circulation system. A final example of a primary input is a user's request for a literature search by the reference system.

***Functional Input* :** This type of input is information or inquiries involving one step—a minor clerical function requiring only routine action. The functional input is further characterized by being acted on by the worker at the level of entry in the system and usually goes no further. For example, notice of delayed publication only requires the clerk receiving the notice of delayed publication only requires the clerk receiving the notice to post routinely the date of expected receipt to the open-order record. A further illustration of the functional input is the verbal input, "Has the book arrived in the library?" A routine check of records and the giving of a "yes" or "no" answer is the completed function, obviously not going beyond the level of entry or the worker receiving the inquiry. Another example of the functional input lies in the acceptance of Library of Congress printed catalogue cards without revision. The function simply is that of typing the added entries as found on the unit card and requires no decision making. A last example is the telephone request (input) to renew all book. The book charge may be simply redated and the charge refiled.

Instructional Input **:** This type of input is one that modifies or explains a primary input by providing instruction for the handling or disposition of the primary input. Such instructions can come from within the responsible system as well as from sources outside of it. For example, a cataloguing worksheet gives direction for the processing of books, the primary inputs to the cataloguing system. A professor requests the purchase of a given bok and at the same time requests that it be placed on reserve for his class when it arrives. This then is an instructional input from outside of the acquisitions system specifying variant handling of one of the system's primary inputs, the book. A further illustration is an instruction that journals shall not be sent on interlibrary loan thereby modifying a primary input of the interlibrary loan subsystem, the offsite request for library materials.

Informational Input **:** This type of input is defined as requested or unsolicited information that may be transformed into any of the other three types of inputs depending on the action taken on that information. An announcement of a new title is on the one hand useless information if the book is regarded as not fitting the library's need. On the other hand the decision to order the bok makes the announcement in primary input to the preorder search subsystem. To illustrate solicited information the library subscribes to the Library of Congress proofcard service. These cards, filed for possible future use in title verification and card reproduction, represent informational inputs. A slip withdrawn from the file becomes a primary input of the card preparation subsystem of the cataloguing system. If cataloguing operations are computerized, the slip may become a primary input for preparing the computer record. As a final illustration a new filing code may be suggested for the library's catalogue records. If disregarded, this new code is simply information; if it is adopted or adapted by the library, it becomes an instructional input.

For the analyst the first two types, the primary and functional inputs, simply must be identified. However, the need for the next two types of input, instructional and informational, should be analysed. The instructional input should be minimized by setting up procedures to cover all possible nonroutine functions. Every effort should be made to eliminate the instructional input by developing, where possible standard procedures for non-routine functions. Regarding the informational input, it is essential for the analyst to identify the decisions and actions occurring both within and outside the system responsible for the entry of the informational input into the system. Further, he should identify the highest level at which these decisions and actions originate and occur. Finally, the analyst should decide which of the other types of input (primary, functional, and instructional) the informational input will become if accepted.

Survey of Inputs—Worksheet

The foregoing questions needing to be answered about each specific input at each level are clarified in the executed Worksheet for the Survey of Inputs which illustrates the Library of Congress proof card as the input to the acquisitions system.

It is noted that the proof card is designated as an informational type of input simply because it is available for use if needed. Nothing is done to change its form or content nor is it put to any use except to be added to a file of proof cards. Being an informational input it can be made viably only if it becomes any one of the other three types of input. The Library of Congress proof card obviously may become a primary input to subsystems of both the acquisitions and cataloguing systems. It becomes a primary input to the preorder search subsystem the moment it can be matched with a book request. It becomes a primary input to the card preparation subsystem of the cataloguing system on receipt of the bok represented by the proof card. The answer of "no other" to the question on the worksheet, "Which of the other types of input does it become?" is true at this level of the processing of the proof card.

As a primary input to the preorder search subsystem it will be used in its original form and in the card preparation subsystem it also will be used in this original form as the basis of the library's permanent catalogue records. It is also seen that the decisions, actions, and functions are of an elementary and limited nature in this operation with the end product being a file of the inputs unchanged in any respect.

This second part is directed in general to questions of the utilization of personnel in this operation: can the job be done more efficiently to conserve worker time for other purposes? Can procedures be changed to effect a time saving? Can the volume of units received, or processed, or both, be reduced? Does the end product serve a purpose justifying the time saving? Can the volume of units received, or processed, or both, be reduced? Does the end product serve a purpose justifying the time taken to provide it? Time and motion and use studies may be required for definitive answers but initially considerable reliance can be placed on the interviewee's estimates of time taken in processing the input and the observed frequency of consultation and the extent of the usefulness of the proofcard file. Further clues about the proper or wasteful use of worker time can be gathered from the interviewee's comments called for near the end of this part of the worksheet. In the filled-in comments it is seen that internal policy change is implied with respect to the subscription for proof cards; it further is thought that the maintenance of the proofcard file is "not worth the candle"; and in connection with the ever-present problem of authority over the source of the input change in methods and procedures of the card division of the Library of Congress, well outside of the venue of the library, is suggested.

Survey of Outputs—Worksheet

The Worksheet for the Outputs, serves to identify an output by name and the job level at which it originates in the system and its type is explored. Is the output a report, financial or statistical? Does the output result in a record or file maintained by the worker? Is it a statistical, financial, or bibliographic record? Is the output a form, such as a purchase requisition, a notification of book received, or an overdue book notice?

The requirement or requirements for which given outputs are generated should be described. Referring to the sample Worksheet for the Survey for Requirements, a requirement of the accounting and reporting subsystem is the maintenance of accurate and current balances for all book fund accounts in order to generate the output that is a tabulated fiscal report on the status of each account as of the end of each month.

In the survey of outputs, as in the determination and survey of the requirements of a system the worker being interviewed is asked to describe the functions, decisions, and actions that enter into the production of each output (the tabulated fiscal report in this instance). The functions include the updating of the posting sheets for each book fund to the month's end, preparation of a draft copy of the required consolidated report, verification of the accuracy of the draft report, and reproduction of the finished report in the number of copies needed for distribution.

The decisions required in preparing this output include determination of the cutoff date in posting to individual account sheets in order to release a tabulated report on the first work day of the succeeding month, determination that the balance for each account is accurate, and determination that posting of new transactions after the cutoff time will not occur until the tabulated report is completed. The actions taken completing this output's cycle are the correction of accounting errors, typing of report, the distribution of the copies of the report to designated persons both within and outside the library, and the filing of one copy in the monthly report file maintained in the accounting and reporting subsystem. Attention again is drawn to the subtlety of the difference between requirements and outputs. The requirement of maintaining accurate and current balances is simply a designated objective. The need for transmittal of information or preparation of a report activates and justifies that objective or requirement of the operation. In analysing the requirements of a system an attempt is made to isolate the outputs that satisfy each requirements; conversely, in analysing the outputs of a system the specific requirements that the outputs are supposed to satisfy should be identified. Because the opening questions about the record kept and the report made are of a quantitative nature, they are self-explanatory and do not particularly require illustration. Answers to many of the questions here serve to prepare the analyst for the evaluation of current methods and procedures. He should be able to determine the necessity for certain records and reports as measured by the extent and frequency of use, importance of the purpose served, and by their apparent duplication and ensuring uselessness. Underlying most of these questions is the possibility of better utilization of staff through alleviation of unimportant functions and unnecessary proliferation of records and multiple copies of reports for distribution to points where they may serve no useful purpose. What is also being analysed is the availability or unavailability of properly designed forms permitting preparation in one writing of multiple copies of a basic record that is needed for various purposes. The multiple-part book purchase form is a case in point; here the various parts carrying the same information produced in one machine operation are required for full control of the book order and processing of the bok when received. Another example is a multiple-part loan transaction card where extra pars are used for overdue notices.

The remainder of the questions are for the purpose of finding out where the output record or report originates. If it does not originate with the interviewee sand is received by him for adding information, where does it come from and what information does he furnish toward completion of the output? Is his function simply that of entering a bit of factual data or that of manipulating or interpreting the data or figures carried by the record received by him? Answers to inquiries of this nature are pertinent because the completion of a report or record through addition or manipulation of data at two or more levels within a system may be more the rule than the exception.

The remaining two questions in the survey of outputs strike at the common problem of duplication of effort. Proceeding on the principle that a record once made should not be duplicated but should be transmitted as a completed function at all the operating levels through which it logically flows, the analyst is constantly on the alert for evidence of multiple transcription and duplication of the same information in other records originating independently elsewhere within the system or by an associated system in the library.

Whether the output is a record or a report, the analyst's study of an activity and a system is aimed at gaining complete understanding of the information furnished by each output, gaining knowledge of the sources of such information including the information needed, if any, from other activities or systems to complete the output, and recording how many outputs the worker prepares or maintains, or both, and the amount of the worker's time consumed in this work. These and other factors entering into the survey of outputs are now outlined, keyed to the instructions and questions in the Worksheet for the Survey of Outputs.

1. Name of output and job level at which it originates in the system with the book receiving clerk, the acquisitions assistant, the circulation assistant, and so forth.
2. Type of output:—bibliographic, fiscal, statistical, and inventory—and the form it takes—sheet or file record or report.
3. The requirements of the activity satisfied in part or in whole by the output.
4. The functions of the activity giving rise to the output.
5. The decisions needed to be made in preparing the output.
6. The actions resulting from these decisions; effect of such actions on the output.
7. Determination for each record maintained by the system of the : (i) size of the file and the number of records added periodically; (ii) type of file (for example leaders, invoice files, card records) and its arrangement; (iii) availability of rules for file preparation and maintenance; (iv) length of time records are kept in active file, inactive file, and other disposition—for example, destroy or transfer; (v) frequency of reference to the record and by whom; (vi) time used to prepare and maintain record; and (vii) time spent updating record and its file.
8. Determination for each report prepared by the system of the: (i) number of copies prepared;(ii) recipients of the report; (c) report status, intermediate for final; (iii) method of preparation; and (iv) time used in preparing report.

A sample copy of each output is obtained from each person responsible for preparing it together with answers to the following concluding questions of the worksheet:

1. What information, if any, is added to the output and where does the added information originate?
2. Is any of the information in this output transcribed to other forms records?
3. Does the information contained in the output appear in other records or reports independently prepared and maintained by another activity in the system or in a system outside of the library?

Survey of Inputs—Summary Worksheet

The culminating step, as in the case of requirements and their associated outputs, is the systematic summarizing of the data gathered about each input at each level where it appears using a Summary Worksheet for the Survey of Inputs. The use of the Library of Congress proof card as an example is continued, together with the book request and the book order. Understandable abbreviations or accepted codes have to be sued for most of the entries called for in the form. This "shorthand" method is used to obtain a consolidated and generalized overview of the inputs to a system, their multiple handling at the various levels, and their ultimate disposition as indicated in the individual input survey sheets resulting from the input analysis at each job level in the system.

These summarized data coupled with the marked copies of samples of input documents uses at each level in the system permit identification of the characteristics and content of inputs in relation to the processing steps each goes through.

Survey of Requirements (Outputs)—Summary Worksheet

The summary worksheets should have attached to them the illustrative records and reports maintained and prepared in support of each of the system's requirements. Another collection of output survey worksheets will detail the methods and procedures followed in preparing and maintaining the supporting reports and records, the sources of the information used in the outputs, and the records and reports used by designated individuals and operations to satisfy of the requirements of the system and of its subsystem.

A summarization for methodical study of the requirements of system as well as of the records and reports purported to meet the those requirements should be prerequisite to measuring the applicability of the data received by a system for meeting its requirements. The filled-out summary worksheet is organized by requirements and associated outputs within each subsystem. Parenthetically it should be understood that the example is but one of a continuum of summary sheets to be prepared by the analyst for the analysis of the acquisitions system.

The Summary survey of requirements should supply the analyst with a general overview of a system, revealing the work flow, the interrelationships, among subsystems, duplication of effort in preparing, maintaining, and supplying the system's outputs, and revealing uses and distribution of reports that may be unnecessary and can be questioned by the analyst in the light of the fairly complete picture of the system he has developed through the summary worksheets.

Flow Charting

Flow charting is the symbolism of the systems analyst. By laying out facts in a common sense way it enables the analyst to view graphically partial or complete systems and to interpret analytically what may have been recorded only as a narrative procedure. Through the use of standardized flowchart symbols a middle ground is created between the librarian and the systems analyst and efficient and effective communication may occur as a result of a properly constructed flow chart. Flowchart symbols can be used to represent in a logical progression the elements (functions, decisions, and actions), the requirements, the inputs/outputs of the system, and the equipment used in the system. Therefore the flow chart illustrates the sequential flow of work and information through a system. The advantage of using flow charts stems from a system's being a process that is constantly changing; therefore in actual operation it is often difficult to understand without diagrams the relationships that exist within a system. The flow chart may be compared to a series of snapshots stopping the action within a system allowing the analyst, systematically, and realistically, to evaluate the current operations and design new procedures if necessary. This is true because functions, decisions, and actions are clearly identified. The construction of the flow chart may be accomplished by one of two methods: *(i)* progression from the top to the bottom of the chart-vertical-flow method; or *(ii)* moving from the left to the right in the chart—horizontal-flow method. Either approach has its merits and should not adversely affect the ability to interpret or construct the flow chart. However, once a method is adopted it should be consistently adhered to. These common symbols used to show the sequential flow of work are connected by directional flow lines with or without arrows. Arrows only need be used when it is necessary to represent an exit or entry line from one symbol to another that is not in the same direction as the flow method being followed.

Special Purpose Symbols

The following symbols may be used when more detail is desired or when the more specific symbols are readily applicable. They may also may be used in the flow charting of automated or computer systems.

Flow Charting Rules

The following general rules should be adhered to when preparing a flow chart:

1. Conventional symbols should be used to facilitate mutual understanding of the logical flow of work.
2. The system, or its components, or both, should have a clearly indicated starting and halting point in the chart.
3. The graphic flow of work should always be in one direction, normally top to bottom or left to right.
4. No directional flow lines should be unconnected at any point. Every directional line should lead to another step in the chart.
5. The descriptive statement within any symbol should be succinct and mutually understandable. The terminology used should be applicable to the system being studied.
6. Wherever ambiguity may be evident, annotation or side notes should be used to provide a thorough understanding of the various parts of the flow chart.
7. Each decision "diamond" should have two possibilities—a "yes' (positive) and a "no" (negative) path.
8. The flow of the work should be clearly indicative of what actually happens in the course of an operation. The realistic sequence of functions in the surveyed system should be followed throughout.
9. Because the flow-charting of a complex system is an involved procedure, it is recommended that other staff members associated with the problem participate in the analysis phase of the flow charting operation.
10. The analysis represented by the flowchart should be consistent within itself. That is to say a flow chart illustrating the process of a document through a system should not be expanded into representation of a clerk's functions having no bearing on the operation being charted.

Constructing Chart

The “make-ready” phase of a flow chart is of vital importance in creating a picture that is representative of the system. Awareness of the component parts of the system to be flow charted is obviously required. With the aid of summary analyses and an understanding of procedures flow charting is facilitated and the analyst should become aware of the distinctiveness of each process and the individual decisions and flow paths that exist under the present procedure. In constructing the chart it is recommended that “pieces” of the system to be charted be written on individual slips of paper so that the initial arrangement of the flowchart layout can be as flexible as possible. Once the arrangement is seen as satisfactory, the system can be transposed to sheet form. For expediting the often necessary photocopying of the finished flow chart a standard paper size such as 8½ × 11 should be used.

Capabilities and Results

A flow chart pictographically representing a library system is uniquely capable of : (*a*) assisting in the organization of the system's structure; (*b*) helping to visualize the system's component parts; (*c*) Resulting in improved techniques, especially since the finished flow chart can be utilized as an effective training device with significant advantages over written job descriptions alone; and (*d*) helping in communication about and understanding of the system. At first in combination with the summary analyses and understanding of procedures the flowcharts should show the existing system with all of its characteristic faults and strengths. One certain proof of the validity of an existing system is whether it can be flow charted effectively at all. If not, the system must be illogical.

By surveying the input to any entry point in the system the analyst as he proceeds step by step through the flow chart can see the uses that will be made of the input, what decisions must be made, how the input affects the decisions, and what action comes from each decision. Thus he can judge whether the decisions are correctly made in relation to the requirements placed against the system. He also can evaluate what effect various demands would have on decisions and their related actions in order to develop the set of criteria or managerial procedures that best satisfies the system's requirements. With the standard rate for each function available, the analyst is in a position to analyse those operations appearing to be overburdened or near breakdown at certain steps depicted in the flow chart. He can then evaluate and suggest alternate paths to be taken, if any, to maximize the system's effectiveness. The basic question to ask in evaluating each of the flow chart's parts would be the possibility of simplifying, eliminating, combining, or rearranging any of the elements of the work flow shown.

The results of the overall evaluation are to be used as the basis of a flow chart serving to suggest new and improved methods of accomplishing the operation under study. These suggested methods will involve major or minor changes according to the past operational success or failure of the present system. The new or improved methods will also depend on the resources available. If any automation is planned, a concept of vital importance in suggesting revision of a system is the establishment of manual procedures and operations that will be machine compatible.

5

Digital Research Tools in Library

By browsing the Internet, much as you would browse the shelves of a library, you can access information on seemingly limitless topics. In addition, web-based catalogues are available in many libraries to assist researchers in locating printed books, journals, government documents, and other materials. Possibly the biggest obstacle facing researchers on the Internet is how to effectively and efficiently access the vast amount of information available with the simple click of the mouse. With the Internet's potential as a research tool, teachers must instruct and guide their students on manageable strategies for sorting through the abundance of information. The search for reliable resources can be both overwhelming and frustrating if students are left on their own in their initial search. A few simple guidelines can make conducting research more manageable, reliable, and fun.

Research Process

Lessons and projects should be designed so that research time on the Web can be maximised in terms of efficiency. This may mean gathering necessary information beforehand, having students work in groups, or focusing on whole-class projects. Barron and Ivers (1996) outlined the following cycle for online research projects.

Step 1: Questioning — Before going on the Internet, students should structure their questions.

Step 2: Planning — Students should develop a search strategy with a list of sites to investigate.

Step 3: Gathering — Students use the Web to collect and gather information.

Step 4: Sorting & Sifting — Students analyse and categorize the data they gathered on the Web.

Step 5: Synthesising — Students integrate the information into the lesson, and draw conclusions.

Step 6: Evaluating — Students assess the results, and if necessary, begin the process again.

Searching the Web

There are millions of pages of information on the World Wide Web, and finding relevant and reliable information can be a challenge. Search engines are powerful tools that index millions of web sites. When entering a keyword into a search engine, you will receive a list with the number of hits or results and links to the related sites. The number of hits you receive may vary a great deal among different search engines. Some engines search only the titles of the web sites, and others search the full text.

One place to begin a web search is on the search pages that are maintained by Netscape Navigator and Internet Explorer. If you click Search on the Netscape Navigator menu bar, you will go to a page that provides quick access to many different search tools. You can select the search engine you want to use from those pages rather than accessing each search engine site directly.

Techniques for using the different search tools vary. For best results, read the search tips or hints that are provided at each search site. Also, note that some of the search engines do not allow Boolean searches that combine words with the logical connectors of AND, OR, or NOT.

Common commands for search engines include:

- Quotation Marks (")

  Using quotation marks will help to find specific phrases involving more than one word. For example: "Martin Luther King"
- Addition Sign (+)

  Adding a + sign before a word means that it MUST be included in each site listed. For example: + Florida + taxes
- Subtraction Sign (-)

  Adding a-sign before a word means that it will NOT appear in the sites listed. For example: + Washington-DC
- Asterisks (*)

  Asterisks can be used for wild-cards in some search engines. For example: Mexic* will look for Mexico, Mexican, Mexicali, etc.

Search Engine Capabilities

Search engines are rated by the size of their index. Large engines such as AltaVista and Google are good tools to use when searching for obscure information, but one drawback to an extensive index is the overwhelming number of results on more general topics. If this is the case, it might be better to use a search engine with a small to medium size index, such as Excite or WebCrawler. The directory structure of engines such as Yahoo! or Lycos is also helpful for categorising the hits.

Many search engines provide directory-listing search tools such as yellow pages, white pages, and email addresses. In addition, many allow you to personalize their site to your needs. For example, you might want to set the attributes of the page to show educational news headlines and your favourite teacher resource links. In the preferences of your web browser, you can then set this page as your home start-up page.

Search Engines Especially for Children

Search engines designed for younger students are useful tools for the classroom. They screen for inappropriate material and provide appropriate sites for students on topics related to educational and entertainment purposes. Using these sites helps to narrow the scope of hits on a search inquiry. As a result, the student will spend less time reading irrelevant material. Although some search engines allow you to turn on filters to help filter out adult content, they are not always thorough or accurate. There are several good search engines that are specifically designed for the younger audience, such as Ask Jeeves, OneKey, and Yahooligans.

Evaluating Internet Sources

Students often uncritically accept information they see in print or on computer screens. Students should be encouraged to carefully evaluate sources found on the Internet. The evaluation tool (below) will help students analyse web resources in terms of accuracy, authority, objectivity, timeliness, and coverage. Consideration of these factors will weed out many of the inaccurate or trivial sites students may encounter.

Analysing Web Resources

Answer the following questions to evaluate web resources.

Accuracy

Are sources listed for the facts?

Can information be verified through another source?

Has the site been edited for grammar, spelling, etc.?

Authority

Is the publisher reputable?

Is the sponsorship clear?

Is a phone number or postal address available?

Is there a link to the sponsoring organisation?

Is the author qualified to write on this topic?

Objectivity

Does the sponsor have commercial interests?

Is advertising included on the page?

Are there obvious biases?

Currency

Is a publication date indicated?

Is there a date for the last update?

Is the topic one that does not change frequently?

Coverage

Are the topics covered in depth?

Does the content appear to be complete?

Setting Bookmarks on the Web

Both Netscape Navigator and Internet Explorer provide a way to create a list of your favourite sites that you can access with a click of the mouse. In Netscape, these lists are called bookmarks, and in Internet Explorer they are called favourites.

The procedure for creating a list of sites is an easy and powerful tool for web use. When you find a web page that you want to bookmark, simply select the "Add Bookmark" or "Add Favourite" option from the menu bar. To return to the site at a later time, choose the name from the bookmark or favourite list, and you will immediately access the site. You can organise your bookmarks into file folders and can save them on a disk to transfer and use on other computers.

Copyright Issues

Teachers and students have a somewhat flexible, but not unlimited, copyright privilege under the "fair use clause" of the U.S. Copyright Act. "Fair use" is the means by which educators of non-profit educational institutions may use copyrighted works without seeking permission or making payment to the author or publisher. Teachers and students are also protected to some extent by the Digital Millennium Copyright Act, which went into effect in October 1998. Under current guidelines, teachers and students are able to make limited use of copyrighted materials for instructional purposes. Currently, copyright law as it relates to the Internet is vague and being challenged and rewritten on an ongoing basis. However, the guidelines of the "fair use clause" can be applied to Internet use in the classroom. Although classroom use allows teachers and students to be creative, you must also be extremely careful. Teachers and students should realise that all materials found on the Internet are protected by the same copyright laws as printed materials. Copyright protects "original works of authorship" that are in a tangible form of expression.

Copyrightable works include the following categories:

- literary works
- musical works, including any accompanying words
- dramatic works, including any accompanying music, pantomimes, and choreographic works
- pictorial, graphic, and sculptural works
- motion pictures and other audiovisual works
- sound recordings
- architectural works.

These categories should be viewed broadly. For example, computer programs and most "compilations" may be registered as "literary works"; maps and architectural plans may be registered as "pictorial, graphic, and sculptural works."

Important questions to ask ;

- What is the purpose for using the material?
- Who is the audience?
- How widely will the material be distributed?
- Will the material be reproduced?

It is allowable under copyright guidelines to use copyrighted materials for class assignments. Check specific guidelines for length of time the material can be kept up on a web site. If you and your students find a graphic or portion of a text on the Internet that you want to utilize in a class project, locate the source of the web site and email them to ask permission for use of their graphic or text. Many web site designers are happy for you to "borrow" their graphics and words. Some ask that you give them credit and others do not. Although your students may be too young to comprehend copyright law, they can understand the concept of respecting someone else's property.

It is advisable for school sites to have an online service provider or an "agent" who can act as a filter on copyright issues. The agent would be the person someone would notify if they found a copyright violation on a student or school web site. In most cases, you are simply asked to remove the offending copyright violation.

Copyright discussions with students may include:

- Does copyright apply to student web pages? Any original work of authorship, whether created by a student, teacher, or professional is protected by the copyright laws. An original piece of work does not need to possess or display a copyright to be protected under the copyright laws.
- May students "borrow" art, sound, animation, etc., from others' web pages? Resources (such as graphics and sound files) from most web sites are copyright protected and require permission to use, but the resources at some web sites are advertised as "free" for use. These web sites may require that credit is given to the original source of the materials.

Citation of Electronic Manuscripts

There are many resources describing how to cite electronic manuscripts. Printed style manuals generally concur with online resources. MLA-style guidelines can be found online at the Columbia Guide to Online Style. This site shows examples of a variety of electronic manuscripts that require citation. Generally, to cite a World Wide Web page, provide the author's name, last name first (if known); the full title of the work, in quotation marks; the title of the complete work (if applicable), in italics; any version or file numbers; and the date of the document or last revision (if available). Next, list the full URL, followed by the date of access in parentheses.

To cite email, give the author's name (if known) or the author's email or login name (the part of the email address before the @ sign), followed by the subject line of the posting, enclosed in quotation marks; the date of the message if different from the date accessed; and the name of the discussion list (if applicable), in italics. Next, give the address of the list, or the newsgroup, followed by the date accessed in parentheses.

A Helpful Hint for Research Activities be Prepared for the Unexpected

If you are planning to use the Internet as an integral part of an assignment, something can (and often will) go wrong. Since the Internet is constantly changing, always preview the sites to verify the addresses and the appropriateness of the content. In some circumstances, it may be appropriate to "whack" the site as a backup, using software such as Blue Squirrel Web Whacker. Whacking a site saves it to a local location, such as a computer or network drive. In case something does go wrong, you are able to continue the activity through the usage of this whacked site.

Search Tools for Teachers

- Google
- iWon
- AltaVista
- Yahoo!

Search Tools for Students

- Ask Jeeves for Kids
- Lycos Zone
- OneKey
- Yahooligans.

Research and Finding Information

In the digital age, the Internet can lead you to vast amounts of information, librarians also help you develop strategies for finding and using the most appropriate information for research. For an academic paper, you should use books and articles as well as Web sites that collect information important to your topic. You might also include documentary films, current news programs, lectures, and even examples of art and film. Indeed, research skills are relevant beyond the classroom. Do you know the best way to find information about current political candidates? How to inform yourself about a medical condition or treatment options? How to find the safest vehicle or best value in insurance?

Internet as a Gateway to Information

Many people think of the *Internet* as a vast storehouse of information, but the Internet is actually the infrastructure that provides access to many different forms of information located in many different places. In fact, the Internet is much more than a vehicle for retrieving information, it is:

- a means of communication
- a tool for marketing and sales
- a democratic forum for discussing ideas and sharing information.

Anyone can publish anything on the Internet. The Internet does not discriminate between true or false information: it only delivers the message. As a student doing research, you need to understand that the Internet makes it possible to find something on almost anything, but not everything— or even necessarily the best thing — for a specific purpose.

Content, Format, and Access

The word *'information'* has many meanings. It encompasses fact and fiction as well as things recorded or perceived. Information includes news about events reported both accurately and inaccurately. You can get clues about the accuracy of information by understanding the content and its context. 'Content' includes both the message and the purpose of an information source. But information does not stand alone: its meaning and availability are affected by both format and access. 'Format' is how information is packaged and presented. 'Access' refers to your ability to get to information when you need it. Access can be easy and direct, or it may be obscured by factors beyond your control. Content is of primary importance. The intended audience, the message itself, and the purpose for a given piece are all driven by the author's need to communicate something. Format may be less important than the content, especially when you consider that one article might be available in multiple formats, such as printed in a magazine and published in the online version of the magazine. The key points of that same article and the author's conclusions might also be summarised and on the nightly television news.

Consider Anne Frank's story. Her story is available as a book, but other formats tell the same story, including film, drama, and possibly other artistic interpretations. Each of these packages contribute to the interpretation of Anne Frank's story. In contrast, a newspaper article about Anne Frank originally appearing in a printed newspaper may also be available online through your Library's subscription to a periodical database. That same article may also be available from the newspaper's Web site, but you may need to use your credit card to read it. Knowing the difference between content and format can also help you understand there may be multiple ways to access the information you need. Access can be facilitated or inhibited by a number of different factors. Different formats present different problems for access. For example, only one person at a time can read a single copy of a printed magazine or article. If the same text is available online, many can access it. But *Ebooks* are sometimes limited to one user, just like print books are. On the other hand, if a book is freely available on the Web, it is available any time, anywhere. Electronic documents, films, or sound recordings require special equipment that may impact your access to information. Speaking of access, consider the tools you need to locate that material in the first place. If you are not using the right tool, you might as well be looking for a needle in a haystack. Physical barriers, policies, and lack of resources can also limit access to information.

Free and timely access to information requires sufficient resources to develop both information collections as well as the tools to find appropriate information. These collections and tools must include access to all kinds of ideas from multiple perspectives so that researchers can draw their own conclusions about based on the information they find. Freedom of access to information is a value expressed in the *First Amendment* of the U.S.

Constitution, and this value is also championed by the American Library Association. Because these issues are so important to research, we use the theme of the First Amendment and *Intellectual Freedom* as a sample research topic.

Research as a Process

Students need to know how to present information to support research papers, speeches, and other projects. For this reason, the chapters in this book cover the essentials of effective research. You will learn about how libraries and other information providers organise information, and you will develop critical skills that help you determine if information is appropriate to your topic and purpose.

Research is driven by curiosity; a researcher wants to know why and how. As the investigation proceeds, each new piece in the puzzle leads to reflection on how that piece fits into a bigger picture. This textbook focuses on developing strategies to make the best use of your research time and on recognising the quality and relevance of the information you find. This book will guide you through the process, teaching you the importance of different kinds of information and how some kinds of information are more appropriate than others for particular purposes. Have you ever thought libraries and librarians might not be needed in the Internet Age?

The next time you need to write an academic research paper you might want to reconsider your options. Many kinds of information are not available through the Internet. The more in-depth research you do, the more often you will discover that the Internet will point you to material that is only available in library print collections or in archives of film, or art gallaries, or museums and even private collections!

Critical Attitudes about Information

Every day you are bombarded with information through advertising, radio and television news, by word of mouth, in school, or on the street. Given that we form opinions based on what we know, isn't it better to feel confident that your opinions are based on accurate and reliable information rather than on opinions? Do you feel confident knowing when it is better to head to Google.com or a reference book for the answers to your questions? Do you recognize bias and unsupported claims in sources you find? Can you find alternative perspectives on a topic? How can you tell if a source is reliable?

Research Methods in Cataloguing

A system administrator who is housed at the University City Public Library manages the business affairs of the Consortium. The library directors meet approximately ten times a year at various libraries with the system administrator. Each director takes a turn as president of the MLC with each term lasting two years. The hardware for the Consortium's ILS is also housed at the University City Public Library. In 2001, with the impending retirement of the cataloguer at the Kirkwood Public Library, their director was interested in the possibility of the MLC sharing cataloguing and processing via the formation of a centralised unit. It was the hope of the director that a possible consolidation would be fiscally beneficial to the Consortium as well as bring about a uniformity of cataloguing practices.

To investigate this, an application was submitted to the Missouri State Library for a Library Services and Technology Act's (LSTA) "Bring in an expert" grant which could be used to study the cataloguing procedures and processes of all the libraries within the Consortium. The grant was awarded in March 2002. The Municipal Library Consortium (MLC) of St Louis County is a group of eight independent public libraries in Missouri that formed in 1996 for resource sharing. The MLC consists of Brentwood Public Library, Ferguson Municipal Public Library, Kirkwood Public Library, Maplewood Public Library, Richmond Heights Memorial Library, Rock Hill Public Library, University City Public Library, and Valley Park Community Library. Each library extends reciprocal borrowing privileges to valid library cardholders of each member library. The combined number of volumes held by the Consortium is over 600,000. The study was conducted in phases. The first phase was a search of the current literature.

The second phase was the creation of a survey tool and visitation of the libraries. Collating and interpreting the results as well as following up with any secondary contacts was the third phase. Finally, the investigators drew a conclusion from the findings and made a recommendation to the MLC. The literature search yielded limited results for consortia the size of the MLC. Much of the literature addressed implementation of centralised departments for statewide public library systems. Even though the literature was dated (30 to 40 years old), survey tools used for these implementations proved useful (Kocher, 1958). The initial survey tool covered all aspects of a library's cataloguing process. Who was doing the cataloguing? Was that person a professional, paraprofessional, or other? How much time was spent in the cataloguing and processing of library materials? Was the cataloguing of library materials the cataloguer's only responsibility? Was the cataloguing and processing outsourced? What type of processing did the library materials require? Was the library interested in using centralised processing if offered? The survey was distributed to, and filled out with, the library director or the cataloguer at the time of each site visit. After the initial interview, it was determined that acquisition and staff salary information would be needed to fully complete the study. An e-mail was sent to each director requesting information on how many new items were received in the past fiscal year. What was the library's acquisition budget and what did it cover? What vendors were used for book and processing materials acquisitions? What was the salary of the person(s) performing the cataloguing and processing duties?

All libraries but one responded to the request for the acquisition and staff salary information. A phone call to the director of that library still elicited no response. In all but two libraries, individuals without a Masters in Library Science performed the cataloguing. However, each non-professional had cataloguing training through Missouri Library Network Corporation's workshops or the University of Missouri.

In all but one of the libraries the person(s) responsible for the cataloguing was also expected to perform other duties within the library. In a reversal of roles, one library had the reference staff and the director check the MARC records for all new cataloguing. All libraries catalogue non-print library materials, such as videos and DVDs. One library had the archivist, who is a professional, catalogue the audiovisual materials. BookWhere was the bibliographic utility of choice for the majority of libraries. The Consortium purchased this product but chose not to renew it in 2002. While the libraries can continue to use BookWhere, there will not be any updates available to them. CatExpress, an OCLC cataloguing product for smaller libraries, is the main bibliographic utility for one of the libraries.

With the non-renewal of the BookWhere subscription a few of the other libraries are beginning to use this. Some other utilities that are being used to locate cataloguing for materials are Z39.50 sites, Title Source II (Baker & Taylor), and First Search, another OCLC product. Three libraries have contracted with their book vendor for some physical processing on their books. The other five libraries do all of their processing in-house. The average length of turn around time from when a book is received until it is on the shelf is 2.5-10 days, with one library not reporting. The fastest turn around time is 24 hours and the longest is one month. When asked how much cataloguing and processing the libraries would be interested in if a centralised unit were formed the answers varied widely. Four libraries replied none, but two would consider it if shown to be logistically efficient. One library would be interested in cataloguing and processing for their children and audio visual materials. One library was interested in centralised cataloguing but would continue with their vendor processing. Yet another library was a conditional yes for both services. One library was a resounding yes for cataloguing, processing, and acquisitions. The most widely used vendor is Baker & Taylor for firm orders. Some other vendors used for ordering are Book Wholesalers, Ingram, Unique, and

Amazon.com. Libraries also purchased books from local bookshops and individual publishers. If ordering were offered as part of a centralised cataloguing unit, two libraries would use this option.

Of these two, one would use centralised ordering for bestsellers only. Another library that currently orders electronically would use this service if there were time and money savings. One library was of the philosophy that this seems to be a duplication of services. They select and order in the same work session. Another library would prefer not to use centralised ordering. Each library was asked if they would be able to host the centralised unit. Six libraries answered no. One library had no objection to it but did not have the space. One library was agreeable to housing the new unit but would need some reconfiguration of their current technical services area. Before a decision on creating a centralised cataloguing and processing unit could be made, several issues needed to be addressed.

The most important consideration was whether the project was a fiscally sound investment for the Consortium. Other issues to be addressed included the location of the unit; how many staff would be needed; and how would they be administered. Yet another important issue was a philosophical one: to whom would the records belong? Finally, what would be the turn around time from receipt of the material to the item appearing on the shelf? Would this project be fiscally sound for the Consortium? To determine this, factors such as anticipated staffing, cost of bibliographic utilities and processing costs needed to be compared with amounts currently spent. The approximate expense for cataloguing and processing for the Consortium in FY2002 was $300,000. Due to incomplete information, this amount includes only an estimate for Maplewood Public Library, where costs are based on their Consortium percentage. In fiscal year 2001-2002 the libraries in the Consortium downloaded 9,928 bibliographic records into the catalogue.

During the same period, 1,937 originally catalogued bibliographic records were created and 29,717 holdings were added. If these numbers remain stable for the current fiscal year, cataloguing costs can be ascertained for a centralised unit. For the purpose of determining staffing requirements it was estimated that 10,000 bibliographic records would be downloaded into the catalogue and that 2,000 original records would be created.

According to Smith's (1988) study of cataloguing production standards, a cataloguer can be expected to catalogue 250-400 titles a month. A title that needs original cataloguing may take between 30-60 minutes depending on its complexity. In the low range of copy cataloguing of 250 titles a month for 10,000 records a year, a library would need 3.69 full time employees (FTE). In the high range of 400 titles a month for the same 10,000 records the library would need 2.27 FTE. The FTE is based on a staff member working 11 months of the year due to vacation and holidays. One half to one FTE would be needed to catalogue the 2,000 original records for the Consortium. It was assumed that the Consortium would have one professional cataloguer for the original cataloguing and to double-check the copy cataloguing. The remainder of the staff would be paraprofessionals. The annual salaries are based on the 2002 Library Salary Survey compiled by the St Charles City-County Library for Class 2 Public Libraries. The amounts are taken from the highest range from the two public libraries in the Consortium listed on the salary survey. The cost of benefits is included in the total for annual salaries in the range of $97,324 to $155,861.

Codes of Cataloguing

The *Anglo-American Catalogueing Rules,* second edition *(AACR 2),* is the result of a progression of ideas about how to approach the cataloguing process in order to prepare catalogues that provide the best possible access to library collections. *AACR 2* represents the current agreements that have been reached in order to standardize cataloguing practice and thereby facilitate cooperation among libraries, it expands on the agreements presented in earlier codes and forms the basis for further agreements that will be added to future codes. The first cataloguing rules were prepared by individuals. Panizzi's British Museum *Rules for the Compiling of the Catalogue* (1841) was the first major modern statement of principles underlying cataloguing rules; as such, it has exerted an influence on every Western world code that has been published since its publication.

Cutter's *Rules for a Dictionary Catalogue,* in its fourth edition at his death in 1903, presented the first complete set of rules for a dictionary catalogue. From the beginning of the twentieth century cedes have been drawn up by committees, but the influence of those early farsighted individuals continued through LC *Rules on Printed Cards* (1903 through the 1930s), LC *Rules for Descriptive Cataloguing* (1949), ALA *Rules* (1908, 1941, 1949), *AACR 1* (published in 1967), and the present *AACR 2.* The ALA *Rules* of 1908 were the result of a seven-year study by a committee of ALA and the (British) Library Association. In 1901 the Library of Congress began its printed card service, with the result that libraries became interested in ways to use LC cards with their own cards. One of the important responsibilities of the committee was to formulate rules to encourage incorporation of LC printed cards into catalogues of other libraries. The committee attempted to reconcile the cataloguing practices of LC with those of other research and scholarly libraries. The use of LC cards increased dramatically between 1908 and 1941; standardisation of library catalogues progressed. However, the ALA *Rules* were not expanded' during this 33-year period, drastically curtailing attempts of cataloguing practice to stay in touch with cataloguing done at the Library of Congress.

In 1930 a subcommittee was appointed by ALA to begin work on a revision of cataloguing rules, and the problems were outlined. Dissatisfaction with the 1908 code was expressed on the grounds of "omissions"; the basic rules were not in question.

The 1941 and 1949 rules were sharply criticised for being too elaborate and often arbitrary; emphasis had shifted from clearly defined principles to a collection of rules developed to fit specific cases rather than the conditions that the cases illustrated. Lubetzky commented that any logical approach to cataloguing problems was blocked by the maze of arbitrary and repetitious rules and exceptions to rules. Because of the omission of rules for description from the 1949 ALA *Rules,* the Library of Congress published its *Rules for Descriptive Cataloguing in the Library of Congress,* also in 1949. This set of rules was much more simplified than had been the rules in Part II of the 1941 ALA preliminary edition. Therefore, these were not criticised, as were the rules for entry and heading, and were incorporated virtually intact into the next edition of rules published by ALA in 1967.

Anglo-American Cataloguing Rules, 1967

The Catalogue Code Revision Committee that prepared the 1967 *Anglo-American Cataloguing Rules* realised that revision must be a complete re-examination of the principles and objectives of cataloguing, not merely a revision of specific rules. First, the objectives of the catalogue were agreed upon; it was further decided that certain general principles should be the basis for rules of entry and heading. These general principles of the new code were based on the "Statement of Principles" approved by 53 countries at the International Conference on Cataloguing Principles in Paris, October 1961. This was an important step toward international bibliographical standardisation.

AACR 1 was oriented toward large research libraries, although in a few instances of obvious conflict, alternate rules were provided for use by non-research libraries. Unlike the 1949 ALA code which was only for entry and heading, *AACR 1* incorporated rules for entry and heading, description, and cataloguing of non-book material. An important shift "occurred in the philosophy underlying the rules for entry: "The entry for a work is normally based on the statements that appear on the title page or any part of the work that is used as its substitute." This meant that information appearing only in the preface, introduction, or text was not to be considered unless title page information was vague or incomplete. Another basic shift in point of view was to that of cataloguing by types of authorship rather than by types of works, and by classes of names rather than classes of people. Unlike earlier codes, *AACR 1* emphasised that choice of entry was a completely separate activity from construction of the heading used for the entry chosen. General principles became the basis for the rules for choice of entry:

(a) Entry should be under author or principal author when one can be determined.

(b) Entry should be under title in the case of works whose authorship is diffuse, indeterminate, or unknown.

Application of rules based on these principles continued the practice of choosing a main entry, with other names and/or titles becoming added entries. However, the choice was no longer a result of first determining the type of work involved and then finding the specific rule for that type. The construction of the headings for names that were to be main or added entries centred on two problems: choice of a particular name, and the form in which that name is presented in the heading.

Rules for form of name became based on a general principle of using the form of name used by a person or corporate body rather than the full name or official name as the 1949 ALA *Rules* directed. Thus a person could be entered under an assumed name, nickname, changed name, etc. However, a person who used both his or her real name and an assumed name was still entered under the real name, and a person who used a full form of a forename, even though rarely, was entered under the fullest form ever used. Another change was to use a firmly established English form of name rather than the vernacular form for many well-known names (e.g., Horace, not Horatius Flaccus, Quintus). Another very important area of change was in the form of entry for corporate bodies. The general rule followed the principle of using the form of name the body itself uses. Entry was usually under that form of name except when the rules provided for entry under a higher body or under the name of the government. However, the North American text gave exceptions exempting specified bodies of an institutional nature from the principle of entry under name; these were to be entered under place as in the old rules. These exceptions were contrary to the Paris Principles and to the British text of *AACR 1,* but they had been requested by the Association of Research Libraries, whose member libraries feared being overburdened with the necessity for changing thousands of entries already in catalogues. The fear of the research libraries was also eased by the Library of Congress January 1967 announcement of the policy of superimposition:

> *This means that the rules for choice of entry will be applied only to works that are new to the Library and that the rules for headings will be applied only to persons and corporate bodies that are being established for the first time. New editions, etc., of works previously catalogued will be entered in the same way as the earlier editions (except for revised*

> *editions in which change of authorship is indicated). New works by previously established authors will appear under the same headings.*

This policy continued throughout the duration of the application of *AACR I.* As a result, thousands of headings were made between 1967 and 1981 in a form created under the 1949 ALA *Rules* or earlier rules on bibliographic records that were otherwise *AACR I* records. The abandonment of the policy of superimposition with the implementation of *AACR 2* was a major step toward ultimate user convenience in finding entries and improved international cooperation; but for many large libraries, thousands of entries in *pre-AACR* form already in catalogues have had to be dealt with since January 1981.

In 1974 the rule in *AACR 1* for corporate entry under place was dropped. But because of superimposition, only new corporate bodies were established and entered under their own names. Besides this change, some 40 other rules were changed, and three chapters were totally revised in the years following publication of *AACR 1.* Perhaps the most significant change was the application of standards of bibliographic description, based on International Standard Bibliographic Description (ISBD), to descriptive cataloguing of monographs, audiovisual media, and special instructional materials. ISBD facilitates the international exchange of bibliographic information by standardising the elements to be used in the bibliographic description, assigning an order to these elements in the entry, and specifying a system of symbols to be used in punctuating these elements. In addition:

> *ISBD requires that a publication be totally identified by the description. It is independent of the provisions for headings, main or added, and of the provisions for the use of uniform titles; these were internationally standardised, by the Paris Principles.*

Anglo American Cataloguing Rules, Second Edition (AACR 2)

The numerous changes to rules in *AACR I* and the progress toward an international standard for description not only of monographs, but of serials and all media, were two of the reasons for the meeting in 1974 of representatives of the national library associations and national libraries of Canada, the United Kingdom, and the United States to plan for the preparation of *AACR 2.* Two other reasons were a proliferation of other rules for nonbook materials that reflected dissatisfaction with *AACR I* treatment of these materials and LC's announcement of intention to abandon the policy of superimposition. The objectives established at that meeting were:

1. To reconcile in a single text the North American and British texts of 1967

2. To incorporate in the single text all amendments and changes already agreed and implemented under the previous mechanisms
3. To consider for inclusion in AACR all proposals for amendment currently under discussion between the American Library Association, the Library Association, the Library of Congress, and the Canadian Library Association; any new proposals put forward by these bodies and the British Library; and any proposals of national committees of other countries in which AACR is in use
4. To provide for international interest in AACR by facilitating its use in countries other than the United States, Canada, and the United Kingdom.

The representatives at the 1974 meeting also agreed to establish a Joint Steering Committee for Revision of *AACR* (JSC) made up of one voting and one non-voting representative of each author organisation. The JSC was to appoint an editor from each side of the Atlantic and was generally to oversee the process of revision through to publication.

The result of the revision process was what the preface to *AA*CR *2* calls a continuation of the first edition: "for, in spite of the changes in presentation and content which it introduces, these are still the *Anglo-American Cataloguing Rules,* having the same principles and underlying objectives as the first edition, and being firmly based on the achievement of those who created the work, first published in 1967." However, *AACR 2,* published in late 1978 but not implemented by the major national libraries until January 1981, had some significant differences that are worth noting here.

In the process of reconciling the North American and British texts, it was decided to use British spelling of words if the British spelling appears as an alternative in *Webster's New International Dictionary.* In cases where terminology differs, British usages were chosen in some cases (e.g., "full stop" instead of "period"), while American usages appear in other cases (.e.g., "parentheses" instead of the British "brackets").

One significant change is in the presentation of rules for description: one general chapter presents broad provisions that can be applied in many different situations. This chapter is followed by specific chapters for different types of materials and for different conditions and patterns of publication. The rules for description are deliberately less specific in legislating ways to handle certain phenomena. The cataloguer is thereby encouraged to exercise judgment in interpreting the rules in light of the needs of the user being served. One possibility for such interpretation is that *AACR 2* provides three "levels" of description with increasing amounts of detail at each level. The cataloguer may choose the level that provides the amount of detail relevant to the particular library's users, and, at the same time, meet the standards called for in a set of international cataloguing rules. In the rules for choice of access points, it is significant that less emphasis has been placed on "main" entry, although the concept is still present. However, many people believe that when multiple access points are readily available, and when the bibliographic description is complete by itself, there is no need to designate one of the access points as the "main" one. This concept, then, may disappear in future codes. A significant change in choice of main entry is that a corporate body is no longer considered to be an "author." Instead, there are now specified categories of works that are entered under corporate body. This concept greatly reduces the number of corporate main entries made, although those corporate bodies that would have had main entry under earlier rules are given added entry under *AACR 2,* and thus there is not a reduction in number of corporate entries.

Another important change in choice of access points is the abandonment of "form subheadings" (e.g., "Laws, statutes, etc.," "Treaties, etc.," "Liturgy and ritual") for legal and religious works. In some of these cases, the function of the form subheadings is now performed by uniform titles.

Rules for form of headings for personal names now emphasize using the form of name most often used by an author (e.g., Benjamin Disraeli instead of Earl of Beaconsfield; Bernard Shaw instead of George Bernard Shaw). If an author uses more than one name and is not known predominantly by one of them, multiple headings are made for that author. For persons who are not known as authors, emphasis is on using the name that is best known. For corporate names, too, there is more emphasis on using the name as it is used by the body, removing provisions for inverting, amplifying, etc., that appeared in *AACR I* (e.g., W.K. Kellogg Arabian Horse Center instead of Kellogg (W.K.) Arabian Horse Center). Geographic names are treated more internationally (e.g., states of Australia and counties of England are treated like states of the United States).

A detailed list of the changes in *AACR 2* may be found in the article "AACR 2: Background and Summary" cited in note 9. This article also points out some general advantages of *AACR 2.* First, *AACR 2* lays the groundwork for much more international and national cooperative cataloguing, which is expected to improve greatly library service of a bibliographic nature and to result in considerable cost savings. Second., by providing the framework for standard description of all library materials, it makes possible an integrated, multimedia catalogue. Third, it is expected to reduce user search time by providing headings that conform more often to the forms found in works and citations. Fourth, personal name headings are expected to be more stable than formerly, thus reducing catalogue maintenance costs.

Rule interpretations made by LC in their process of applying *AACR 2* are published regularly in *Cataloguing Service Bulletin.* Official changes made to the rules are also published there. In an attempt to reduce costs of implementing *AACR 2,* LC chose during the first three years of using *AACR 2* to allow certain already established names to continue to be used in *pre-AACR 2* form when the change was relatively insignificant and did not affect the first entry element of any name and in some cases, later elements of a famous name. A list of these "compatible" headings was published in *Cataloguing Service Bulletin."*

Other libraries had to decide whether to follow LC's lead in this implementation. Those libraries that use LC copy found, for the most part, that the cost of *not* following LC would be prohibitive. Even following LC, however, libraries found that there were administrative problems in applying new rules within a catalogue based on several earlier sets of rules. There was a flurry of local *AACR 2* studies, among which was the author's dissertation. The results of these studies (which are summarised in the aforementioned dissertation showed that somewhere between 14% and 20% of headings dealt with during the first year would be different under AACR *2,* but only 7% to 13% of all headings would cause conflict in a catalogue (depending upon the size of that catalogue). A few libraries decided to close their existing card catalogues and to start new ones with the new rules.

Bibliographic Utilities

For the purposes of this study, it was assumed that the centralised cataloguing unit would obtain MARC records from Baker & Taylor, the most widely used book vendor, and OCLC's CatExpress. Costs for bibliographic cataloguing utilities were projected on the estimated 12,000 records that were used for the staffing salary estimates.

Calling on personal experience with Baker & Taylor MARC records, the study assumed an 80 per cent hit rate for the Consortium. Since Baker & Taylor charges $0.25 per record sent, the cost for this service would be $2,000. CatExpress would be used to catalogue the remaining 2000 records. For FY2002-2003 OCLC is charging $1,470 for a block of 2000 records (OCLC, 2002). For the upload to OCLC for ILL, the records from Baker & Taylor would be loaded at a cost of $0.15 a record. No information was obtained about uploading the originally catalogued records to OCLC. If those records are uploaded to OCLC as a billable item they will cost the same as the Baker & Taylor records. If they can be uploaded to OCLC as original cataloguing the Consortium will realise a credit of over $4.00 per record. The assumption used was that the Consortium would be charged the $0.15. That cost would be $1,500. The total costs for bibliographic utilities would be $4,970.

Just fewer than 30,000 holdings were added to the catalogue in 2001-2002. The costs were based on books being processed by the vendor. For the purposes of this study, the 30,000 items are books, 50 per cent hardback with jackets, and 50 per cent softbacks requiring a Kapco-like cover. Libraries also receive video recordings in VHS and DVD formats, magazines, and books that do not require covering. Since this information was not separated out, the actual costs will vary.

The processing being performed by the vendor will be bar-coding, spine labelling, one stamping, and Kapco or Mylar covering. The total estimated cost for vendor processing of books is $55,500.

Taking into account only the staffing, bibliographic utility, and processing costs, a potential saving of between $83,669 and $142,206 could be realised for the Consortium. However, there are still other factors to be considered that have not been addressed that would have a financial impact on the Consortium.

Turn Around Time

While the average turn around time is 2.5-10 days from the time the item is received to the time it appears on the shelf, all libraries wanted the ability to get a popular book out in 24 hours or less. How the books arrive at the centralised unit has not been addressed. Will they be received at the ordering library, shipped on to the cataloguing unit for processing, and then shipped back to the library for shelving? The time frame for this could be unacceptable to the library directors.

The Consortium has established courier service arrangements with St Louis County Library for its borrowing between libraries. An increase in usage would probably result in an increase of fees from the County Library. This was not addressed in the estimate of costs to the Consortium.

To save time, could the books be shipped directly from the vendor to the centralised cataloguing unit? This gives way to other questions:

- Does the ordering library wait until the books return from the centralised unit to receive and invoice the shipments?
- How will problems be reconciled? What if a title is received that was not ordered? What if a shipment is damaged?
- Would the central unit need access to the acquisitions module?
- What materials get priority treatment or are "rush" orders?

Location

The location of the centralised cataloguing unit is very important to the success of the project. Several factors needing consideration are:

- The location needs to be central to all of the libraries.

- There needs to be an adequate labor pool.
- The transportation or courier system needs to be efficient.
- The location needs adequate space (Nelson Associates, 1967).

Two of the members expressed an interest in hosting the cataloguing unit. Neither of these libraries was near the geographic center of the Consortium. One of the libraries would have required an addition to their current building. Both libraries would need additional staff to accommodate a centralised cataloguing unit.

The largest library in the consortium in both space and volumes held would be best suited for a centralised unit. This library is centrally located to the entire Consortium. Their current technical services space is ideal for the operation. This conclusion is from a visual assessment of the library. They have nine staff people participating in some form of cataloguing and processing. However, this library also houses the hardware for the Consortium as well as the system administrator and may be hesitant to take more on. Wherever the unit is located the Consortium will probably need to address overhead costs for the use of the space within the library.

Loss of Bibliographic Control

Another concern that would need to be addressed is the loss of bibliographic control. Each library cataloguer is very possessive of their bibliographic records. The "this is MY record" attitude would have to be overcome. The Consortium members would have to understand that the bibliographic records belong to every library in the system. Each library should be able to add holdings to any record. Any library should be able to edit or enhance a bibliographic record. Yet, no one should remove anything from a bibliographic record that would negatively affect access or cause a loss of useful information. The MLC has a cataloguing committee that has already established some cataloguing guidelines. The centralised unit could follow these guidelines when cataloguing. The need for this committee would be even more necessary to monitor adherence of those guidelines and to make any adjustments when necessary. Authority should be given to the cataloguing unit for clean up of the database.

An important question that arose was: If an MLS professional were doing the cataloguing, would there be a need for the double and triple checking that is taking place in some libraries with reference staff? If not, perhaps staff time could be freed up for other projects. This would have additional cost saving implications.

Centralised Acquisitions-cataloguing Facility

Would it be more efficient to establish a centralised acquisitions-cataloguing facility? The MLC may migrate to EpixTech's Horizon product.

The acquisitions module has the ability to electronically e-mail orders to book vendors. Each library on the acquisitions system can generate orders. The centralised acquisitions-cataloguing unit can gather the orders and send them to the vendors. If no bibliographic record exists in the catalogue for the order, a MARC record may be requested from the vendor. At the time the order is received it may then be received and invoiced and any ordering problems resolved.

A less complicated form of acquisitions may be to centrally order bestsellers. All of the libraries order bestsellers for their patrons. An ordering policy can be established as to the quantities that each library needs. When a bestseller is published, the centralised unit can automatically generate the order (Gibson, 1995).

The information used for estimating the cataloguing and processing costs was based on how many bibliographic records, original cataloguing, and holdings were added to the database. This information was not broken down into what percentage were books (hardback and paperback), videos, magazines, or any other type of material that a library orders for its patrons. This would need to be ascertained, as well as, the specific processing needs for each library.

What would the compensation be to the library that houses the new department? Who would be in charge of that department? Would the head cataloguer be in charge? If so, to whom does that person report? Would it be the director of the host library, the system administrator, or the Consortium? If the director of the host library or the system administrator of the MLC becomes the supervisor, does that person get extra compensation? All of these questions need to be addressed.

If acquisitions were added to the charge of a central cataloguing and processing unit, additional staff would be needed. The same is true of authority control for the catalogue. The staffing required for authority control in a centralised environment could change, and the question of who does this and how many staff would be involved also needs to be examined.

Given the information in the study for staffing, cataloguing, and processing costs the creation of a centralised cataloguing and processing unit would be feasible. If the Consortium should decide to move forward with centralised cataloguing or even a combined centralised acquisitions-cataloguing unit, a more in-depth study would be needed.

6

E-Books in Digital Library

Publishers and printers are constantly working on how to make better, cheaper hard bound books since the time of Gutenberg. The only noticeable improvement achieved was the introduction of convenient, low cost paperbacks. It was about 60 years ago. These days, there are much more cost effective, convenient, simpler, and more importantly, environment friendly options are available. Just think about creating paper books. You have to kill trees for the paper (reducing the global ecosystem's capacity to generate oxygen and getting rid of poisonous carbon dioxide from the air we breath). Warehousing and transporting paper supplies back and forth uses a great deal of resources which also pollute the environment.

On the other hand, an electronic book [eBook] has none of these harmful side effects. An eBook can be stored and transmitted at virtually zero cost. When you consider the economic and environmental prospective, eBooks are an obvious choice of any cost conscious person. We would like to think, in the near future, all published books and works will use an eBook format instead of paper. A close observer of publication dates will note that one of these books has been sitting on my 'to be reviewed' shelf for rather longer than it ought to have been. However, perhaps that has turned out to be for the best, since it offers the chance to examine three books that deal with the concept of the digital library. Rather ironic, to have so many 'old-fashioned' artefacts like books that deal with such a modern idea. Two of the books (Ar ms and Borgman) are in the same MIT Press series on Digital Libraries and Electronic Publishing (the series editor is Arms), while the third, and earlier publication is in the Morgan Kaufman Series in Multimedia Information and Systems, edited by another well-known figure in the digital libraries field, Ed Fox of Virginia Tech. As might be expected when three books deal with essentially the same subject area, there is some overlap — this is most readily seen in Arms and Lesk: for example, both deal with text conversion standards, information retrieval, usability issues, multimedia, archival concerns, economics, and intellectual property.

However, they cover these topics in different ways, and each includes topics that they other omits: for example, Lesk deals to a greater extent with digital library initiatives around the world, while Arms says more about meta-data and about organisational issues. Lesk's work has more and better illustrations, a better index (although neither is a perfect model), and a bibliography. Shamefully, Arms provides neither footnotes nor a bibliography, leaving his readers scrambling to find, 'A 1998 article in the *New York Times*...' or other, similarly disguised citations, as well as the appropriate sources for the numerous standards he mentions — how the publishers can have allowed this is beyond me. Although these two books cover much of the same ground, they are complementary and both will be of value anyone seeking an understanding of what the digital library idea means today.

For the student, Lesk's book is probably the most useful and it could be used as a standard text on the subject. Arms's work is also of value to students, but perhaps of more value to the library manager seeking to map out the future of the library in whatever community he or she serves. Borgman's book differs from the other two in adopting what she calls 'a social informatics perspective' in her examination of this phenomenon. In my opinion 'social informatics' is a particularly obscure term, since it does not convey what is meant by its adoption. 'Informatics' is from the French, informatique, meaning simply (according to Larousse) 'data processing' — adding 'social' clarifies this not at all, since it seems to convey the idea of some kind of collective data-processing.

To say 'adopting a social perspective' would have served just as well. And, indeed, that is what emerges in what is an excellent text — excellent in more ways than one: where Arms provides us with no bibliography, Borgman gives us one of forty pages, along with a much better index. Part of this significant body of literature is Borgman's own work in the fields of human-computer interaction, digital libraries, and on-line searching — along with her consultancy work in Eastern Europe under the auspices of the Soros Foundation Open Society Institute. The result is a rich, well-informed text, which deals with digital libraries as social phenomena, as well as with some of the technological aspects dealt with by Arms and Lesk. For example, Borgman also touches on the economics of electronic publishing, on retrieval systems and on text-encoding standards, but her analysis of these topics feeds into the intended, more socially informed perspective. What makes Borgman's work different, and in my opinion, more interesting than that of either Arms or Lesk, is not only the social perspective but also the concept of the 'global information infrastructure', found in the sub-title. She presents a serious analysis of the concept of 'infrastructure', based upon Star and Ruhelder's eight dimensions of embeddedness, transparency, scope, learnt nature, practice conventions, standardisation, installed base and visibility on breakdown, and shows how these dimensions are applicable to an information infrastructure. Borgman believes, rightly, I think, that the adoption of technological innovation is a matter neither of revolutionary or evolutionary change but of what she terms 'co-evolution', that is change in social and organisational practices along with the adoption by people of such innovations as work for them. This process results not only in changes in work practices, for example, but also in the innovations themselves as they are adapted to work practices. On the basis of this analysis, a 'global information infrastructure' or GII is:

> *...a technical framework of computing and communications technologies, information content, services and people, all of which interact in complex and often unpredictable ways.'*

Where the problematical concept of a 'digital library' is discussed: is a digital library an institution like a university library, which happens to enable access to its resources digitally, or is it distributed, digitised content to which digital access is enabled. The first, says, Borgman, is favoured by librarians, the second by researchers into the digital library. My own feeling is that the distinction is disappearing and cannot persist: the institutional base of the digital library cannot persist because users have access from their office desks, their student halls and their homes to digital resources well beyond the bounds of any institution to which they may belong and not necessarily requiring access to be negotiated by any library. This leaves, of course, the question, 'What, then, happens to the institutions we call libraries?' (a question I have tried to answer, at least in part, elsewhere (Wilson, 1998)) and Borgman debates this issue, 'Whither, or wither, libraries', but, to a degree, leaves the answer to both questions hanging. Libraries are social and cultural phenomena as well as institutions for access to information and, rightly, Borgman believes that their roles and functions need to be re-thought. How they might be rethought is less than clear, however, and she concludes that:

> *'In developing new approaches to managing distributed information resources, it should be possible to draw on the best theories, principles and practices of libraries, archives and museums. The fundamental goal is to balance cooperation and competition in implementing social strategies that continue to support cultural values for a digital age.'*

From which we take it that she believes that the principles of librarianship will survive in the digital age, since they are the principles of information organisation and access, but that the institution of library will need to map out new functions in order to complement new forms of information access and services and, having done so, will find itself competing for users and, hence, resources in the global information infrastructure.

Naturally, some things are happening in the intervening chapters, Borgman considers the nature of access to information in digital libraries, including topics such as meta-data, which are covered by Arms and Lesk; electronic publishing in general, and scholarly publishing in particular; why digital libraries, with the present state of the technology, are so hard to use and what might make them easier to use.

Most of this is concerned with setting out a research agenda under various headings. Enough topics are mentioned to keep several research teams busy for some years to come: some of them are the old questions in a new light — such as how to improve upon IR systems to make them both easier to use and more effective (a lost cause in my opinion, given the dead end of the present research paradigm), and other issues, such as the transferability of information from pre-digital library systems to digital libraries, which are brought about by the existence of this new phenomenon.

The issue of 'Acting locally, thinking globally', that is, how to ensure that 'global' information resources are *accessible* globally — in other words how to achieve interoperability, when resources may be prepared in different languages and in different character sets, and so forth. What standards will be required, based upon those that are now available, to ensure the existence of the true global library?

The other chapter takes this further by asking how the technology available is to be scaled up, how access is to be provided, and how to transfer the technology and services to '...parts of the world with different traditions and practices than those of the Group of Seven major industrialised nations that laid the technical and political framework for a global information infrastructure.'

This last point is perhaps the most significant challenge: those of us who use the Internet every day and live in conditions that enable and foster its use, may forget that we are privileged and that, as a recent correspondent (Grosser, 2000) to the pages of *Communications of the ACM* reminds us, 'Half of the total [of the world's population] have never seen a computer or even made a telephone call.' and that more than two-thirds are illiterate — there is a great deal to be done before any truly 'global digital library' can have any relevance for the greater proportion of humanity, and most of what needs to be done has nothing to do with computer technologies.

Guidelines & Functions

Branch Library

A branch library should have only the following items of work behind the screen:

1. The receipt of the current issues of periodical publications;
2. Maintenance of the stack-room.
3. Maintenance of the building and the stores.

As a result, the staff of a branch library should be able to devote practically all its time to circulation work, reference service, and extension work. This will satisfy the Fourth Law.

Step in Book-Selection

The first and foremost step in the distinctive part of library administration relates to book-selection.

Central Library

Practically city or district central library should spend only minimum time in classification and cataloguing. This will be made possible by the system of centralised classification and cataloguing coming into vogue in the country. Thus the books will arrive at the city and district central libraries with the call numbers printed in the back of the title-page and tooled on the spine. Printed catalogue cards for all the book entries will also come along from the State Central Library. At any rate, they can be bought from that Library.

Sources

The chief sources for selection of books in English are the *Bookseller and* the *Publisher's circular* of U.K. and the *Publisher's weekly* of the United States, which are weeklies; also the *English catalogue* of Great Britain and the *Wilson's catalogue* of the. United States, which are available as annuals.

The chief sources for selection of books published in India are the *Quarterly* list of publications issued by the Registrars of Books of the Constituent States and the Indian National Bibliography and the State Bibliography of each State publishing it.

Other sources of both kinds of books are the catalogues of individual publishers and booksellers; the bibliographies in books; independent bibliographies; and book reviews in periodicals. The Sunday editions of the *Dailies* in India contain literary pages in which reviews are published. Besides these different publishers and distribution companies print publicity organs, consisting of latest arrival—monthly or annually.

Demand Ascertaining

The subject-distribution of the circulation of books in the library will give a picture of the demand current in the locality. The library should also anticipate potential demand by studying the happenings in the locality, in the country and in the world, and the special festivals and celebrations expected to occur in the year. The amount for books should be allocated for different subjects in the light of the details arrived at in assessing the demand. Without making undue deviation from the prevailing reading standard and taste, the library should seek to elevate them progressively.

Suggestion Tray

Books of probable interest to the readers are likely to be brought to the notice of the library by the readers themselves. When the suggestion reaches the library, a book selection card should be prepared and filed in the suggestion-tray in a classified sequence.

Routine

The sources for book selection should be scanned systematically as and when they become available and a book-selection card should be prepared for each selected item. It should be roughly classified and its standard symbol (like elementary, ordinary, advanced, and so on) should also be tentatively put on the card. These cards should be filed in a classified sequence in different sets according to the standard. The accumulated cards should be discussed at convenient intervals — say once in a month on the appointed day—with the concerned specialists and the sanction of the Library Committee or the Librarian, as the case may be, should be obtained for the finally prepared Indent.

Weeding Out

The printed sources should be systematically filed on shelves. As and when a new edition of the source arrives, the old edition should be discarded in the case of ephemeral materials or removed to the bibliographical collection if they are worth the retention.

Forms and Registers

Look Selection Card. Printed, 6 pt type. Bristol Board, white for purchased books, green for gift books. Red for bound volumes of periodicals.

Book selection consultation letter form. Stencil. 21 lb. Printing paper. White. The text of the form is as follows:

Subject: Book Selection

I have the honour to enclose herewith (number) book selection cards in (subject) for your consideration. Please be good enough to sort them into

The three group "approved" "daferred", and "rejected". The three group may be separately bundled and sent to me along with a covering letter embodying your recommendation. The balance available for purchase of books in your subject within the current financial year is Rs.... Expecting your reply within a week.

Ordering of Books

The work of ordering books in Indian libraries is at present more difficult than it is elsewhere. It is English and American books that figure most in them. Thus, the chief book-markets are thousands of miles away in far-off London and New York. As a result, Indian Libraries are not able to get books on approval or to choose between different editions by actual inspection of books. The task of deciding whether a new edition is substantially different from the one already in the library becomes extremely difficult. The Book-Order Section in Indian libraries has therefore to take a much greater responsibility and put in much more work in checking the indents with the stock, than in European and American libraries. Of late however, a few enterprising booksellers have begun to stock general books in important state capitals, such as Bombay, Calcutta, Delhi, Lucknow and Madras.

In the matter of Indian publications, the situation is even worse. The publishing trade is not yet properly organised in India except for text-books. In many cases, the author himself has to play the role of publisher and bookseller. He may live in an out-of-the-way place, and as may be expected, he has not developed business methods. Not infrequently it happens that he does not respond at all to orders.

Contract

It is necessary to stipulate certain conditions of a bibliographical nature in appointing standing vendors. They should be asked to undertake the following responsibilities:

1. The contract is liable to be cancelled if the supply is not completed within three months of the order;
2. Every volume should be carefully collated before being sent. If any defect is discovered at this end, they should take back the defective copy and supply a sound copy at their own cost, including the to and fro freight;
3. If the order contains a note that a certain edition of a particular book is already in the library, they should find out if the later edition in the market is substantially different from the one in the library. If not, the book should not be supplied, but an advice should be sent. In cases of doubt, they should state the case and supply the book only after receiving a confirmatory order;

4. The latest edition of the book is to be supplied, unless there are specific instructions to the contrary;
5. If the book is a reissue of another book under a different title, they should advise the library about it and send the supply only after receiving a confirmatory order;
6. If a book is an off-print from a periodical publication or another book, they should advise the library about it and send the supply only after receiving a confirmatory order;
7. If a book is really a foreign publication, though listed in the trade lists of their country by the local representatives of the foreign publisher, they should advise the library about it and send the supply only after receiving a confirmatory order;
8. If any book occurs in more than one order or is covered by any of the standing orders, only one copy should be sent and a second copy should not be sent without getting a confirmatory order;
9. If there is any difference in the name or in the spelling of the name of the author or in the title, they should advise the library about it and send the supply only after receiving a confirmatory order.

Second-hand Books

Most often, in the matter of out-of-print books, it is best to obtain quotations from different second-hand booksellers and decide the vendor in each case on its merits, rather than appoint a single standing vendor. Very often the catalogues of the second-hand booksellers may obviate even the necessity for enquiry. But these catalogues should not be relied upon, if the amount is considerable. It may be possible to get better terms by obtaining competitive quotations.

Standing Vendors

It is a moot point whether it is advantageous for a library to buy its books directly from the publishers or through a standing vendor. In the case of most books, there may be an advantage to have a standing vendor. The Library Authority should select the standing vendor once in three years. The choice should be settled by the competence of the vendor to make complete and prompt supply. There should be a clause in the contract for the cancellation of the contract for delay of more than three months. After the introduction of net-book agreement, the monetary terms of the contract will be simple and uniform. Even till then, the pestering practice of calling for tenders for every order should not be adopted.

Procedure of Ordering

It is desirable that order-work is distributed evenly throughout the year and an order is sent out regularly once in a week or a month on an appointed day. The routine for each order may be as follows: Arrange the finally sanctioned book-selection cards alphabetically by the names of authors and check carefully to eliminate unintended duplications of all kinds. For this purpose, check with the

(a) Catalogue of the library;
(b) Standing-order-cards;
(c) Outstanding-order-cards;
(d) Bills awaiting payment; and
(e) Exchange list of the library if any.

Separate the cards for the books which can be got as gifts and apply for them. Type four copies of the order-list for the surviving cards, send one with the order to the vendor. Leave one for use in advising readers. Use the third as office copy. File the fourth copy behind a guide showing the week in which the supply is due. This will be used for the Vigilance Work described in section Vigilence Work. The corresponding book-selection cards now gain the status of order cards. Insert these in their proper alphabetical places, in the order tray which contains the outstanding cards.

Standing Order

It is desirable to give standing orders for the following classes of books:

(a) *Series-books,* i.e. belonging to a series all the volumes of which the library has decided to buy;
(b) *Multi-volumed books,* i.e. books in two or more volumes all the volumes of which are not published simultaneously;
(c) *Instalment-books,* ie books published in successive parts or fascicules which should be accumulated in the library and bound after the title-page arrives;
(a) *Subscription-books,* i.e. books for which advance payment is to be made either in full or in part before actual publication.

Receiving the Supply

When the supply arrives, arrange the books in the sequence in which they are entered in the bill. Lift the order card of each book from the order tray and insert it on its title-page. If there is no order card for a book, it has been either already paid for or it was never ordered. When all the books have got their respective cards, carefully collate the books, scrutinise and approve them only if they answer to every detail furnished in the respective order cards. Then pass the books on for classification, cataloguing, and shelf-registering. Defects may also be detected at this stage. Hence, defer cutting, stamping, accessioning and payment till those processes are over. Retain the order cards with you. They form the control to ensure that all the books come back for accessioning. Various difficulties may crop up in this work.

Supply of Standing Order

The procedure for receiving supplies of standing order, and watching their regular supply, should be similar to the one described in section "Periodical Publications".

Periodical Publications

Periodicals are prone to develop idiosyncrasies of several kinds. Of these, irregularity in publication and supply affects the administrative routine most. If the non-receipt of a particular issue is not brought to the notice of the publisher promptly, there is a great probability of the library never getting it.

Hence the greatest amount of vigilance and promptness is necessary in dealing with periodical publications, and it must be achieved without undue dependence on mere memory. It is best done by means of a simple Three Card System. A card 125 ´ 75 mm will last for 6 years for weeklies and for twenty-five years for monthlies, if they are ruled on both sides. It may not be worthwhile to bind and preserve all the periodicals. What must be preserved should be decided by the authorities.

Renewal Order

It is desirable not to change the list of current periodicals violently from year to year. A periodical which it has been decided to have bound and preserved should not be light-heartedly discontinued in one year and renewed in another year. Thus most of the periodicals should be given a standing order. It is conducive to good business to send a renewal order once in a year on an appointed day and call for bills for subscription. For subscriptions of most periodicals are payable in advance. This is enforced by the publishers since they cannot otherwise decide how many copies they should print. Foreign periodicals will, therefore, have to be renewed even in October so that payment may reach the other side before the year begins. For convenience of routine it is better to renew Indian periodicals also in October.

Three Card System

The prompt receipt of the current issues of each periodical publication is to be watched with vigilance. Vigilance is best practised by the Three-Card System in a big library and by a Two Card System in a small library. One of these cards is called the Registered Card. Its use is described in section 533. Its structure is given in section 537. The second card is called the Check Card. Its use is described in section 534. Its structure is given in section 537. The third card to be used in a large library is called the Classified Index Card.

Registering

As soon as the mail arrives each day, after satisfying yourself that each packet is addressed to the library, open the wrapper of each and insert it in the periodical. Arrange the periodicals alphabetically by the title. The rest of the work is to be done for each periodical successively. Collate it, and see if any abnormalities need attention. Note them at the top of the back of the front cover. Put all such cases aside in the deferred tray. If it is normal, pull out its register-card. If it is not a duplicate copy, make the necessary entry in the register-card. Taking the class number from the register-card, write it near the right hand top corner of the front cover of the periodical. If the issue is not the one immediately after the one last registered, the entry should not be made in the next vacant horizontal line but in the line that would be appropriate to it. Write a reminder card for the earlier issue not received and put it in the week's current box for despatch. If it is a gift periodical and if an acknowledgement is due, write out the acknowledgement and put it in the week's current box. If the title-page, contents, and index are due but have not come, write a reminder card for them also and put it into the week's current box. Stamp on the covers, on all the plates and on the first and the last pages of the periodicals registered and enter the date of receipt on the cover.

Vigilance

As soon as a periodical is registered, pick out its check-card. It should be found among the cards lying behind the current week's guide. Transfer it to behind the guide-card of the week in which the next issue is due. For example, if we are now in the first-week of March, the current week's guide-card will be 3.1. If the periodical is a weekly, the check-card should be transferred to behind the guide-card 3.2. If the periodical is a monthly, the check-card should be transferred to behind the guide-card 4.1. If the periodical is a quarterly, the guide-card should be transferred to behind the guide-card 6.1, and so on. If the check-card is not found behind the guide-card 3.1, lookup the register-card for the date on which the preceding issue was registered. Add the period of the periodical to the number of that week. The result will show the guide-card behind which the check-card could be found.

Notifying: On the last day of the week for each of the check-cards still lying behind the guide-card of the week, write out a reminder card. Fill up in each check-card the details about the reminder. Then transfer all the check-cards to behind the next week's guide-card.

Display

If any sheet in any of the periodicals registered is loose, fix it up. The Laws of Library Science require that all the periodicals should be promptly registered and displayed for the use of the public. A compact display table for periodicals was designed by me in 1937. It is now being widely used all the world over.

It adds to cleanliness and strength without taking away the distinctive look of each periodical if it is encased in a plastic cover now available in all suitable sizes with Libraco Company of England. Otherwise, leave the periodical as it is without any cover. Arrange the periodicals in the classified sequence. Take them to the display-table. In the case of each, take out the preceding number lying on it and insert the current one. All the older numbers collected in this way should be distributed in the loose-numbers-shelf, so that they may be readily available for consultation.

Rounding-off Completion of Volume

As soon as the title-page and index are received for a volume of a periodical, register it, collect together all the issues covered by the title-page and index, collate them, and bundle them up. At the end of the week get accessioned and catalogue each completed volume of a periodical that the library has decided to keep permanently.

Faulty Cases

All faulty cases due to wrong delivery, defects found in cumulation, duplication, and all other cases should be attended to each week.

Payment of Subscription

Every week collect the bills received for payment of periodicals. For each bill examine the register-card. Certify in the bill that the amount may be paid. It will be good to have a rubber stamp for it with the headings: (a) Volume last paid; (b) Date of last payment; (c) Amount of last payment; (d) Volume for which claimed; (e) Amount claimed; and (f) Explanation of discrepancy if any. As soon as payment is sanctioned, note on the register-card, the voucher-number and its date.

Accessioning

As soon as a cumulated volume is accessioned, note the accession number in the registration card against the number of the volume.

Cumulative Index

Scan through the pages of the periodicals received, for announcement of cumulative index. If any such index is announced, take steps to order for it.

Loose Numbers

Lending of loose numbers of periodicals or newspapers is not generally allowed in public libraries. However, we have found a tendency in the libraries of many of the developed countries to lend out current issues of periodicals after they had been on the display-table for at least one week in the case of weeklies and for one month in the case of monthlies and periodicals of longer periodicity.

The non-receipt of an issue, if any, will be notified either immediately on receipt of the latter issue or within three months after its duo date, when it is known to us.

The cost of a volume is to be recovered by sending a bill in duplicate in advance, after the completion of the volume and supply of the tide-page, contents, and index.

This may be treated as a standing order until countermanded.

Weekly diary: It should have the following headings:

1. to 22 same as for S 25 of Book Order Section
2. Order cards checked
3. Orders issued
4. Volumes made up
5. Binding slips written
6. Accession cards written
7. Made up volumes transmitted
8. Accession numbers noted
9. Cumulative indexes ordered
10. Cumulative indexes received
11. Bills passed.

Daily receipt diary: It is to show the number of periodical publications received from day to day. Its headings must consist of the symbols for the main divisions of classification system used or some suitable modification of them. The files are to be transferred to the record sequence one year after it is closed. The records may be destroyed after five years.

Accessioning

Accession and Donation Number

Every volume to be included in the stock of the library must receive a serial number called Accession Number. Donated books must receive a Donation Number, in addition to the accession number. Cumulated volumes of periodicals should also receive accession numbers and if necessary also donation numbers, if the volume is to be bound and preserved in the library.

Numbering the Books

Then copy the accession number, and also donation number in the case of gifted books, class number, book number, one below the other on the back of the title-page of each book. The collection symbol also should be written. The class number should begin just half an inch below the central line of the back of the title-page. If that place happens to be printed over, start it as near that place as possible. If the book has no title-page write these numbers on the top of the first page leaving space for at least two lines between the top-edge of the book and the call number. Write these numbers also at a certain other conventional place in the book.

Accession Numbering

As soon as the classification and cataloguing of books and completed volumes of periodicals to be preserved are finished, arrange the purchased books in the sequence of their entry in their related bills, and the periodicals and the donated books in the sequence of their call numbers. Use the order cards of the purchased books as their accession cards. Write green and red accession cards for donated books and for periodical publications respectively. Arrange also the related shelf-register cards, the accession cards, and the catalogue cards in an exactly parallel sequence. Look up the accession cabinet for the last accession and donation numbers which had been already given. Starting with the next numbers, assign the accession number, and donation number if warranted, in correct numerical sequence in each of the shelf-register cards, the accession cards, and the main catalogue cards.

Billing

As soon as the writing of the numbers of the purchased books is over, write the accession number against the respective items in the bills for the purchased books. Strike off the items not supplied or rejected and make the consequential changes in the total amount of the bills. Then pass the bills for payment with the remarks "Brought into stock register. Bill may be paid."

Accession Register

On receiving accession numbers, the order cards attain the status of accession cards. File all the accession cards in the sequence of their accession numbers in the accession cabinet. This must be kept under lock and key, as these cards constitute the basic record of the books in the library, giving, as it were, a complete history of the respective books.

Books Preparation

The books themselves should be prepared. Ease the back by opening the book somewhere in the middle, placing it on a fiat table and gently running the thumb from the top to the bottom along the inner margin, working your way through the book to the two covers, turning a few leaves at a time, and simultaneously pressing. As the glue at the back of the volume is likely to have hardened, this easing work has to be done in a very careful and gentle way, so that the back of the book does not break.

Stamping

Then put the library stamp, without disfiguring printed matter, in certain conventional pages such as the lower half of the half-title-page, the lower half of the back of title-page, the bottom of the earliest chapter that ends after the fiftieth page, the bottom of the last page, each map, plate, etc. and so on.

Cutting Open

Cut open the pages with a cutting bone and not with a finger or a pencil as the latter will spoil the edges and even damage the text in books with narrow margins.

Date-Labelling

As soon as tagging is over, fix the date-label to the volume. The date-label is to be gummed only at the top and bottom corner of the left edge and it is to be fixed on the very first page after the cover, whether that page is an endpaper, half-title page, or even the first page of the text. Then write the book-ticket and insert it into the pocket at the bottom of the date-label. Enter the call number, accession number, and the date of release on the date-label. Now the book is ready to reach its destiny — which is reader's hand — and to rest on the shelves of the library when not solicited by readers.

Tagging

After the stamping is over, stick a tag on the back (spine) of the volume. If there is a jacket, remove it temporarily for this purpose and replace it after the tagging is over. Apply tag exactly 2-5 cm above the bottom of the book. It will be convenient to have a piece of metal, 1.5 cm wide and bent at right angles with each of the arms exactly 2.5 cm long to mark the position for applying the tag.

If the volume is too thin to have the tag on its spine, fix it on the front cover close to the spine, adjacent to the position it should have occupied on the back. Write the call number on the tag.

Classification and Cataloguing

As it has been already indicated in section "Accession Numbering", classification and cataloguing is done even before the book is accessioned. But, the preparation work mentioned in sections "Easing" and "Date-Labelling" should be done only after accessioning is done.

All this work should be done on a weekly basis like most other work in a library. Every attempt should be made to round off the week's work without any arrears. This work will require constant use of the library catalogue. It is therefore necessary that, in addition to the catalogue in cards for public use, there should be a copy of it in slips for office use.

Process Slip: Insert in each volume a process slip, i.e., a slip 125 ´ 75 mm. Even a waste slip with one side blank will do. On this slip various notes regarding the volume should be entered. Ultimately this process slip will have to be used for preparing the monthly statement of amendments to the Classification Code and the Catalogue Code and destroyed thereafter.

Draw a vertical line dividing the length of the slip exactly into two parts. Reserve the left hand side for noting cross references. Divide the right hand half into three compartments by three horizontal lines. Use the first compartment to indicate class index entries, not requiring consolidation, the second to indicate cross reference index entries, the third to indicate the book index entries or main entries or class index entries. Any further notes which arise in the course of classification and cataloguing should be entered in this slip.

Classification Routine: Sort rapidly by their main classes the volumes to be accessioned in the week. Then decide the class number of the books one by one. If any volume is elusive and requires detailed study, or appears to call for the creation of a new class, put it aside temporarily in the group of deferred volumes. For normal books, determine the call number and write it at the leading line of the process slip. Add the appropriate sequence number wherever necessary. By examining the main slip in the office-copy of the catalogue, see that the class number you give is consistent with the old placings. If there is any catalogue slip in the same ultimate class and with the same book number as the volume on hand, add the appropriate digit as the accession part of the book number. In cases of doubt compare the old books with the new ones. Note down on the process slip notes for cataloguing work. As soon as each volume is thus treated, pass it on with the process slip for cataloguing.

After all the normal volumes are dealt with take up the more difficult volumes and proceed with them when the catalogue cards of the other volumes are being written.

Amendments Noting

If any addition or amendment is made either to the rules or the schedules in the Classification Code, note them down in the official interleaved copy of the Classification Code.

Source Slips

If any source outside the volumes classified and outside the common reference books is used in determining the class number, note it down with details on a source-slip 125 ´ 75 mm. The source-slip should contain in successive sections the call number of the volume classified, the call number of the source, the heading of the source, its short title, and the exact page reference. All such source-slips should be filed away in a classified sequence in the source-slips tray.

Cataloguing Routine: Sort out the classified volumes according to their cataloguing difficulties. The following groups may arise:

1. *Fresh cards group* consisting of volumes which are in familiar languages and whose process slips do not indicate consolidation of cards;
2. *Consolidation group* consisting of volumes which are in familiar languages and whose process slips indicate consolidation of cards and periodical publications;
3. *Linguistic fresh card group* consisting of volumes in unfamiliar languages which do not require consolidation of catalogue cards;
4. *Linguistic consolidation group* consisting of volumes in unfamiliar languages which require consolidation of catalogue cards; and
5. *Refractory group* consisting of volumes of unusual cataloguing peculiarities.

Deal with the first four groups first so that the maximum number of volumes can be pushed forward without any delay.

Maintenance

The books should be arranged on the shelves so as to fulfil the Fourth Law of Library Science, viz, "Save the time of the reader". Reference books like encyclopaedias, dictionaries, current yearbooks and directories, and recent additions should be located in a prominent place as near the entrance as possible so that those who come for ready-reference alone may do so quickly and without disturbing the serious readers. The arrangement of the other books in the stack-room itself requires special skill. The arrangement cannot be permanent in the changing library world. It will have to be judiciously varied and readjusted from time to time. Several factors will have to be examined from time to time for this purpose. One would very much like to have the books and periodicals arranged in the sequence of the subjects in the schedule of classification for the mere satisfaction of having them arranged in strict accordance with the schedule sequence. But the standard helpful sequence of the main classes found in the schedules of classification is seldom strictly parallel to the popular sequence. Nor is the popular sequence a permanent one. It does and must change with time.

Multiplication of Collections

The collection of books of current interest may be called the Main Collection. There may be a second collection consisting of periodicals and serials and a third one made of books of archaic interest and hence of comparatively infrequent demand. These may be called Secondary and Tertiary Collections respectively. A suitable symbol may be put above the class number of a book in all but the main collection to indicate the collection to which it belongs. Such a collection symbol may not be necessary in a bound volume of periodical, as its very look will show that it is a periodical.

Closed Collection

Again, certain types of books, if they are put in open access shelves, are likely to be adversely affected by their being mal-handled by a few black sheep to such an extent that they are of no use to others who really want them. In this category we may include Fine Arts books, books full of art plates, and books of pornographic interest. Such books may be kept in a non-open-acceess or closed collection (not necessarily in closed shelves). By a closed collection is meant that readers will not normally be allowed to have direct or open access to the shelves containing it, but will obtain their books in most cases by the old application slip system. This restriction may be waived in the case of certain classes of responsible readers. This closed collection arrangement gives us control over the use of these books. Fine Arts books will be exposed to loss of plates if they are placed in the open access shelves. Similarly all pages savouring of obscenity are systematically purloined (to satisfy the morbid curiosity of the black sheep) from otherwise scientific treatises. Such books also should be taken over to the closed collection. Such a closed sequence may be called a Special Collection. Their book numbers may be put between two horizontal parallel lines to indicate their location.

Abnormal Size Collection

To come to the actual arrangement of books on the shelves, it is quite necessary to see that the shelves present an aesthetic appearance. This presentable appearance is of extreme importance in an open access library;

for, the first thing that creates a good impression in a reader is the trim condition of the shelves with sufficient direction guides, bay guides, and shelf guides. It is a most unsightly thing in a library to see on the shelves giants, pygmies, and weaklings, all in a conglomeration minus the respect due to their ordinal arrangement. Hence, all volumes which, on account of their size and weight, preclude easy handling should be kept in a separate collection — this may be called Oversize Collection. The bottom-most plank throughout the book-racks may be used for this collection. To indicate their location, their book numbers may be overlined. Pamphlets and miniature volumes may be kept in a closed collection. This may be called Pamphlet Collection or Undersize Collection. Their location may be indicated by the underlining of their book numbers. If this is not done, such volumes invariably get themselves squeesed and even lost, either amidst other volumes or in the pockets of book-vandals.

Formation of Collections

Hence, the rigid arrangement of main classes by their numbers results in wasting the time and energy, not only of the reading public, but also of the reference staff. In an arrangement like this, a majority of readers may have to waste their time and energy in walking unnecessarily great distances to get at their books. The reference staff also are affected in the same way, as their movement is dependent on the movement of the readers. It is quite necessary to break the schedule-sequence and judiciously repermute the main-classes on the shelves. For example, literature, as the most popular subject attracting the greatest number of readers, may be located as near the entrance as possible, irrespective of its proper place in accordance with the schedule of classification. Other subjects may be arranged at distances from the entrance varying inversely with their popularity. Any one arrangement should not be considered as final (merely on the ground of unwillingness to undertake additional labour). Use utility must be constantly tested by experience in the light of the statistics of issue. Any reshuffling of subjects found to be necessary should be immediately carried out even at the cost of additional labour and time, as the convenience of the readers is the convenience of the library.

Temporary Collections

The above mentioned sequences by no means exhaust the collections to be maintained in a growing library. While these sequences are of a permanent nature, need is felt for the formation of certain temporary sequences.

Correction Collection

If the library makes any attempt whatever to keep itself abreast of the times, there will be constant need to revise the class numbers assigned to the books in stock, in the light of the experience gained in serving the books to the readers and in consequence of the realignment and reorientation of the divisions of knowledge brought about now and then in the learned world. Change in cataloguing policy, which should be occasionally necessary, may require the revision of the catalogue entries of certain books. When groups of books are segregated for correction of class number or catalogue, they have always a tendency to stay for long, away from the stack-room. Special steps have to be taken to call for them at systematic intervals. It is better to make a separate collection of them. This may be called Correction Collection. They should be constantly watched and pushed forward.

Binding Collection

Another factor which calls for a temporary collection is one of necessary occurrence in a popular library, which gets its books well-used and well-thumbed. As the books get worn out by such legitimate use, it fails to the lot of the Maintenance Section to play the role of the family doctor to such books. At the right time, the Maintenance Section is to send such books to the hospital on medical leave. The process of relieving them, keeping them in mind when they are patients in the bindery, and reclaiming them promptly when their treatment is over, is best regulated by looking upon them as forming a Temporary Collection, called the Binding Collection. Here again, it is likely that more than one monthly batch will be in the hospital simultaneously. The binding collection should therefore have a number of sub-collections. It may also be wise to have their call numbers re-examined and reshaped before they are sent away to the bindery, as they are likely to have their call numbers marked permanently on their back in glittering letters of gold when they come back hale and healthy from their sojourn in the bindery.

Topical Collection

Apart from finding for every reader his book and for every book its reader, the Reference Section has also to satisfy the Fourth Law, viz, “Save the time of the reader”. In certain situations, the Reference Section can achieve maximum result in this matter, if and only if the co-operation of the Maintenance Section is forth coming. This co-operation, the Maintenance Section can and should easily offer. One of the vital reasons for maintaining the shelf register in cards on the basis of “one volume, one card”, is the extreme mobility that it gives to the arrangement of books.

The Maintenance Section should exploit this mobility for the benefit of the readers by freely forming Special Temporary Collections to meet the special demands that may arise from time to time. A few concrete examples will make this clear. When a special course of lectures on educational experiments was being delivered to a large class of teachers, the syllabus of the lectures was perused in advance. In consultation with the lecturer, all the books in the library, with a bearing on the course of lectures were assembled together, and put in a special cup-board as a special temporary collection dubbed Educational Experiments Lecture Collection. The Principle of Parallel Movement enabled the Maintenance Section to form such a sequence and have easy control over it, thus enabling the Reference Section to serve the teachers attending the lectures with the least loss of time. Apart from the saving of time, the psychological effect was felt to be much more vital. The data on which a topical collection may be broken up may be written on the date-label and encircled. Every class of library, which wants to function up, will find occasion to form such Topical Collections from time to time. Local festivals, local celebrations and, any other important local event will give the occasion to the library to form such temporary topical collections. The discussion of a Bill or any momentous resolution that may come up before the legislature may prove to be an occasion to form such a temporary topical collection. The rush of enquirers and the pressure of time in a Legislative Council Library would make the work of the librarian inefficient, if not impossible, if such temporary topical collections are not intelligently sensed and formed in advance and, their formation would be impossible even if they are sensed, but for the extraordinary power which is given to him by this wonderful invention, by the library profession, of this extremely mobile shelf-register-in-cards, and the equally facile Principle of Parallel Movement.

Parallel Movement Principle

Having been obliged to disturb the schedule sequence and to arrange the books in so many collections, it is a great responsibility for the Maintenance Section to maintain correct sequence in the shelves and to see that every book is in its correct place. The mechanical apparatus invented by the library profession to cure this is what is known as the Shelf Register. It is made up of cards of standard size, viz, 125 × 75 mm, written on the principle — one title, one card — with the call number in the leading line. These shelf register cards are kept absolutely parallel to the books on the shelves, which means that they are to be arranged in an equal number of collections. What is more, except when the books leave their proper place on the shelves to get into the hands of a reader, every movement of the books should be controlled and imitated by an exactly parallel movement among the shelf register cards. The discovery of this Principle of Parallel Movement has turned out to be panacea of most of the ills in the management of the books in the library and brought in its train the inevitable genesis of the Maintenance Section. The shelf register cabinet is the hub of the stock in the library and correspondingly the Maintenance Section is the hub of the staff of the library.

Guides

The Maintenance Section should put up guide-boards to places like reading room, periodicals room, catalogue room, stack-room, etc. so that readers can by themselves find their way about in the library. Within the stack-room itself, there should be tier-guides and gangway-guides showing the subjects in the respective tiers and gangways. There should also be bay-guides in each bay showing the subjects contained in it. It has been found from experience that each bay-guide may have to be in at least six lines. All the above mentioned guides may consist of thick card boards 35 ´ 12 cm coveted with white paper. Each bay, whose standard width is about 1 m will require two guides. The legends, which should consist of the class numbers and their equivalent in the natural language, may be stencilled on these guide-boards. Each shelf-plank also should have shelf guides. As the standard length of a shelf-plank is about 1m, it is found helpful to have an average of three shelf-guides in a plank. These shelf-guides may be strips 125 ´ 12mm cut from white Bristol boards. Discarded catalogue-cards with one side blank may be used for cutting these strips. The shelf-guide also should give the class number and its equivalent in the natural language. Since we have said that on an average there will be one shelf-guide for every 25 cms of shelf-plank, it is obvious that in a stack-room accommodating 25,000 volumes, about 3,000 shelf-guides will be needed. It is not an easy matter to maintain these shelf-guides. As the books will be frequently moving forward as a result of new accessions, these shelf-guides also will have to be frequently moved forward and adjusted. This will add to the task of maintaining the shelf-guides. The best way of facilitating this work is to provide wedge-shaped grooves along the front edge of shelf-plank in which the shelf-guides can be slided.

Open Access Without Guides

It is sheer callousness to adopt open access system without plenty of guides, or even if there are guides, to leave the guides unchanged in an ever-changing library. It will be frustration to readers. It will even irritate them. It will bring odium on the library staff. There is no doubt that maintenance of plenty of guides in their right places will consume considerable staff-time. Library authorities should take this into account in providing staff. But on the side of the staff also, they should have a sense of value which is sufficiently compelling to make them feel miserable even if one guide is in the wrong place or one plank is without guides.

Reshuffling

To take away from the monotony of the appearance of shelf-arrangement, to exploit the Principle of Novelty, to help every book to get its reader, and to keep step with the slowly changing scale of popularity of subjects with the reading public, it will be desirable to reshuffle the disposition of the subjects in the stack-room at suitable intervals. Once in five years the whole library may have to be reshuffled. Every year some particular region may have to be reshuffled.

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Adjustment of Guides

It must be a matter of prestige for the Maintenance Section that no guide tells a wrong tale. The shelf-guides will have to be carefully watched and adjusted, from time to time, into their proper position. The bay-guides may not require such frequent attention. But whenever books have to be transferred from one bay to another the bay-guides should be immediately corrected. The gangway-guides and the tier-guides will not require even as much renewal as the bay-guides.

Renewal of Tags

The tags on the backs of books should be rapidly reviewed each day. The entire stack-room should be covered in this way at least once in a month. During this review, all worn-out tags should be replaced by fresh ones and the call numbers copied on them. All the newly written call numbers should be verified by somebody else or by the same person on the next day before the volumes are back on the shelves.

Addition of New Books

The work of absorbing the accession of the week into the stock should be done on a weekly basis. As soon as the preparation of the new volumes of the week is over, sort them out according to their collections. In each collection arrange the volumes by their call numbers. Do similarly for their shelf-cards. Books of a normal nature fit for display in the recent additions shelf should now be separated with a parallel separation of shelf-cards. These separated shelf-cards should be put ha the recent additions box behind the guide "Collection 0". Take this box and the new volumes to the recent additions shelf which should be in the first row of shelves in the stack-room. Pull out all the volumes corresponding to the shelf-cards behind the guide "Collection 2" As each volume is pulled out, turn its shelf-card in its own plane through a right angle so that it stands on its shorter edge. If any volume is not to be found, trace it out.

Alter all the books have been traced out, transfer the guide-card "Collection 1" to the place where the guide-card "Collection 0" is, transferring the latter to the end of the current week's cards. Put the current week's books, meant for display, on the recent additions shelf in the classified sequence.

Released Books

Hand over to the counter all the released books which have been bespoken. Take the remaining books along with the other books of the current week and shelve them in their proper places. Take out from the recent additions box the shelf-cards which are standing on their shorter edges and put them along with the shelf-cards of the week's additions which are not to be put on the recent additions shelf. File these cards in the proper places in the shelf-register cabinet.

Consulted Books

Every hour, walk round the reading room and collect the books left by readers on their respective tables after consultation. Enter the statistics in the consultation counting sheet and shelve the books in the returned-books-shelf in a roughly classified sequence. This shelf may be in the first row of shelves in the stack-room.

Borrowed Books

The books returned by members at the discharging counter should also be brought to the returned-books-shelf at convenient intervals and shelved in a roughly classified sequence.

Replacing

Readers should be allowed to take away for consultation on loan any books lying in the returned-books-shelves. There is no gain in segregating them and keeping them away from the use of readers until they go back to their permanent places in the stack-room.

On the other hand since the books in the replaced-books-shelves will be popular ones, there is every chance that many of them will go into reader's hand in the course of the day and that the books to be actually replaced will be considerably reduced in number — resulting in the saving of the time of the staff.

But the volumes which stay back in the returned-books-shelf should be replaced in their permanent places once in a day at an appointed hour. This hour should be the slackest hour in the library.

Rectification and Verification

In an open access library, readers are never allowed to replace books on the shelves. They have freedom only to pick out books from the shelves. In spite of this convention, books do get mixed up as a result of the reader's browsing round the stack-room. Even apart from criminally-minded people deliberately putting a book in quite a distant place, the unintended misplacements within the same shelf-planks would in the long run mount to very near chaos. Unless the books are put back in proper sequence periodically, readers will be put to much difficulty; nor can the library staff find books easily. The process of restoring order among the books is called Shelf-Rectification. There is also need for periodical Stock-Verification. This is normally done once in a year. This practice usually involves much disturbance in the rhythm of the work of the library. Some libraries go to the criminal extent of closing down to the public for the period of stock-verification. This practice violates all the Laws of Library Science. The necessary shelf-rectification and stock-verification can be combined into a single process. In other words stock-verification will be automatically done not merely once in a year but even more than once if shelf-rectification is properly designed and correctly carried out.

Cycle for Shelf-Rectification

All the regions of a library may not be equally prone to disturbance by readers. The main collection will be the most disturbed. The closed collection will not be disturbed at all. The secondary and the tertiary collections will be disturbed much less than the main one. It is desirable that shelf-rectification should be done in the main collection at least once in a month. That for the secondary collection may perhaps be done once in six months. It may be enough to attend to the other collections once in a year. But, the frequency of periodical dusting and cleaning of these collections should be in just the reverse sequence. This is because in the main collection the books are constantly disturbed by the readers themselves and dust and insects cannot therefore accumulate very much. But in the other collections they will accumulate.

Checking with the Charged Tray

One of the persons should read out, from the charged tray at the counter, the call numbers of all the book-cards lying within the range of the day's quota. As each call number is read out, the second person should turn its shelf-card through a right angle in its own plane so as to stand on its shorter edge.

Final Checking

Then take the trays to the region of the stack-room to be checked. One person should go on reading the call numbers of the books on the shelves.

The other person should go on looking up and pushing towards himself, the corresponding shelf-register cards. If any shelf-register card standing on its shorter edge intervenes, it must be turned down to its normal position. If the book corresponding to any shelf-card lying in the normal position is not read out by the man at the shelf, that shelf-card should be turned so as to stand on the shorter edge. The result will be that at any moment the cards that stand on the shorter edge in the checked region will be those of untraced books. On the other hand the cards which stand on the shorter edge in the unchecked region will be those of traced books. As the checking proceeds, misplaced books will happen to be read out by the man at the shelf. It may happen that the card of a misplaced book is found standing on its shorter edge in the checked region.

It may then be restored to its normal state of standing on the longer edge. It may also happen, that the shelf-card of a misplaced book is in the unchecked region of the tray. If so, ask the man at the shelf to shelve the book at the proper place. If any reader takes away a book of the unchecked region of the day's quota, before he leaves the region, the shelf-card of the book may be turned so as to stand on its shorter edge. Thus there will be no obstruction whatever for readers to use any book they like when the shelf-rectification *cum* stock-verification is proceeding. As soon as the checking of the day's quota is over, enter in the investigation notebook the details of the cards standing vertically on their shorter edges; and then restore the cards to their normal position. Insert the shelf register tray in its proper place.

Binding Process

An important part of maintenance work is to keep the books in a physically fit condition. The standard of artistic binding of books for private use — which means very sparing use — is quite high. But re-inforced library binding to stand constant wear and tear has not yet come into vogue in India. Even concepts like split boards and French joints are unknown. The necessary materials of good quality are not easily available. It is therefore necessary that the most detailed specification should be given for library binding. It would be a good policy to ask the binder to take personal instruction from the librarian. A specification of library binding is given at the end of this chapter for ready reference. Each library should also train some member of the staff to make petty repairs. A stitch in time saves nine, as the saying goes.

Waste Books

As already stated in sections 331, 33231 and 33286, the damaged books should be picked up by the circulation staff and segregated for attention. It is also desirable to walk round the stack-room and pull out books needing re-binding. All the cumulated volumes of periodicals intended to be preserved will require to be bound. It is again a matter of policy whether a book should be sent to the bindery after the publishers' case is worn out or even at the beginning before it is released for circulation. We are of the opinion that the life of the book will be considerably lengthened if the latter course is adopted. If we can get books from publishers unbound in sheets, it is well and good. In Norway where few publishers agree to do so, we found that the Director of Libraries ruthlessly pealed off the publishers' cases as soon as the books arrived from the publishers. He even employed a fairly large staff to do this pealing work ! In any case books in paper covers should not be released for the use before being bound. At the same time every book may not need costly library binding. In the case of books of passing interest, particularly ordinary fiction, usually printed on bad paper, it may be cheaper to buy additional copies than to have them bound in the library style.

Bound Volumes

Before forwarding begins — that is, before the covering material is applied — inspect the books in the bindery to see if the specification has been fully followed. When the bound volumes come back to the library, check them with the binding slips, scrutinise if the tooling has been properly done, insert the books in their proper places, merge the corresponding shelf cards in their proper places, and check the binder's bill with regard to style of binding and the rates claimed.

Volumes for Binding

Perhaps binding work is best done on a monthly basis. As soon as the quota for the month has been collected, arrange them in a classified sequence. Take out their shelf-register cards and form a binding collection of them. Scrutinize the volume from the point of view of their binding peculiarities and form them into homogenous groups. Arrange the volumes in each such group in classified sequence. Prepare binding slips for each of them. Make an order copy for binding from out of these slips. Ask the binder to come to the library and collate all the volumes. If any volume is defective, decide whether it is worth binding. If it is, note the defects in its binding slip. Hand over the volumes to the binder. Keep the slips in the *binding box.*

Assembling

(a) *Collation :* All books received by the contractor are to be examined and collated and any found to be imperfect or seriously damaged are to be returned unbound to the librarian. Torn leaves and plates are to be neatly repaired. A periodical shall not be held to have been collated properly nor to be perfect, unless all the parts of a volume are bound in correct order of pagination and the usual title and contents pages and indexes are inserted in the proper places. Unless each imperfect and damaged book is reported upon to the librarian and unless the librarian has instructed the contractor to proceed with the work on such books, the bill will not be paid for any such books bound or repaired.

(b) *Wrappers and advertisements* in periodicals and books are to be bound in, if the contractor is instructed to do so; otherwise, they are not to be bound in.

(c) *Sewing:* Books printed on paper of good quality are to be sewn one sheet on (except where thinness of paper makes it necessary to sew two sheets on) with unbleached thread of suitable thickness over unbleached linen tapes. Books printed on soft, spongy or brittle paper are to have the sections lined at inner and outer folds with strips of thin but tough paper before they are sewn. All sections broken at the back are to be lined with tough paper or linen strips, and where necessary neatly overcast on modern methods of cross stitching before being sewn to the tapes. The first and last sections of all books are to be enclosed at back in linen strips.

All separate leaves, plates, maps, plans, etc., are to be mounted on guards of linen or tough thin paper and to be sewn in. Pasting on is not to be permitted. Double plates are to be guarded at the fold. No charge is to be made for the first dozen plates so guarded in each book. For books up to post octavo (6¼” ´ 3-$^{7}/_{8}$”) three tapes, one-quarter inch in width, are to be used. For books of crown octavo (7½” ´ 5") four tapes, one-quarter inch in width, are to be used. For books of larger sizes the number of tapes and their width are to be increased in proportion. Two of the tapes are to be placed within one inch of the head and tail of each book.

Straight-line machine stitching will not be accepted. Books printed on calendared or heavily loaded art paper are to be reported to the librarian and a quotation sent to him for lining each leaf of such books with a linen hinge on a throw-up guard.

All folded *maps and illustrations* are to be mounted on jaconet or thin linen of good quality and to be charged for separately.

End-papers: End-papers are to be of good tough opaque paper of approved mild colour, with at least one plain white leaf between each of them and the printed matter. The endpapers are to be made with strong linen or cloth joints and to be sewn on as a section.

Cutting edges: Unless otherwise instructed the contractor is to cut edges of books accurately and to take care to leave margins as wide as possible. Unless other instructions are given, the edges are to be sprinkled or tinted with a colour harmonising with the colour of the materials used for covering.

Rules for Regulations

Time of Opening Library

The hours, when the... library will be open to the public, shall be fixed by the Library Committee from time to time.

The Library Committee has decided as follows for the time being.

The library shall be open to the public on all days from (7 A M to 9 p m).

Admission in Library

No person, who is not of sound mind, nor cleanly in person, nor properly dressed, shall be admitted into the library. The rules may provide for admission by special permit in the case of specified classes of persons, such as non-tax payers, strangers, etc. A person desirous of using the library shall enter his name and address legibly in the gate register kept for the purpose. Such entry shall be taken as an acknowledgment that the person agrees to conform to the rules of the library. Sticks, umbrellas, boxes and other receptacles and such other articles as are prohibited by the circulation staff shall be left at the entrance. Dogs and other animals shall not be admitted. Silence shall be strictly observed in the library. ISpitting and smoking are strictly prohibited. Sleeping is strictly prohibited. No person shall write upon, damage, or make any mark upon any book, manuscript, or map, belonging to the library. No tracing or mechanical reproduction shall be made without express permission from the librarian. A person shall be responsible for any damage or injury done by him to the books or other property belonging to the library. He will be required to replace such books or other property damaged or injured or to pay the value thereof. If one book of a set is injured, the whole set shall be liable to be replaced. Before leaving the library each person shall return to the circulation staff any books, manuscripts or maps, taken by him for consultation. Cases of incivility, or other failure in the service, should be reported immediately to the librarian, or his deputy during his absence.

Loan Privilege

Membership

Any of the following is entitled to take out books on loan on enrolment as a member of the library:

1. Any tax-payer residing or having his place of business within the area of the library.

2. Any person living within the area of the library and guaranteed by any tax-payer resident within the area of the library.
3. Any person employed in an institution within the area of the library and guaranteed by the head of the institution.

To get enrolled as a member, a person shall fill up and sign a Form of Enrolment, which can be had free of cost at the library counter [and make a cash deposit of Rs......].

Reader's Tickets

Each member shall be given as many reader's tickets as the number of volumes, he is entitled to have with him on loan at one time.

The tickets of a member will be valid for twelve months. They can be renewed by filling up a fresh Form of Enrolment and returning to the librarian all the expired tickets along with it.

A book will be lent to a member only in exchange for one of his tickets. This will be handed back to the member when he returns the book, unless it is returned after due date, in which case the ticket will be handed back only after overdue charge is paid.

A week's notice shall be given before a deposit is withdrawn. No deposit shall be repaid until all the books outstanding against the member and all his member's tickets have been duly returned and all the dues from him are paid.]

Loss of Tickets

A member who has lost a ticket shall make a written report of the same to the librarian.

Three months' time shall elapse after the date of such notice, before a duplicate can be issued. During this period, the member shall attempt to trace and recover the ticket if possible and send a second report at the end of the period, stating the result of his endeavours.

If the ticket has not been traced, the member shall give an indemnity bond in the prescribed form and pay a fee of... for each duplicate ticket required.

After the receipt of the indemnity bond and the fee, the duplicate ticket will be issued.

If a member, who has lost one or more of his tickets, applies for withdrawal of deposit amount, no action will be taken on such application till the expiry of six months after the report of loss of ticket. If the ticket is not recovered by the member before the end of that period, he shall give an indemnity bond in the prescribed form in respect of the lost tickets.

After the receipt of the indemnity bond, the application for withdrawal will be dealt with in the usual way.]

Conditions of Loan

Each member may have out on loan not more than... separate volumes at one time. He must make his own arrangement for the conveyance of books to and from the library or any of its delivery stations, except that in the case of invalid or lady members, books may be delivered once a week at their residence on payment of an advance quarterly subscription of....

Before leaving the counter, the member shall satisfy himself as to whether the book lent to him is in sound condition; and, if not, he shall immediately bring the matter to the notice of the librarian or his deputy in his absence; otherwise he is liable to be held responsible for the replacement of the book by a sound copy.

If one book of a set is injured or lost, the member concerned shall be liable to replace the whole set.

The value shall be immediately paid to the library. It will be returned after the book or the set is actually replaced. Periodical publications, directories, works difficult to replace, and such other works, as may be declared reference books by the librarian, shall not be lent out.

Members are not allowed to sub-lend the books of the library.

All books on loan shall be returned at the expiration of a fortnight from the date of issue.

Books temporarily in special demand may be lent for such shorter period as may be necessary or may be temporarily declared reference books under Rule 43.

Loans may at any time be terminated by order of the librarian.

If a book is not returned to the library when due, an overdue charge of five e paise per volume per day shall be levied.

Loan may be renewed for a further period of one fortnight provided:

1. The renewal application reaches the librarian not less than three and not more than five clear days before the date on which the book is due;
2. No other reader has applied for the book in the meantime; and
3. Not more than three consecutive renewals shall be allowed for the same book without its production to the library for inspection.

In case condition (2) is not satisfied, the librarian shall cause a letter to that effect to be posted to the member concerned and the book shall be returnable on the due date.

A member against whom any overdue or other charge is outstanding shall not be allowed to borrow books [or withdraw his deposit] until he has paid the amount due.

General

The librarian may refuse, under special circumstances, admission into the library to any person or the use of any book without assigning any reason therefore. The library Committee may refuse, under special circumstances, any application for the privilege of loan of books without assigning any reason therefore.

The Library Committee may grant special loans on such conditions as it may prescribe.

Any infringement of the rules will render the privilege of admission to and of borrowing books from the library liable to forfeiture.

Sentinel at the Rubicon

The counter is the Rubicon. The Circulation Staff are the sentinels watching and regulating the entrance and the exit of the users of the library. They should have all the loyalty and the precision of sentinels. And yet they should remember their being employees of the humane library department and not of the military department. They should be courteous without being lax, strict without being offensive, and friendly without becoming chatty. The rules of the library should be enforced in this way.

Vigilance of a Sentinel

The Circulation Staff should have all the vigilance and circumspection of a sentinel. Their responsibility is particularly heavy in an open access library. Nobody should be allowed to get in or get out except with their consent and under their surveilance. No book should be allowed to be taken out of the library or brought in without their permission. For an open access library implies *extreme vigilance* at the entrance and exit, and *extreme freedom* in the inside of the library to all readers. To mechanize the going out and the coming in of books, the "Reader's Ticket, Book Ticket" method of issue is being used currently. This method secures the automatic enforcement of many of the rules of the library.

Variety of Functions

In addition to playing the role of humane sentinels, the Circulation Section has the following variety of functions connected with the observance and enforcement of the rules of the library:

1. Maintaining all the records relating to all the thousands of users of the library;

2. Admitting users as members of the library and dealing with their withdrawal;
3. Maintaining all the records about the loan of books including inter-library loan, overduing, and collection of overdues;
4. Taking charge of all the books returned after 'consultation by users; and
5. All the work connected with the bespeaking or reservation of books by users, and for staff purposes.

Circulation Apparatus

Parts of the Circulation Apparatus

The parts of the circulation apparatus fall into the following groups:

1. Materials to be carried by the book ;
2. Materials to be carried by the reader; and
3. Other materials needed at the counter.

Materials Carried by the Book

The parts of the circulation apparatus normally to be found in the book are the following:

1. Date Label; and
2. Book Ticket.

Date Label

The code number for *Date Label is* O61. It is of octavo size. It should be pasted in the book so as to be its first leaf. It should consist of a sheet of 16 pound white printing paper 19 ´ 11.5 cm. 4 cm of its bottom should be turned over. This turned portion should be pasted along the edges so as to form a pocket whose mouth is 6.5 cm wide. This is to hold the book-ticket when the book is inside the library. A picture of it is shown in the next page. The turned flap should be printed in 8 point type and the rest of the label should be ruled as shown in the picture in the next page.

Book Ticket

The code number for *Book Ticket is* A62. It is of abnormally small size. It should be made of Manilla paper in the form of a pocket. This is to hold the reader's ticket when the book has gone out of the library. The back-fold should be 7.5x4.5 cm. The front-fold should be 4 ´ 4.5 cm. The exposed portion of the inside of the backfold should have the class number of the book in the first line, its book number in the second line, and its accession number in the third line. The frontfold should have the name of the author or its substitute used as the heading of the book in the first and second lines, its short title in the third line, and the series of the book, if any, as the last line. The picture of the date label opposite shows the portion of the book-ticket, projecting outside the pocket in the date label.

Book-Pocket

Till now the usual practice has been to have a separate Book-Pocket to hold the book-ticket. It is made of Manilla paper; It has suitable dimensions to contain the book ticket. The practice has been to paste it inside the front cover of the book at a distance of 2.5 cm from the bottom-end and centred between the two side-edges. The alternative suggested in Section 4111 is cheaper and neater.

Materials Carried by the Reader

Each member should be given as many reader's tickets as the rules of the library allow. The code number for the *Reader's Ticket is* A61. It is of abnormally small size. It should be made of thick bristol board or its equivalent, say about 0.3 cm thick. The reader's ticket should be capable of being inserted into a book-ticket with ease. It should be 6x4x0.3 cm. One side should have the crest of the library printed in the centre. The words "Not transferable" should be printed above the crest and the name of the library below the crest. The other side should be left blank. The number of the ticket will be written in the first line, the name of the member in the second line, and the forenames or the initials within brackets in the third line. The address of the member should be written after these. The accompanying picture shows the two sides of reader's ticket, a book-ticket, and a book-ticket with the reader's ticket inserted in it.

Ticket Number

The following interpretation of the ticket number in the picture shows how a ticket number is to be constructed:

006	=	Expires in June 1960.
D62	=	Member's main interest is Machine Tools.
12	=	Twelfth member admitted in June 1959.
3	=	Third ticket of the member.

Automatic Control

It may be explicitly stated here that assuming for definiteness that a member is given three reader's tickets at any time the number of library books in his possession *plus* the number of free tickets with him, should be equal to three. If he has three books, he will have no free tickets. If he has two books, he will have one free ticket. If he has one book, he will have two free tickets. If he has no book, he will have all the three tickets with him. Thus Rule 32 of the Rules of the Library is automatically enforced.

Colour Scheme

The following is a model colour scheme for tickets:

Children's Tickets	Red
Fiction Tickets	Yellow
Ordinary Tickets	Green

Usually even an ordinary book can be taken on an yellow ticket. But no fiction can be taken on a green ticket. If there are other privileges like loan of periodicals other suitable colours may be used to indicate such privileges. The colour scheme also helps automatic enforcement of rules.

Materials Needed at the Counter

The counter should be provided with the following materials:

1. Trays to file reader's tickets;
2. Rubber dater and inking pad;
3. About 100 Twin-Tokens of the size and shape of Book Tickets and Reader's Tickets made of Manilla paper and numbered 1 to 100; and
4. Tokens for the custody of private property like umbrellas, sticks, boxes;
5. Date guides numbered 1 to 31; and
6. Over-due guides marked 5np, 10 np, etc.

Ticket-Trays

About a dozen primary charging trays are necessary. Their inner dimensions should be 25 ´ 5 ´ 4 cm. Three or more secondary or sorting trays are necessary. These should be triple trays. The inner dimensions of each member of the triple tray should be 45 ´ 5 ´ 4 cm. There should be three (or as many as may be necessary, depending on the number of members) tertiary or filing or charge trays. Each of them should be a 9-pIe tray. The inner dimensions of each member of the 9-ple tray should be 45x5x4cm. Each 9-ple tray as a whole may be of the inclined sort — the nearer edge resting on a reeper 4 cm high.

Conscience Box

Near the entrance wicket-gate, there should be a conscience box — a locked box with a small slit in its lid as we have in temples to collect offerings — into which the members who have delayed the return of books beyond the due date may drop their overdue charges. After practising the Victorian method of formally collecting the overdue charges with formal receipts and maintenance of separate accounts, libraries have learnt that

1. the game is not worth the candle; and
2. a splendid opportunity for the development of civic conscience is thereby being lost.

The conscience-box method is now adopted even for the collection of bus-fares in America. Our libraries should straightway begin with trust in this manner. Trust will beget trust.

Charging Work

Mode of Presenting

Members should be trained to present the books to be charged — i.e. taken home on loan— in a helpful way. They should present them with the front cover thrown open and one of their reader's tickets placed on it, so that the man at the counter can easily read the date label. Of course, they should also be trained to respect the rule of queue. If the book is in a damaged condition, set it aside for binding and tell the reader that it can be taken after repair.

Charging and Vigilance

For each book, rapidly tally the call number and the accession number on the book-card with those on the date-label. If they are alright, insert the reader's tickets into the book ticket, taking care to see if the class number of the book has reasonable correlation with the member number of the reader. If it is satisfactory, stamp the due-date in the earliest vacant compartment of the date-label. While doing so, release the wicket-gate. Allow the reader to pass out. Hand over the book to him. Insert the coupled ticket-pair in the charging tray. Any discrepancy in the call numbers and member numbers should be disposed of quickly. If it is too complicated, pass it on to others, as the stream of members crossing the wicket-gate should not be held up and stagnated by tumbling over one case. Without offence but with extreme vigilance, watch every person crossing the wicket-gate, whether taking a loan or not, and make sure that he does not carry away with him, unauthorised, any book or reading material of the library either forgetfully or wilfully.

Issue of Bespoken Book

When a reader calls for a bespoken book, take back his bespeaking card, satisfy yourself that he is the right person and issue it in the usual way. If there is a red slip with a name other than his in the book ticket, retain it while charging.

Sorting

As pick-up work whenever you are free from readers, arrange in their classified sequence the coupled ticket-pairs collected in the charging tray. Mark the loan-counting-sheet for them by putting against the appropriate subject a vertical stroke, except that the fifth stroke should be a horizontal one across the preceding four. This facilitates counting in blocks of five. As the statistics are being marked for each book, transfer the coupled ticket-pair to the sorting tray and file it by its class number.

Unusual Period of Loan

Care must, however, be taken in the case of a book loaned for an unusual period. The coupled ticket-pair must be filed, immediately after charging, behind the proper date-guide in the charged-tray at the entrance counter, after marking the statistics in another colour.

Daily Statistics

At the end of the day, total up the statistics. Tally the total number of issues with the number of coupled ticket-pairs standing in the sorting tray. Investigate and set right discrepancies if any. Remember that the coupled ticket-pairs mentioned in sec 425 will cause discrepancy. Transfer the coupled ticket-pairs to behind the correct due-date in the charged tray.

Closing Routine

Before closing down, change the dater to the due-date corresponding to the next working day. Put up a new counting-sheet for the next day. See that the charging counter is cleared of all accumulated materials and kept in a clean condition to start work on the next day.

Cumulation of Statistics

Add up the statistics and post the figures in the Daily Statistics Register. At the end of each week, month, and year, write the cumulative total.

Discharging Work

Essential Items of Work

Discharging work consists of

1. Renewal of loan;
2. Charge of private property of readers ;
3. Discharging of loan ;
4. Recovering overdue books; and
5. Other routine.

The man in the discharge counter is the first person whom the reader meets in the library. He should therefore give him a genial welcome, answer his queries and makes him feel like walking, into the library and accepting its service. At every hour, the hour should be entered at the end of the last filled-up line in the gate register.

Opening Routine

As the first thing in the morning, pick out, from the coupled-ticket-pair standing behind the date-guide of the day, those that have white slips in them. Hand them over to the charging assistant so that he may renew the loans.

Genial Reception

When a reader approaches the entrance wicket-gate, receive him in a genial way. This does not mean getting into conversation with him. Take charge of all his private property including books, sticks, umbrellas, bags, boxes and receptacles of all sorts. Give him a token in exchange. Place its twin on his property.

Discharging

If the reader has a library book to return, he should be trained to present the book in a helpful way. He should present it with the front cover thrown open so that the man at the counter can easily read the date-label. He should also be trained to respect the rule of the queue. From the last due-date stamped on the date-label and the call number of the book written on it, locate its coupled ticket-pair. Lift it up. Insert the book ticket into the pocket in the date-label, provided the accession number in the book-ticket is the same as that on the date-label of the book. If it is not, you have picked out a wrong coupled ticket-pair. You must restore it to its place and begin again. If it is alright, pull out the reader's ticket from the coupled-ticket-pair. Hand it over to the member or his agent asking him to verify whether the ticket is the right one. Release the wicket-gate and admit the person inside the library. The book-ticket will stay inserted in the pocket at the bottom of the date-label of the book.

Returned Volumes

If the book-ticket does not contain a red slip, place the book on the returned-book-shelf. If it contains a red slip, it is a bespoken book. As and when the returned-book-shelf within the counter gets filled up, the books in it should be transferred to the returned-books-bays in the stack-room.

Auxiliary Work

If the date-space in the date-label of the returned book has been filled up, paste down a new date-label. Enter the call number and accession number of the book at the proper places in it. If the book is in a damaged condition, keep it aside in the damaged-books-shelf. If it had been bespoken, write to the member concerned that it had been set aside for repair.

Overdue Book

If a book returned is overdue, its coupled-ticket-pair will be behind an overdue-guide marked in naya paise. Before handing over the ticket to the reader, suggest to him gently to drop the coins into the conscience box, if he does not do so himself. The old method had been to collect the overdue charges from him and give him along with the ticket a defaced overdue-stamp of the correct value. And even older still was the practice to prepare a receipt in the miscellaneous receipt book, give the original to the reader and retain the duplicate as office copy. If the reader has not brought cash, write the amount due from him on a slip of paper. Initial and date it. Attach it to his ticket with a jem-clip. File the ticket in the kept-tickets-tray alphabetically by the name of the reader. Ask the reader to recover his ticket when he pays his overdue charges.

Rush Hour

In rush hours, the process of locating the coupled-ticket-pair may hold up readers at the entrance-gate resulting in a long queue and the breakdown of their patience and temper. A similar undesirable situation may also be created if any casual mistake had occurred in the arrangement of the coupled-ticket-pairs in the charged tray and you have to fumble about for the correct ticket. This fumbling in the presence of readers will induce confusion and a sense of inferiority complex which will worsen your capacity for work. All this is undesirable. It is to obviate all these undesirable contingencies that you are provided with a supply of numbered twin-tokens. The moment you feel that stagnation begins, insert the pocket-member of one of the numbered twin-tokens into the book-pocket at the bottom of the date-label of the book returned. Hand over its plain member to the reader in exchange for the book. Request him to take his ticket when he leaves the library, or if he wants to go back immediately, the next time he calls at the library. Don't put such a book on the shelf reserved for books returned. Put all such books on the shelf for Held-up Books. When you get respite from the marching-in of readers, take up in succession each of the books in the held-up-books-shelf. Locate its coupled-ticket-pair with composure.

When it is found, insert the proper book-ticket in the book-pocket, having taken out of it the pocket-member of the twin-token. Insert the reader's ticket into that pocket-member. Place the book on the returned-books-shelf or bespoken-books-shelf or damaged-books-shelf as the case may be. File the coupled-ticket-token in the held-up-tickets-tray in the sequence of the numbers on the token. When the reader calls for his ticket, collect from him the plain-member of the twin-token given to him in exchange for his book. Pick out from the held-up-tickets-tray the corresponding coupled-ticket-token. Hand over the ticket to the reader. Couple the numbered tokens. File the coupled-token-pair in the proper place in its tray.

Bespeaking Work

First Routine

Whenever a person desires to bespeak a book, give him a bespeaking card. Ask him to enter the call number, author and title of the book, and his own address in the proper places, and to affix the proper postage stamp in the proper place. In token of your having satisfied yourself that the person has filled up the necessary particulars correctly and affixed the stamp, initial the card at the left hand bottom corner and stamp the date of the day just near it. Then place the card in the temporary bespeaking box.

Locating

As pick-up work, take each of the cards out of the bespeaking box. Locate in the charged tray the coupled-ticket-pair which has the call number mentioned in the bespeaking card. Prepare a red-slip with the name of the bespeaking member and the date of bespeaking adding the serial number thereafter if there is one. Insert this red-slip inside the book-ticket. If the book-ticket is not found in the charged tray but the book is in the bespoken sequence, insert the red-slip into its book-ticket. If the book is not traceable at all, search for it, and do the needful.

Enter near the right hand bottom corner of the bespeaking card, the date on which the book is due back in the library. Insert the bespeaking cards in the bespeaking cards box. All the cards in it should stand in the sequence of the class numbers of the books bespoken. If there be two or more bespeaking cards for one and the same book, arrange them among themselves in the sequence of the dates on which the bespoken cards were received.

If there be two or more bespeaking cards for one and the same book and with one and the same date stamp, arrange them among themselves in the sequence of the digit entered after the date stamp. Put in the serial numbers after the due date in each of the cards.

Bespoken Books Shelf

The bespoken books returned to the library are to be arranged in the Bespoken Books Shelf near the entrance-gate in five groups, viz,

(a) Zeroth group consisting of the books whose bespeaking cards have not yet been forwarded;

(b) First group consisting of the books whose bespeaking cards were forwarded on the day;

(c) Second group consisting of the books whose bespeaking cards were forwarded one day earlier;

(d) Third group consisting of the books whose bespeaking cards were forwarded two days earlier; and

(e) Fourth group consisting of books whose bespeaking cards were forwarded three days earlier.

The books in each of the groups are to be kept in the sequence of their call numbers. The groups are to be separated by guides. A guide is just a strip of card board 15x5 cm with the group number written prominently at both ends.

Notification

Towards the end of the day but in good time to catch the last mail of the day, for each of the volumes in the zeroth group, pick out the related bespeaking card from the bespeaking cards box. If there be two or. more bespeaking cards of the same volume, pick out the one which is the senior-most as determined by the serial number after the due date entered at the left hand bottom corner. Tally the volume with the entry in the bespeaking card. Sign and despatch the bespeaking card to the member concerned.

Changing Group Guides

As soon as all the bespeaking cards are despatched, release all books behind the group guide numbered 4. Examine if they have been bespoken by others, and if so, transfer them to the zeroth group to be newly formed thereafter. If not, place them in the temporary replacing table. Then, shift the group guides in the appropriate manner — ie shift guide '4' to the place of guide '3'; guide '3' to the place of guide '2'; guide '2' to the place of guide '1'; guide '1' to the place of guide '0'. Place guide '0' so as to cover the books, whose bespeaking cards are to be forwarded on the next day.

Lost or Damaged Books Action to be Taken

Occasionally a reader may lose a volume of the library or damage it. In the former case he should be asked to supply the library with a fresh copy. In the latter case, the treatment to be given will depend upon the extent of damage. The volume may either be repaired locally, or if the damage is too serious, the reader may be asked to furnish the library with a fresh copy.

Special Deposit

If the decision is to get a fresh copy from the user, find out the published price of the book from the Accession Section or from trade lists, as the case may be. If the book is a rare one, it may be necessary to estimate the current price of the book from secondhand catalogues. If the decision is to have the book repaired locally, get from the Binding Section the estimated cost of the repair. In any case, make a liberal estimate so as to avoid the contingency of recovering excess amount from the user at a later stage. It is always easier to refund the balance rather than recover the excess.

Advice about Special Deposit

As soon as the estimated cost is obtained, inform the user concerned in person, if he is present in the library, or by letter about the amount and ask him to pay the amount as a special deposit immediately.

Receiving Special Deposit

As soon as the user brings the special deposit, receive the amount. Prepare and give him a receipt for the amount. The amount is to be transmitted to the Finance Section at the end of the day along with the miscellaneous collections.

Release of Tickets

As soon as the receipting special deposit is over, pick out the related coupled-ticket-pair. Place the book-ticket in the lost-volumes-sequence. Return the reader's ticket to the member. If it is a case of damaged volume, it may happen that the user is not a member. In that case, simply transfer the book card to the lost-volumes-sequence.

Overdue Levy

There is the question, how long overdue charges should be allowed to accrue in the case of a lost or damaged volume:

1. Overdue charge may be made to accrue till the fresh copy arrives; or
2. The levy of the overdue charge may be stopped with effect from the date of payment of the special deposit; or
3. The levy of overdue charge may be stopped with effect from the date of notice of loss.

The adoption of the first alternative is rather too hard in Indian libraries. For a fresh copy of the book has often to be procured from foreign countries. It takes not less than six weeks for the fresh copy to arrive. It is doubtful whether it is desirable to continue to levy overdue charge for such a long time. A more humane alternative seems to be the adoption of the second one. But there is a cunous abuse of this alternative by certain unscrupulous members. In this alternative, it is open to a member wanting to retain a book for a long time after the due date, report loss of the book, pay the special deposit, and produce the old copy after he no longer requires it, with the story that he has recovered it somehow. Some members succumb to the temptation to do this, especially in the case of books of topical importance and particularly text-books which are of great importance in connection with examinations. I wonder whether this abuse may not be guarded against by providing that, in case a user returns the old library copy, he should pay the overdue charges till the date of return. Of course in this case we have no means of distinguishing genuine loss and recovery from pretended loss and recovery. The third alternative is not desirable. Because special deposits are not easily forthcoming unless the overdue charge is made to accrue until the date of payment of special deposit. The library has to wait indefinitely long to get the special deposit.

Replacement

In the case of a lost book, either ask the reader to purchase a fresh copy or take his written consent for the library to purchase it on his behalf. As soon as the fresh copy arrives, pick out its book-ticket from the lost-book-sequence. Attach the date-label. Enter the accession number in the usual places. Insert the book-ticket into the pocket at the bottom of the date-label. Advise the reader that the book had been replaced. Settle his special deposit account. The damaged copy may then be returned to the member concerned with the following endorsement written on its title page: This copy has been replaced by a fresh copy by Mr.... Hence, this copy is given away to Mr.... This b no longer property of this library.

Unprocurable Book

If the book is not procurable even second-hand, write off the book from the stock of the library. Appropriate the special deposit to the library fund.

Repair

In the case of a damaged book, as soon as the repair has been completed, inform the person concerned about it and settle his special deposit account.

Members

Admission

When a person desires to become a member of the library give him two application cards. When he gives them back duly filled, examine carefully if all the items have been filled up. Verify the accuracy of the statements and also the signatures contained in them whenever necessary.

If there is any discrepancy, get it rectified by the applicant. As soon as you are satisfied that everything is in order, send him into the library to acquaint himself with the arrangement and to get initiated into the library set-up and apparatus. Another member of the staff— the reference staff— may be asked to help him in this.

Guarantor's Signature

Remember that in the case of a person who is not a tax-payer of the locality, he should be asked to obtain the guarantor's signature on one of the application cards.

Preparation of Tickets

When he is thus taken care of otherwise, prepare the necessary number of tickets of the proper colour in accordance with the rules. Each member should be given a Member-Number. Apart from the serial admission number which will be put in the application cards, the member-number also should be in it. It will be a great convenience if the member-number is so constructed that it is a short representation in ordinal numbers of the year and month in which his tickets will expire and should be returned for renewal and the main subject of interest of the reader, as determined by his vocation and other factors. The example given in section 322 will make this clear.

The life of a reader's ticket may be fixed as 1, 2, or 3 years according to local conditions. The tickets should be initialled and dated by the librarian. When the member comes back to the counter, hand over the tickets to him.

Filing Application Cards

Towards the close of the day, take the application cards of all the members admitted in the course of the day. Arrange one set alphabetically by the names of the members. Arrange the other set by the Member-Numbers. File the former in the alphabetical register of members. File the latter in the classified register of members.

Renewal of Membership

The persons at the charging and discharging counters should detect the Reader's Tickets which are in or after the month of their expiry. The members concerned should be advised to present all their tickets at one time and get them renewed for a further period. As the tickets are renewed, their old application cards may be transferred to their respective new sequences with a note of their dates of transfer and with any alternations that may be necessary in them. It may be a good habit to make a list of the expired admission cards lying in the classified register, find out the members concerned, and get the tickets renewed.

Lost Tickets

The experience with cases of lost tickets in the Madras University Library is of some interest. For some years, the following practice was adopted. Whenever a member notified loss of tickets, he was asked to report at the end of three months the result of his endeavour to trace them out. If, at the end of that period, he was unable to trace them out, duplicate tickets were given without any charge. It was found that this privilege was abused in several ways. After taking the duplicate tickets, the old tickets were also presented. The tickets reported to be lost were sometimes presented by the relatives of the members, the relatives stating that the member gave them the tickets for their use. Some members reported loss of tickets repeatedly almost every year. While the tickets of some members were locked up in the library against overdue charges, they used to come months later with the story that the tickets were lost. Due to one cause or other, notice of lost tickets came to be received almost every week.

Then, it was felt that something should be done to help the formation of a higher sense of responsibility in the matter of library tickets. The practice introduced was to charge a fee for the issue of duplicate tickets and to ask the members to execute an indemnity bond. No doubt, it is not happy to have this procedure. But this practice had the desired result. Notification of loss of tickets fell down largely in numbers.

Observation Slip

When a member notifies loss of a ticket, send him a copy of the rules regarding loss of ticket and the procedure to be followed. Then prepare an Observation Slip. This should have the number of the ticket in the first line, the name of the member in the next line, and the date of notice of the loss of ticket in the third line. The Observation Slips should be kept in the Observation Slips Box in a classified sequence.

Detection Work

As a pick-up work, the person at the discharge-counter should examine the charged tickets-tray to find out if any of the lost tickets lies charged. The man at the charging counter should also have before him a list of the numbers of the lost tickets to facilitate detection in case any of them is presented. When any ticket is presented, it must be filed in the kept-ticket-tray with the necessary note explaining the circumstances of detection. The owner should be notified about it. If any mal-practice is suspected, it should be pursued in a proper way.

Duplicate Ticket

At the expiry of three months, or whatever period is provided therefore in the rules, the member concerned may be asked to make a report about the results of his endeavour to trace the lost ticket. If it is still not found, he may be furnished with a draft form of indemnity bond and asked to produce the bond on the appropriate stamp paper. If the bond is in correct form, he may be asked to pay the duplicate ticket fee prescribed by the rules and then a duplicate ticket may be given to him with the word "duplicate" written across it.

Overdue and other Collections

The Circulation Section is likely to collect money as overdue charges, special deposits, and fees for duplicate tickets. Open the conscience box before the Accounts Section closes for the day. Hand over to the Accountant the total sum received on all the three heads mentioned above. The date and the amount should be entered in the Transmission Register and the signature of the Accountant taken on it in token of his having received the amount.

Overdue Stamps

In case the conscience-box system is not introduced, but the overdue-stamp system is adopted, the Circulation Section should take a permanent advance of overdue stamp books worth Rs 5 or any other amount fixed according to local conditions, from the Accountant. Every evening the maximum integral number of rupees contained in the overdue collections of the day should be given to the Accountant and overdue stamp books of equal value should be taken.

Receipt Book

If the antiquated receipt book system is still insisted on, the entire collections of the day should be remitted to the Accountant each day and the signature of the Accountant should be received not only in the Transmission Register but also on the back of the counter-foil of the last receipt covered by the amount. The Transmission Register may give also the inclusive receipt numbers covering the amount remitted.

Files

File Numbers

The following table gives a scheme for numbering the files of the Circulation Section. The meanings of the terms will be found explained in section 508.

Transfer to Record

All the files of this section are to be transferred to the record sequence one year after it is closed.

Destruction of Record

The files relating to used or permanent bespeaking cards returned by members may be destroyed after one year. All other files may be destroyed after three years.

Forms and Registers

In what follows if the first letter of the code number is 'A', the form is of abnormally small size. If the first letter of the code number is 'C, the form is of card size 75 „ 125 mm. If the first letter of the code number is 'Q', the form is of the quarto size. If the first letter of the code number is 'S', the form is of the folio size.

A66 *Overdue-stamp.* Overdue-stamp should be designed in a form similar to a postage stamp with the coat of arms of the library as the device. The value of each label should be marked as 5 naye paise. They should be bound in booklets of Re 1.

C612 *Bespeaking card.* Printed. 8 point type. Bristol board. White.

One side is reserved for call number, author, and title. The text of the form is as follows:

(Name of the library) (Date)

Dear Sir,

The book mentioned on the other side is now available in the library. Kindly arrange to take it within three days.

The book will not be issued unless this card is produced.

The left half of the other side should have the following words printed:

Call Number

Author

Title

The right half is reserved for address.

Col *Overdue-notice card.* Printed. 8 point type. Bristol board.

White. The text of the form is as follows:

(Name of the library) (Date)

Dear Sir,

The undermentioned book/books due from you on........... has/have not yet been returned. Kindly return it/them immediately along with the overdue charges.

C62 *Application card.* Printed. 8 point type. Bristol board. White. Tray. The text of the form is as follows on one of the sides:

(Name of the library) (Date)

Adm Numb Memb Numb

Name in block letters (write last word first and the other words or initials after it in circular brackets)

House address

Business address

Vocation or subject of main interest

The second and the later lines may be printed so that the last line ends near the bottom of the card. This will leave ample space between the first and the second lines to write revised admission numbers and member-numbers for a number of years.

The text on the other side of the card should be as follows. The unwanted part will be struck off.

I request to be admitted as a member of the........... Public Library and I agree to abide by its rules. I am a tax-payer and I reside in Numb........... of Street of Ward Numb...........

Date Signature

I am a tax-payer and I reside at Numb.............. street of Ward Numb...... The person mentioned above is known to me. I recommend that he be admitted as a member of the library.

Date Signature

C64 *Lost ticket observation slip.* Stencil. Ledger paper. Box. The row headings are to be as follows:

Name of the member

Number of the ticket lost

Date of notice

Date of report of the endeavour to trace cha lost ticket

Date of issue of duplicate

Remarks

Q64 *Overdue register.* Printed. 8 point type. Ledger paper. White. Loose leaf binder.

The number of rules below the column headings is to be 10 on each side. Row headings near the top are to be as follows:

(Name of the library) (Date)

Address................ Name.....................

Deposit Numb Numb and nature of tickets

Below that the following column headings are to be printed:

Call number (4 cm); Due date (2.5 cm); Return date (2.5 cm); Days overdue (1.5 cm); Overdue charge R Np (2.5 cm); Date of collection (2.5 cm) Receipt number (2.5 cm); Remarks (2.5 cm).

Q66 *Miscellaneous receipt book.* Printed. 8 point type. 21-lb printing paper. White. To be bound in booklets of 50. Each sheet is to consist of a receipt form and its counterfoil. The boundary line between the receipt form and the counterfoil is to be perforated. The text of the receipt form is as follows:

(Name of the library)

Ser Numb

Received from.... the sum of R......... Np........ as per details given below:

Special deposit

Fee for.... duplicate ticket

S61 *Gate register.* Printed. Display type. 21 lb printing paper. White. To turn on the longer edge. The number of horizontal lines below the column headings in each side is to be 15 and are to be numbered 1 to 15. The columns are to be parallel to the shorter side.

The column headings are to be:

Ser number (2.5 cm); Name in block letters (7.5 cm); Full address (15 cm); Qualifications (4 cm); Token number (1.5 cm); Remarks (4 cm).

The text of the form above the column headings is to be as follows:

PLEASE WRITE LEGIBLY (Name of the library)

Enter your name and address in token of your agreeing to abide by the rules of the library.

S62 *Loan counting sheet.* The vertical columns may show either each hour or longer intervals for the period when the library is open each day.

A sufficient number of columns may also be provided for the totals at suitable intervals, say one at 9 A M, another at 12 noon, another at 3 PM, another at 6 p M, another at 9 p M, and another for the grand total. In addition it may be advisable that columns may be opened to note the actual number of readers in the library at some important moments to be decided according to local conditions. The row-headings should be the symbols for the main classes of subjects and such of the sub-classes as are of special interest to the locality. In recording the count of books issued, in a particular subject in a particular hour or time interval, the first four strokes may be vertical and the fifth a horizontal one across these four. This will facilitate counting.

S63 *Consultation counting sheet.* This may be similar to the Loan Counting Sheet.

S64 *Circulation diary* (Daily). The main headings of the columns are to be the symbols for the main classes of the subjects and such of the sub-classes as are of special interest to the locality. For each subject heading, the sub-headings should be "Consultation", "Loan" and "Total". There should also be the following additional headings: Grand total with the sub-headings "Consultation," "Loan" and "Total"; Total Number of Readers; Receipt of Inter-Library Loan; and Issue of Inter-Library Loan. The row-headings should be the dates of the month with additional rows interpolated at proper places—for the total of the week and cumulative total for the month at the end of dates 7, 14, 21, 28 and the end of the month.

S65 *Circulation diary* (Monthly). The monthly Circulation Diary should have column-headings similar to the daily circulation diary. Its row-headings should be the months with progressive totals, that is to say January: February; Cumulative total; March; Cumulative total; etc.

S66 *Routine diary.* The column headings should be:

General Correspondence

11 Authorisation letters received; 12 Authorisation fetters disposed; 13 Other letters received; 14 Other letters disposed; 15 Letters originated; 16 Reminders sent.

Renewal and Bespeaking

Renewal requests received; 42 Renewals done; 43 Renewals rejected; 44 Bespeaking requests received; 45 Bespeaking cards sent; 46 Bespeaking cards untraced.

8

Online Libraries and Support System

The magnitude of technological advancement even within the third generation can be shown by comparing two disk transport systems, the IBM 2314 and the IBM 3330, from the late 1961s and early 1970s. The 2314 utilised removable pack; a piece of information could be assessed in an average of 75 milliseconds, and information could be read into memory at a rate in excess of 800,000 characters per second. As processing speeds and storage capabilities were increasing, the size and price of the machinery were decreasing.

By the early 1970s, computers appeared on the market that were comparatively so small and inexpensive that they warranted the label of "minicomputer." Slower and less powerful than their contemporary larger counterparts, minicomputers processed capabilities that matched and exceeded the most sopnisticated second-generation computer of barely a decade before, and at a mere fraction of the price. In a 1977 issue of Library Technology Reports, William Scholtz put the comparison in perspective: In 1960, the IBM 1620 computer needed a room that was approximately 20 by 30 feet... In 1974, a similar machine in terms of capability took up.a space that was approximately 3 feet by 3 feet, [and] could perform identical tasks to those performed by the IBM 1620 in about one quarter the time. And finally, the cost to buy the 1974 machine was about what it cost to rent the IBM 1620 for one month. The main implication of these technological advancements in terms of library application was to usher in the era of online automation. Although the mini-computer would play its own role in this development, earlier online library systems in the last 1960s were based on use of the larger third generation computers. The computers for these systems were shared among a number of users and invariably were located outside the library in a centralised data processing facility. Another difference between second-and third generation facilities was the extent of the latter's timesharing capacity.

Second-generation systems were generally not capable of timesharing; the computer processed one job before moving to the next job in the queue. The remarkable advancements in speed, all tasks associated with design, and storage capacity in third generation systems allowed them to process a number of jobs simultaneously or so it seemed. In actual fact, the computer still performed one task at a time, but could handle several jobs coincidentally and execute tasks so quickly that it appeared to each user that the computer was interacting exclusively with their programmes, files, and commands.

Commercial Online Systems

In fact, commercial enterprise played a pivotal role in library automation long before the advent of online systems. Automation *via* unit-record equipment had been almost the exclusive domain of IBM. Remington Rand offered unit-record equipment comparable to IBMs, but its impact on the library market was negligible. IBM continued its domination into the early 1960s, when offline computer processing came into use in some libraries.

As the decade progressed, however, computers manufactured by other firms began to appear in universities, corporations, and municipal facilities. By the end of the decade, IBM was still the predominant name in computers for library applications, but it no linger maintained the exclusively it had once enjoyed. During its years of dominance, IBM had been responsible in devoting time and effort to assist in applying its equipment to the library environment. Libraries certainly did not receive an undue share of attention, but IBM representative were often assigned to help libraries with implementing applications, and the corporation published descriptions of and guides for use of its equipment in library applications. The company also sponsored seminars, the most notable being a symposium held in Endicott, New York, in 1964.

Although IBM and its new competitors expressed at least nominal interest in library applications during the 1960s, it was evident that this was an infinitesimal share of the total computer market. According to estimates in the early 1970s, less than one-tenth of one percent of the computers in the United States were being using by libraries in the way. To make these facilities still less conductive as a market, even those with computers were inevitably using equipment purchased by host institutions for a variety of applications, the foremost usually not being those of the library. Libraries had little control in either the selection of equipment or in the decision to replace one manufacturer or model with another. As long as large-scale, multipurpose mainframes were the only available computers, libraries were essentially at the mercy of their host institutions.

Although some libraries established excellent relations with their computer centers and did play a role in automation decisions, procurement was an unpredictable and uncontrollable environment for many. The advent of minicomputers radically altered the computer field for libraries, enabling at least the large ones to perhaps purchase their own equipment and create a more predictable environment. A number of libraries did purchase their own equipment and designed applications software in-house in the 1970s, but another alternative began to emerge in that decade-the library specific commercial vendor of automated library systems.

CLSI and Circulation

One early commercial venture came from Computer Library Systems, Inc., later shortened to CL Systems. Inc., and later again simply to CLSI. The company's first automation efforts involved acquisitions systems, and one of its first installations, in 1972, was at the Cleveland Public Library, which had been using a batch processing system on IBM equipment for eight years. In a description of the CLSI system at Cleveland Public, Richard Palmer observed that, over a five-year period, the cost of the new online system was expected to be less than one-half the cost of the IBM batch processing system, had it been continued. In addition, the new system offered broader and more library-specific features. CLSI soon turned its attention toward circulation control. Its LIBS 100 system and other vendor-supplied systems introduced subsequently come to be known as "turnkey," a reference to the premise that, upon delivery and installation, virtually all that was required to make the system work was to plug it in and turn it on.

Although in practice this has not always exactly proved to be the case, the idea was essentially sound and formed the basis on which these systems would become cost-effective alternatives to in-house development. As so many libraries had learned in implementing their own online or even batch processing systems, the cost of design and development were considerable. With a mass-marketed system, such up-front development costs could be distributed among many customers and hence would be far less for each library then independent design and development.

With a turnkey system programming expertise was not required of the library staff or even at the host institution. Perhaps most importantly, the library's minicomputer could be operated and maintained within the library itself, and the software was marketed by vendors whose entire business was specifically library applications. Other vendors joined CLSI in the online circulation control market during the early and mid-1970s, not for several years the field was fairly unstable. Various companies entered and left the market, were purchased by other companies, and radically redesigned their systems. By 1975, five commercial vendors were offering turnkey automated circulation systems with varying degrees of online and offline capacity. Two years later, three of them had cased marketing efforts in the United States and another had been sold and its system totally redesigned. CLSI provided the only continuity in this short span of time. The year 1977 was pivotal, however, in that several new vendors of circulation control systems entered the market and would prove more stable than most of their predecessors. Among these were Data Phase, Geac, and Universal Library Systems. Entering the 1980s, CLSI was still the leading force in the commercial market, with 177 installations and more than 300 other libraries remotely accessing computers located at one of the installation sites.

The fastest growing computer was Data Phase with 50 installations, followed by Geac with 22. Gaylord, active since 1978, had 11 installations by 1981. Although not actively marketing in the United States since about 1977, the Plessey online circulation system popular in Great Britain had 9 users in the United States and Canada.

Acquisitions, Serials Control, and Cataloguing

With the exception of early CLSI efforts, commercial activity in online acquisitions and serials control has lagged behind circulation control and did not really begin to make an impact until the late 1970s and early 1980s. The primary source of commercial developments also differed between the two areas. For the most part, vendor-supplied online circulation control systems have resulted from new commercial ventures into the library marketplace. In acquisitions and serials control, in contrast many of the earliest efforts came from long established library vendors; book jobbers for acquisitions and.subscription agents in serials control.

Baker and Taylor's offline BATAB system was available to libraries since the 1960s, and by the late 1970s the system had been redesigned, enhanced, and offered online as LIBRIS. Around the same time, Brodart also announced availability of an online acquisitions system. By the early 1980s, book jobbers had been joined by other vendors, such as Ringgold and Innovative Interfaces, in offering online acquisitions, as well as by each of the four bibliographic utilities. In addition, several vendors of circulation systems were in the process of testing acquisitions modules, promising even more competition.

Commercially available online serials control systems have appeared comparatively recently, two major subscription agencies, Ebsco and Faxon, each announced plans for an online system in 1981, capable not simply of ordering, but encompassing functions such as check-in and claiming, and not limited to titles ordered through the respective agency. Ebsco eventually abandoned development of its own on line check-in component, while Faxon did incorporate one into its online system. Also in 1981, the MetaMicro Corporation of San Antonio, Texas, announced a serials control software package for minicomputer application, although active marketing of this system eventually ceased. Activity in the not-for-profit sector also showed signs of life in the early 1980s, exemplified by marketing of the CHECKMATE serials control system by the California Library Authority for Systems and Services (CLASS) and by OCLC planning efforts to make its rather dormant serials check-in subsystem more attractive: Changes in the OCLC sub-system were made in 1983, but had a negligible impact in attracting new users.

Although the bibliographic utilities emerges during the 1970s as the clearly predominant supplier of automated cataloguing systems, there were a few commercial attempts to penetrate the cataloguing market. One of these was the BIBNET system, announced by Information Dynamics Corporation in 1974. BIBNET was to operate similarly to OCLC in a number of ways: it was principally intended to be a shared cataloguing database; it was to contain member input master records as well as LC MARC records; the master database was to be stored on centralised computers; and library identifier symbols were to be affixed to each bibliographic record as an aid to interlibrary loan. Several features of BIBNET were plaunyed conspicuously different from DCLC and attempted to answer some of DCLCs more pressing problem areas.

Keyword-in-title search capability was to be available, along with plans for the eventual introduction of subject searching of the database. BIBNET users would be encouraged to access the system though a mini-computer housed in the library to facilitate local production of offline products and to reduce telecommunications cost. By using a minicomputer, libraries could retrieve records from the master database, copy them onto a cassette tape, and then break the telecommunications link.

Master records copied onto the cassette would then be displayed on a CRT terminal connected to the mini-computer, modifications made to the records, and the revised records copied into a second cassette. Catalogue cards and other offline products could be printed locally, based on the modified records on the second cassette. Although access to BIBNET could be gained through means other than a minicomputer, the front-end interface was strongly promoted as the most useful for allowing flexibility. Information Dynamics had ambitious intentions for BIBNET. Not only was it to contain post-1968 LC MARC records, but there was a plan to centrally input access points into the online system for more than 3.5 million.

Library of Congress manual cataloguing records created between 1953 and 1968. When a library retrieved such an index entry, it could notify Information Dynamics through the system that it would like a full record in the database for that title, Information Dynamics would then create a record in MARC format for the title requested and load it into BIBNET within four days. BIBNET'S entry into the marketplace coincided with the rapid and successful expansion of OCLC. The system simply never established a firm position. A more successful venture was launched several years later by Informatics, Inc:, with the introduction of MINIMARC. It was mini-computer-based, but with no pretense as a networking system. The entire LC MARC database was supplied on floppy diskettes. The library retrieved these records locally on its mini-computer and modified them according to need. For titles not found on the LC MARC database, the library could create and input records into its own working file. Catalogue cards and other offline products could be locally produced. Since a premise of MINIMARC was local processing, the system did not incur the telecommunications charges as did use of a bibliographic utility, and the overall cost were not as per-unitdependent.

On the other hand the initial investment could be as tenfold that of joining a bibliographic utility, and monthly maintenance and other costs were substantial enough to make participation in a utility more economical for smaller libraries.

A limiting feature of MINIMARC was that, as a non-networking system, its core database was restricted to LC MARC records and was therefore smaller than those of the bibliographic utilities. Since its emphasis was so much on being a local system, it did not serve in any capacity as an interlibrary loan locational tool. In 1981, however, Informatics, RLG, and the California Library Authority for Systems and Services (CLASS announced availability of 'an interface whereby MINIMARC users would be able to search the RLIN database through, their MINIMARC system equipment, an arrangement that would enhance MINIMARC as a local system with access to a broader utility. By 1981, more than 30 libraries had installed MINIMARC, and the number had increased steadily since then. Another successful commercial venture into automatated cataloguing was the Carrollton Press REMARC project.

In 1980, Carrollton announced a five-year project in which it would convert more than 5 million Library of Congress cataloguing records, not included on MARC, to machine-readable from. Libraries could submit brief data to Carrollton, in either machine-readable, or nonmachine-readable form, to match against both the LC MARC database and the REMARC database being created by Carrollton. For items for which a record could be found, Carrollton would supply machine-readable bibliographic records containing relatively complete LC cataloguing data. In addition to MINIMARC and REMARC as alternatives to the bibliographic utilities, a number of commercial book jobbers and COM vendors were maintaining machine-readable cataloguing databases for their customers. These were really a quite different matter, since initially with these stored databases, a customer did not have direct online access to its own database. This circumstance has been changing, as some of these vendors now provide online access. In the late 1960s, the only choice for libraries implementing an online system was to design and develop it in-house and use a large mainframe computer housed in central facilities at their host institution. During the 1970s, additional alternatives emerged: systems designed and developed be bibliographic utilities and commercial vendors; systems that could be operated on library-owned mini-computers and, more recently, on micro-computers.

What was once a very restricted environment has broadened into a increasing range of options. As with unit-record equipment and batch processing computerised systems, the use of Onfine has been a learning experience for those libraries implementing their own systems, for the bibliographic utilities, and for the commercial vendors.

Libraries implementing online systems in the late 1960s and throughout the 1970s provided a valuable basis of experience upon which other institutions could draw. This building on experience has helped to create a more solid foundation of general principles and specific tenets for automation of technical processing operations, but changes in technology and increasing competition in the marketplace certainly give assurances that the options available to a library are not likely to become stagnant or mundane.

In-house Circulation Developments

Much as with unit-record equipment and computerised online batch processing, the earliest online library system focused on circulation.

Illinois State Library System

One of the first online systems was at the Illinois State Library in Springfield, in late 1966, at a time when many other libraries were designing full offline systems. The backbone of the system was and IBM 1620 computer located in the state processing facility. The equipment in the library consisted of IBM 1033 prints and 1031 card readers, which were similar in operation to the 357 Data Collection System, requiring insertion of machine-readable book cards and borrower identification badges. Rather than producing transaction cards or recording transaction data on tape, however, the 1031 at the Illinois State Library transmitted data directly to the computer. By later standard, the online system at the library was primitive.

Although transaction information was conveyed directly to the computer as it occurred, it was stored on a separate daily transaction pack and was merged with the main circulation file only on a once-a-day batch processing basis. The system did not include item-specific online query, so that it was still necessary to use offline batch-produced circulation lists to trace circulation information pertaining to a given item. For these purposes, the system was much like wholly offline batch processing systems. What set it apart from those, however, was its ability to perform two important functions online: checking borrower registration numbers for validity and checking each returned item against an online holds file.

Each time a borrower identification card was inserted into the designated slot of the 1031, the borrower number was automatically checked against a computer-stored file of valid borrower numbers. If the borrower's number did not have a counterpart in the file, that fact was generated immediately on the 1033 printer. This was a major improvement over completely offline operations. Where such validation, if done at all, could be performed only by manual look up in a printed directory of borrower numbers. The other important online function of the Illinois State Library system was checking holds, and that had equally important implications.

When the book card of a returned item was placed in the 1031 for discharge, the call number was checked against an online list of call numbers of items placed on hold. If the cell number of the returned item matched a call number in the holds file, a message was automatically generated on the 1033 printer showing call number, identification number of the patron who had placed the item on hold, and the data when the hold had been placed. In this manner, greater control over holds was realised than was possible in offline batch processing computerised circulation systems.

Midwestern University System

One more early online circulation system was implemented in late 1967 at Midwestern University in Wichita Falls, Texas. The Midwestern system was unique in that it was, at least insofar as its designers know, the first and perhaps only online circulation system to operate on an IBM 1401 computer, a decidedly second-generation machine. Like the Illinois State Library system, Midwestern used IBM 1031 input stations and 1033 printers, validated borrower identification numbers, and checked items against an online holds file. But it went further than the Illinois system in several important respects. Not only did the Midwestern systems check borrower numbers during a charging operation for general validation, but it also determined if a borrower had any outstanding overdue items or unpaid fines. If so, the computer generated an immediate list of the charges on the 1033 printer. The Midwestern system had an online query capability, albeit restricted to searching on a borrower number. The keying in of a number prompted the computer to respond by printing a list on the 1033 containing all items charged to that borrower. But perhaps the fundamental difference in the Midwestern system was that the main circulation file was online in the strict sense of the term, with the file being updated immediately upon completion of each transaction, rather than in a batch mode.

Eastern Illinois University System

In September 1968, the Booth Library at Eastern Illinois University in Charleston began to operate its own version of a online circulation system using a third generation IBM 360/Model 50 computer and the IBM 1031 input stations and 1033 printers. The Booth system had the basic functional characteristic of the Midwestern system, but with an important additional query feature. The Midwestern system had query capability by patron number; the Booth system supplemented this with item query by call number. By entering a particular two-digit code followed by a call number, a terminal operator could retrieve bibliographic information and current circulation data about a specific item.

A further extension of this search capability was a scanning command that displayed bibliographic entries in call number-sequence. Since the Booth Library online file was an inventory file containing an abbreviated bibliographic record for nearly even item in the library not just items currently charged out-the scanning capability allowed shelflist searching of the entire library collection. The structure and search capabilities of this system suggested possible extension as a public-access tool, and in fact plans were announced to locate a public access CRT terminal near the card catalogue in fall 1971.

Still, the known item query capability of the Eastern. Illinois system allowed more immediate information about the circulation status of an item-ever if the query had to be generated by a circulation attendant-than was possible in an offline system.

Mini-computer-Based Hybrids

By the early 1970s, a number of academic libraries began to incorporate minicomputers in their circulation operations. A significant feature of these systems was that at least part of the processing hardware was located in the library itself, although a larger computer, outside the library, still played an integral role. Typically, the minicomputer in the library contained certain files for immediate online access and captured transaction data for later batch transmission to as larger computer located outside the library on which the main circulation file was stored. One of the most common mini-computers in this type of configuration was the IBM System/7 in use in circulation control in at least six libraries by early 1974. In the system operational at the University of Pennsylvania in Philadelphia, five online files were stored in the minicomputer. Each of these contained critical information against which various types of transactions were checked. There were three item files against which renewal attempts and discharges were checked. A call number file contained the call number of all items placed on hold, the access number file contained a list of all items recalled, and a reserve book file contained all items for which in request had been placed to transfer the item to a reserve book collection upon its return.

Another file, against which all patron identification numbers were checked, was the restricted patron file, containing a lost of borrower identification numbers of all users whose further attempts to charge materials were to be blocked for some reason. The fifth online file was the daily transaction file, which recorded the day's activity. Once a day, this file was transmitted to the main computer, an IBM 370/Model 168, located at the university data processing center, for batch updating of the main circulation file. This transmission, usually involving information for about 3,000 transactions, required about 30 minutes. For the most part, improvements, gained in the Online circulation systems of the late 1960s and early 1970s over what was possible in an offline system were focused on immediate access to information about restricted items, such as holds, and better control of patron privilege.

Although improvements regarding access to information about restricted items enhanced public service by allowing more rapid reshelving of returned items and a better system for regulating holds and ensuring identification upon return, these benefits were not always immediately evident to the average library user. The second common capability, immediate access to Online delinquent patron files, could as likely cause ill feelings as goodwill between the library and its users. The lack of reliable backup measures, inexperience in dealing with online systems, and continued reliance on batch-produced circulation lists combined to make early online circulation systems less than revolutionary in terms of public service.

Ohio State University System

Most probably the outstanding example during the early 1970s of online circulation system that could, facilitate user services; to a degree not possible in an offline system was demonstrated by Ohio State University's Library Control System. The entire philosophy behind the design and 'application of the system for the Ohio State University libraries was, as described by Hugh Atkinson, "that the system should be one which would speak to the problems of its users rather than simply the problems of the library." These problems included, among others, a decentralised library structure consisting of a main library and more than 20 branches.

Only one catalogue—the main library's—contained complete information for all items in all 21 libraries. Similar to several earlier online circulation systems, Ohio State opted for an "inventory" file approach in which the main machine-readable database contained records for all items in the libraries rather than an "absence" file, which would have contained records only for those items in circulation. This principles as fundamental at Ohio State since the system was to be used as a locator file as well as for circulation operations. A massive conversion effort, perhaps the largest of its kind carried out by any library to that date-was contracted to a vendor, which put into machine-readable form records containing call number, unique item number, author, title, date of publication. Library of Congress card number, language code, form of publication code, and holding for each of 1 million distinct titles and 2.5 million items. The key to the Ohio State system was its items query capability. Searching was possible by call number, title key, and a combination author/title key.

When the desired item was retrieved, it was possible to see which library or libraries on campus owned a copy of the item and whether each copy was charged out. Search terminals were available in the main library and in most of the branches. Thus, the entire union catalogue of the libraries' holdings could be assessed from any library in the system. Although this in itself was a fundamental improvement over the single union catalogue in the main library.

An item not already checked out in one library could be charged on terminals located in any a copy was found to be available in a different branch library, the circulation attendant could issue a command that would generate a charge slip in the branch library that had the copy. The item would be retrieved in that library and placed on a shelf to await later pickup by the patron. The online union catalogue, showing location and circulation status of each item throughout the system, combined with the capability of remote charging to remove much of the patron uncertainty that was inherent under prior circumstances. The Ohio State University library system, like all other online system, was not entirely free of problems, but many of them could eventually be alleviated by design changes and the system was such an improvement over earlier conditions that the problems were of comparatively minor consequence. The impact of this system on library service was probably best exemplified by the fact that, during the first 18 months it was in operation, circulation at the Ohio State University libraries increased by more than 40 percent.

The system was an important achievement owing to its scale of implementation, its query capabilities, and its emphasis on public service problem solving. The same system was later taken by Atkinson to the University of Illinois and implemented; today it is the basis of an important networking system in libraries throughout Illinois. Apart from circulation, the late 1960s and early 1970s saw the development of a number of online technical processing systems. One of the earliest acquisitions systems was designed at the Washington State University Library in Pullman and was implemented in 1968; an online serials control system was up and running at University Level in Quebec the same year. Predating both of these was the beginning of a comprehensive online library system at the Redstone Scientific Information Center in Alabama. Some parts of the system, were operational as early as 1966. And by the early 1970s, acquisitions, cataloguing, authority control, serials check-in, and circulation were online.

Offline computerisation had been an important development in acquisitions, providing for machineassisted production of purchase orders, improved methods of fiscal control, and more timely updating and generation of status lists. Still, a significant amount from handling and paper file maintenance remained in many of these systems. The online acquisitions systems developed in the late 1960s and early 1970s represented major improvements by reducing the amount of manual handling and maintenance of paper products, as well as further enhanced those functions that had been performed well in offline computerised system.

Acquisitions

One of the more ambitious projects in the late 1960s was carried out at the Oregon State University Library at Corvallis. Christened LOLITA, this online acquisitions system required nearly seven "staff years" in programming, systems, and clerical labour to develop. It contained three Online files: order/in-process file contained three display screens of information input when an order was placed, and updated as an item passed through the acquisitions and cataloguing procedures: The first screen included basic bibliographic data, the second screen contained accounting data, and the third screen allowed for local cataloguing information such as call number and location.

The amount of time and file maintenance that this system saved the staff, particularly when compared with a manual system, was considerable. LOLITA generated four paper copies of each order, two going to the vendor, one later used as a cataloguing workshop, and one retained as a general hard copy record for the library. The two copies for library use were a reduction over most offline systems, and some libraries went even further. With the online acquisitions systems in use at the University of Massachusetts Library and the Dartmouth College Library, neither library retained any paper copies of the order form in technical processing at all. One of the greatest contributions made by online systems in general was the expansion of access points, and these early acquisition systems were no exception. It was possible with an offline system to produce lists or maintain paper copies of order forms by more than one point of access, such as by order number, author, and title if desired, but that merely increased the number of lists to be consulted or files to be maintained. As a resiilt, the number of listing parameters was usually minimised in offline systems.

In online systems, all files and their indexes could be maintained in the computer, and multiple access points to a single record would not mean an increase in hard copy materials to be consulted or maintained. LOLITA, however, only provided to access points, order number and author, to each record in the system The early online acquisitions systems retained some of the capabilities that had been included in their offline predecessors, but the newer systems were much improved in quality, speed, and ease of handling.

LOLITA, along with several other early systems, provided for handling of partial shipments and authorisation of partial invoice payments, capabilities that were handled, if at all, only with some difficult by offline systems. The fund accounting component of LOLITA was also successful.

A year-end encumbrance report could be generated in 20 minutes, and LOLITA was to only much faster, not also judged more accurate and detailed in a controlled comparison with manual ledgers. Perhaps the most important characteristic of online acquisitions systems was that, in most cases, it was only one part of a broader integrated technical processing system that brought the acquisitions and cataloguing functions closer together.

The online order record, upon receipt of an item, became an online cataloguing record. This greatly reduced duplication between acquisitions and cataloguing and also provided an end product consisting of a machine-readable bibliographic record for each item entering the collection.

In LOLITA, the final steps in the online processing after an item had been received were for a cataloguer to verify the bibliographic information originally entered by the acquisitions department and the complete the record by adding local cataloguing data. The completed record was removed from the online file, but not before it had been copied onto magnetic tape as a permanent machine-readable record.

One of the most comprehensive uses of MARCrecords evolved in the University of Chicago Library Data Management System. Orders could be searched against the MARC files, and there was a retrospective searching capability whereby incoming MARC records were searched against the local bibliographic file to identify previously created local records as potential candidates for bibliographic upgrading by the new matching MARC record. These features in one from or another could be found in other systems, but an interesting feature of the Chicago systems was its use of MARC tapes as a collection development tool.

Subject profiles, defined by Library Congress classification numbers and ranges of numbers, could be maintained online, and each incoming MARC tape was matched against them. The result was an offline list of items falling into each subject profile for use in identifying potential orders for the library. The system also allowed access to these lists online if a bibliographer wished. The system also allowed access to these lists online if a bibliographer wished. Supplementing the LC class number profiles were certain national bibliography online profiles used to identify potential orders from an area studies prospective. In addition to profiles designed to identify items of potential interest for the library, the University of Chicago system also included a capability designed to assist in better control over blanket orders from publishers. The first four digits of an International Standard Book Number (ISBN), MARC field 0207 are unique to each publisher. Each record on the MARC tapes was automatically searched on these first four digits at Chicago.

Bibliographic Utilities

Left with an alternative of in-house, single-library development projects, only the largest and most well endowed libraries could have used an online system for any technical support systems during the 1970s. As early as 1967, however, a second alternative was being formulated, and the outgrowth of this and similar efforts was the evolution of four system—OCLC, RLG, WLN, and UTLAS-whose use by the early 1980s, extended into several thousand libraries on the North American continent.

BALLOTS

Many of the largest research libraries in the United States were interested in the concept of an online integrated technical processing system as early as the mid-1960s, although actual systems could be implemented at these institutions only after several years of planning, design, and experimentation. These of the more well publicised of these large-scale efforts included the Northwestern Online. Total Integrated System (NOTIS), the University of Chicago Library Data Management System mentioned earlier, and Standford University's Bibliographic Automation of Large Library Operations using a Time sharing System (BALLOTS). Without minimising the importance of achievements elsewhere, BALLOTS was perhaps the most sophisticated online technical processing system developed in the early 1970s.

Because of its later adoption as the online bibliographic component of the Research Libraries Group (RLG), its impact on American librarianship during the 1970s and early 1980s has been greater than any other system originally designed for use by a single institution. An experimental version of BALLOTS was brought online as early as 1969, but it was not until 1972, after further design and modification, that the system was dully implemented. It ran on the Standford University campus computer, an IBM 360/Model 67, with a Digital Equipment Corporation PDF 11 mini-computer in the library as a front-end communications processor. The hardware for BALLOTS was in itself an important achievement. The selection of terminals with a programmable capability was based on the design requirements for the terminal display features desired. Two important functional considerations were to allow for protected fields in an online record that could not be modified by a terminal operator, and at the same time to permit line insertion to allow expansion in length of certain non protected fields. At the time BALLOTS was being designed, either one of these further could be incorporated by using a non-programmable terminal, but not a combination of the two.

Only a programmable terminal, such as the Sanders model could allow both protected and expandable fields. In addition, it was possible for several programmable terminals to share a single communications line rather than each requiring its own dedicated line. BALLOTS was designed around several modules and contained four online files critical to technical processing. One was a MARC file, which held the most recent 6 to 12 months of MARC records from the Library of Congress. A second was an In-Process File (IPF), which contained a record for each item anywhere in the processing stage from initiation of an order to final cataloguing. Once received and catalogued, the record was transferred into a third file, the Catalogue Data File (CDF), which contained an online record for each item fully processed on BALLOTS.

Fourth was a Reference File (REF), which included see references, and explanatory and history references. When a request for an order was submitted a terminal operator first searched the MARC file to see if as corresponding MARC record was available. If a match was found, the operator requested an online ordering work form, which contained mnemonic fields into which information could be entered. Appropriate bibliographic data were automatically transferred from the MARC record to the work form, requiring the terminal operator to input only the additional information pertaining to the order, such as vendor code and accounting data.

An online order record could easily be created for an item where there was no available MARC record, but this naturally required more time since bibliographic information had to be supplied from other sources and typed onto the Online work from offline products, such as purchase orders, a cataloguing workslip, and a temporary order slip, were printed each evening for all items entered into the In-Process File during the day. Stanford found the traditional 3" x 5" slip too small for its purposes and, as described by Veaner, "because copies of certain forms no longer had to be filed, the forms themselves could be designed around their data requirements rather than a filing cabinet size." The online order from was updated as its status changed, such as when an item was received.

After receipt was indicated the item was given to the cataloguing department for final processing. One of the helpful features of BALLOTS was its tracing procedure; the location of an item within the processing unit was kept up-to-date online ever to the name of the specific cataloguer handling the final processing. It was the responsibility of the cataloguing department, with item in hand, to verify and, if necessary, modify the information on the online record created in acquisitions and to add any additional pertinent data. Catalogue cards and spine labels were then printed offline, with the day's production of all cataloguing cards sorted into filing order sequence. BALLOTS had a number of built-in features that made input and modification of records easy for a terminal operator and at the same time reduced the likelihood of operator error. Fields that were inappropriate for operator-input or modification were automatically protected so the operator could not even place the cursor in those positions on the screen display. After entering information into a nonprotected field, the operator could move the cursor to the next nonprotected field simply by depressing the shift and tab keys.

Throughout the procedure were default protocols that assumed the operator's next most logical step but these could be overridden by the operator if an item required a typical treatment. The system also had validation capabilities for certain types of information such as account codes. When an account code was entered by an operator onto the online order work from, the system checked the code validity. This check did not prevent a valid inaccurate code from being assigned to an item, but it did insure that nonexistent accounts could not be charged. Ordering selected volumes of a multipart set hard always been a problem in acquisitions systems, but BALLOTS handled this in a way that minimised the work of the terminal operator and still allowed flexibility in subsequent processing. If, for example, volumes 1, 2, 3, 8 and 9 were being ordered, the operator merely typed 1-3 and 8-9 in an appropriate field on the order work from, and the system automatically "exploded"' the record into five distinct records, one for each volume ordered. One of the strongest features of the BALLOTS system was its search retrieval capabilities. Unlike most other technical processing systems.

BALLOTS offered a wide complement of sear fields and allowed searching on truncated words, variant forms of entry, and keywords. A terminal operator could search the MARC file by Library of Congress card number, personal name, corporate or conference name, and title. The Catalogue Data File allowed for searching by all these elements, but also by Library of Congress subject headings, call number, and BALLOTS ID number. Searching of the In-Process and Reference files was more restricted than searching of the Catalogue Data File, but less restrictive than searching the MARC file.

As an automated technical processing system, BALLOTS was a landmark project far more sophisticated than earlier offline systems and more successful than its online contemporaries of the early 1970s. As might be expected, it had a tremendous impaction Stanford's operation, such as integrating technical processing functions more closely than before. The Acquisitions and Cataloguing departments,, although remaining under separate supervision were physically consolidated. They had previously been located on different floors of the library. In addition, the number of staff was reduced. One-third of the staff positions in the Order Division were eliminated, as were several positions that previously had been responsible solely for typing unit entry cards, duplicating and typing headings on them, a sorting them into filing order: all functions that were computerised under BALLOTS.

Although serials control is an integral part of technical processing, development of automated systems for serials handling has usually been carried out somewhat independently of acquisitions and cataloguing. This had been the case with unit-record and offline batch processing systems and was equally typical of online development. Offline systems allowed libraries greater control in some aspects of the serials operation, particularly in claiming, and enabled holdings lists to be updated and printed much more frequently and with far less staff effort than in unit-record systems.

A considerable amount of manual card and paper handling still was required, however, and the offline lists were a problem in that they tended to be generational, with periodic supplements to other periodic supplements to less frequent master cumulations. Online capabilities offered the potential of reducing the amount of handling and making available up-to-date records of holdings in one place. In the early 1970s, and on perhaps a somewhat less dramatic scale, the system developed at the UCLA Biomedical Library was to serials what BALLOTS was to acquisitions and cataloguing and what the Ohio State University system was to circulation.

Although not the first online serials control project to be implemented, the UCLA system was generally considered more sophisticated and flexible than its contemporaries. Design objectives included, among others, the elimination of all card handling and the generation of fewer hard copy lists. By 1972, there were records in the serials control database for about

12,000 titles, slightly more than half the library's current subscriptions. The format of the online records was similar to MARC, but with fewer fields. When an issue of a title was received, the operator retrieved the online record and updated it by keying a simple code. Other codes were defined for updating holdings when back or skipped issues were received. In additional to the check-in operation, the system had automatic overdue detection and binding status monitoring. Keyword searching of the database could be performed, an especially crucial capability given the complexity and similarity of serials titles.

The search component also allowed retrieval of titles by fixed field. Online systems had many advantages over those based entirely on batch processing. The volume of paperwork and hard copy files was reduced, as well as the amount of staff time required for their maintenance. Although the "up-to-the-second information" characteristic of online was highly touted, many of the earlier systems only partially had this capability, as evidenced by some circulation functions that used minicomputers as front-end communications systems.

Nevertheless, even those systems were able to store some of their more critical files in virtually current status. One of the most important characteristics of online systems was search retrieval capability. Again, some of the early ones are very restricted in inquiry capability, but others were considerable sophisticated, such as at Ohio State University, Stanford, and the UCLA Biomedical Library described earlier. The design, implementation and continuing operation of the more sophisticated online systems were landmark achievements, but their costs were correspondingly high. In many instances, funding was aided throng grants or heavily subsidised by the host institution's general operating budget; the costs were far out of reach of the vast majority of libraries. It was estimated, for example, that the continuing production and development costs in operating BALLOTS due a single month in 1974 were $34.225, and this figure pales in comparison to the design and development costs incurred before the system's implementation.

RLIN

The concept of resource sharing was the basis for the formation of a number of formal cooperative ventures during the 1970s. One such, begun in 1974, was the Research Libraries Group (RLG), comprised of Harvard, Yale, Columbia, and the New York Public Library. Its board goals focused on the sharing of resources, collection development, and preservation and conservation of library materials. RLG felt that a common automated bibliographic system would enhance cooperative efforts among member libraries. By early 1978, the four systems under final consideration for adoption included OCLC, Standford's BALLOTS, the University of Chicago

Library Data Management System, and the New York Public Library bibliographic control system. In spring 1978, RLG announced agreement with Stanford for the use of BALLOTS as the group's automated bibliographic component. Although RLG may merely have chosen what it considered to be the best available system, the choice drew strong reactions from within, and outside the group. In June of the year, Harvard announced withdrawal from RLG, although Director of Libraries Douglas Bryant indicated that the choice of BALLOTS was not the motivating factor.

A wide spectrum of emotions was expressed throughout the library community concerning RLG's decision not to go with OCLC, which many saw as the emerging national bibliographic network. In comparing the online features of BALLOTS and OCLC, there is no question that BALLOTS was the far more sophisticated and flexible technical processing system. Unlike OCLC, it also provided for online storage and display of an individual library's cataloguing data in a network environment, as well as other features such as searching by title keyword and subject, not available on OCLC. Although on a smaller scale than OCLC, BALLETS had also proved capable of serving as a shared system as early as 1975 when seven public libraries in California entered into a networking arrangement with Stanford, and the number of libraries using it has increased since then.

The greatest source of resentment among OCLC libraries about RLG's selection of BALLOTS was probably not so much the choice itself as it was the accompanying implicit, and sometimes explicit, attitude that OCLC and its "ditty database" were unacceptable, and that the needs of RLG members were somehow quite apart from those of the rest of the library community-including those of many prestigious research libraries that remained ardent supporters of OCLC. Equally crucial in the reaction, OCLC had come to be recognised by then as much more than a shared cataloguing database. Because of library identifier symbols attached to each bibliographic record, OCLC had grown into a tremendous tool for facilitating interlibrary lending and, to many, was the most current and reliable source of occasional information available in the United States.

The selection of another system by RLG virtually cut off those libraries and their collections from this soiirce of information and ejected a major obstacle to their participation in resource sharing on a broader scale. To many OCLC libraries and even to those using neither system, his detachment seemed a conscious and motivated effort to minimize the role of RLG members in the broader context of American library cooperation.

The reaction to RLG did little at that time or later to discourage the image of elitism. Full membership in RLG, in essence, required a library to be a member of the Association of Research Libraries (ARL), and this restricted potential membership in RLG to a pool of early 100 libraries.

RLG permitted other libraries to apply for participant status, meaning a library could use and contribute cataloguing data, but the feeling was that this did little to soften the image of elitism.

BALLOTS, which in the RLG environment became the Research Libraries Information Network (RL1N), may have been functionally superior to OCLC as a technical processing system, but not all of its distinctions were carried over into the new network. At Stanford, the system had been, and remained, a full technicals processing system, which traced an item and built on its online record from the initial point of ordering to its final point of cataloguing. Crucial in this progression was the In-process File (IFF), described earlier in this chapter. Although any RLIN member library had searching access to Stanford's IFF, there was no capability for other members to build a similar file for their own institutions. Thus, one of the strongest features of the original BALLOTS, which provided the continuity for its realisation a more complete technical processing system, did not exist under RLIN in its earliest manifestation for any library other than Stanford.

OCLC

Although some libraries continued to develop their own in-house systems for certain library functions, it was apparent by the mid-1970s that automated cataloguing in particular was evolving in a different direction. The basis of this transformation was the Ohio College Library Center (OCLC), a system based on the simple premise that, recognising minor local variations, cataloguing data for a given item were essentially similar from library to library. The Library of Congress MARC project had been as major breakthrough in the concept of shared cataloguing information in an automated environment, but the general pattern of sharing had been unidirectional and on an institution-by-institution basis. MARC tapes were sent from the Library of Congress to subscribing institutions, each of which then loaded the tapes and manipulated the data on its own computer.

The idea that evolved for OCLC was a central file of cataloguing records that could be maintained on a single computer system and accessed through terminals sharing dedicated communications line connected to that computer. Not only would this enable libraries to share a MARC file, but it would centralize development costs of the system and virtually eliminated the need for each participating library to use' the host institution's computer system. Because the Library of Congress catalogued only portion of the universe of materials received by libraries, and since the MARC tapes included only the OCLC online system was the capability for allowing original input of records, using the MARC format, by the participating libraries themselves. The impact of this is seen by the fact that even by the end of the decade, less than one-fourth of the master bibliographic records in the OCLC database had been supplied by the Library of Congress.

OCLC was chartered in 1967 and Frederick G. Kilgour named as its executive director. System production first began with offline batch processing in 1970; 54 member academic libraries in Ohio submitted punched IBM cards with Library of Congress card numbers of items for which they wanted catalogue cards produced. The punched cards were searched against a file consisting of the Library of Congress MARC records, and when a match occurred, catalogue cards were generated and sent back to the requesting library within two weeks.

In 1971, OCLC went online, installing terminals that allowed each library to search the growing OCLC Online Union Catalogue (OLUC), the bibliographic database of the system. The library could order catalogue cards merely depressing a couple of command keys on the keyboard attached to the CRT display terminal. During the first several years of OCLC online operation, a number of far-reaching decisions were made that would enhance-and sometimes plague the cooperative effort. The display format revolved around the concept of a bibliographic "master record"; in theory there was to be only one'record in the database for any given bibliographic entity. When this master record for an item was retrieved by a library, any of the MARC fields could be modified to i reflect local practices with respect to subject headings, forms of name entry, local call number, and so on; virtually any element in the record could be modified. All local changes were reflected on the catalogue cards printed I offline at OCLC and mailed to the library (and eventually on the library's magnetic tapes of its cataloguing activity when this service became available). These modifications, however, were not stored permanently online for the library. Therefore, when a library retrieved a record it had previously used for cataloguing, the bibliographic a master record was displayed online, without the local modifications that the library had previously made. The lack of capability to permanently store local information was probably justifiable in OCLC's initial stages.

The amount of storage required to maintain this data for each cataloguing use of each record by each library would have been enormous, especially since most members of OCLC at that time had 'a low incidence of adding copies for titles they had already catalogued once. Nevertheless, it was not long after the system went online that some members began to express concern over the lack of a permanent online record containing local modifications for previously, catalogued materials.

A characteristic of OCLC during the 1970s was a perpetual gap between announced plans and actual implementation, and the permanent storage and display of local cataloguing data-or at least of a scaled-down version of local holdings from selected fields-perhaps provides the most exemplary illustration. In early 1974 "Definition and Use of the 049 Holding Field," detailing a critical field used to record local data for card production and tape purposes, was published by OCLC partially in anticipation of an impending change, which would allow storage and display of modifications to master records. The actual change proved far less than imminent. Five years later, in 1979, OCLC's development schedule projected the capability of local holdings display for current cataloguing records to be available to members in January 1980, with access to local information for previously catalogued materials available sometime later.

But less and less discussion of this capability emanated from corporate headquarters and the capability eventually disappeared from all development schedules. The strategy initially used in creating the online file of bibliographic master records in OCLC revolved around the creation of as large a database as possible in as little time as possible. This may be over generalisation, but there is little doubt that it was prevalent enough so that a great many of the permanent master records entered into the database by member libraries in the early years suffered in quality and completeness of information. Master records, particularly for retrospective cataloguing entered into the database, were frequently created from a description taken solely from the Shelflist card of the first member library to convert the title.

As such, quality and completeness depended in great part on any given library's past shelflisting practices, on the library's policy for input of new records into the database, and, beyond that, on the accuracy of the terminal operator. The philosophy of rapid creation of a database at the expense of detail and completeness of record could be seen in OCLC's approach in 1975 to providing records for serials titles, for which a specifically designed MARC format had only recently become available. To greatly increase the number of serials records in a short time, tapes of the Minnesota Union List of Serials (MULS) were loaded into the OCLC database.

Although MULS contained accurate information as far as it went, it was primarily a locational tool and provided very abbreviated bibliographic data for cataloguing purposes. Perhaps the greatest quality control complication in the long run was the extreme difficulty of upgrading master records when a mistake was detected or information found to be incomplete. Written forms had to be completed by a member library and mailed to OCLC; when received, the master record was examined by OCLC staff and modified according to the reported additions or changes. This process was time-consuming and cumbersome for member libraries, and not exactly a foremost staffing priority at OCLC. The result was that a library could easily retrieve a master record containing an obvious typographical error that presumably had been modified locally by any number of other libraries for their own card production, but that remained in the master record due to backlogs at OCLC in record upgrading. Owing to the prominent role of the OCLC database in the Conversion of Serials (CONSER) project, a limited number of libraries were given the capability of making permanent online modifications to OCLC serials master records from their own terminals, thus bypassing the manual error reporting procedure. This proved a tremendous success. The possibility of enabling a small number of libraries a similar online capability for records in other formats was a topic of discussion for several years, and was finally initiated in mid-1984. The approach used in creating its database and the difficulty in correcting errors in master records earned OCLC a reputation in some quarters as a "dirty database." To be certain, many early records in the database did suffer from lack of quality control.

An often overlooked factor by critics, however, was that OCLC was an experiment without direct precedent and included among its membership a segment of the library community that had virtually no previous experience with any type of library automation. OCLC was not the first online system used for collective representation of cataloguing data from a number of independent libraries, but immediate predecessors were based on centralised input and thus centralised control.

This was quite different from the structure of OCLC, in which any member library could input an original bibliographic master record for an item. Given this degree of autonomy and decentralisation, combined with the lack of previous experience with library automation on the part of most of its members, and a lack of precedence to gauge the implication of shared databases, the early 1970s were an individual and cooperative learning experience for OCLC members which served to demonstrate both the strong points and the problem areas of cooperative ventures in library automation. During its first year of online operation.

OCLC remained a cooperative venture of Ohio academic libraries. During 1972, membership was extended to Ohio non-academic libraries, and in 1973 to libraries outside the state. Although the major computer facilities were to remain centralised at OCLC headquarters, a decentralised approach to the provision of general support services emerged by the mid-1970s. OCLC and various independent state and regional agencies entered into contracts for the broke ring of OCLC services and for provision of training and ongoing assistance. Some of these networks had predated OCLC; others were formed in direct response to the need for an agency to provide OCLC services in a particular area. Two exceptions to the general pattern of independent brokering were the formation of OCLC Western (referred to as PACNET-the OCLC Pacific Network), consisting of several branch offices on the Pacific Coast, and OCLC Europe, both being service agencies under the direct administration of OCLC. The independent affiliate networks, which have usually numbered about 20, have remained administratively separate from OCLC a relationship that has at times worked to the benefit of OCLC and at other times served as a source of conflict. Within four years after OCLC's decision in 1973 to expand its base of participation beyond Ohio, the number of libraries using the system had increased to more than 800.

Increasing numbers of public and special libraries were joining, but the majority of new members continued to be academic libraries. These included many members of the Association of Research Libraries as well as medium-sized university libraries, but an influx of new participants continued from among the ranks of four year colleges, a pattern that underscored OCLCs role in introducing automation into smaller institutions. A major factor in the opportunity for these smaller academic libraries to join OCLC during these years was the availability of the Kellogg Foundation implementation grants.

WLN

During the 1970s, work was also being conducted at the Washington State Library on the design of an online bibliographic system. Supported by a $1.2 million startup grant from the state legislature, the system went online in 1978, the Washington Library Network (WLN) was being used in 12 public and 9 academic libraries in the state, along with 2 libraries in Alaska. Later that year, 3 libraries in Idaho and 1 in Oregon joined WLN. From the start, it was apparent that WLN was a well-designed, and highly sophisticated system. It included retrieval of local information, subject access, and, not long thereafter, authority control. WLN took a cautious approach to building its bibliographic database. As in RUN and OCLC, Library of Congress MARC tapes were loaded, but unlike the other two utilities, WLN established a standing, policy to centrally review all records input by member libraries. In January 1979, the library press reported that the National Library of Australia had signed for membership in WLN had sold its system software to the National Library. The distinction was significant. All three of the major utilities OCLC, RLIN, and WLN-were based on a centralised computer system linked through telecommunications lines to terminals in member libraries; none of the utilities up until that time had attempted to transfer any part of its system for use in another computer. In 1978, it was not entirely clear to American library community what role WLN would assume in national bibliographic networking. Although WLN was focusing on regional cooperation in the

Pacific Northwest, OCLC had also been a geographically limited system at one time, and BALLOTS had been implemented in a single library. It seemed possible that a third nationally competing system may have been emerging in the form of WLN. In 1979, however, the network reaffirmed its regional emphasis, adopting a policy that expansion outside the Pacific Northwest would be restricted to sale of the WLN software in a manner sirmlar to what had taken place with the National Library of Australia. In the years immediately following, a number of such transactions occurred, including sales to the Southeastern Library Network (SOLINET), the University of Illinois, and the University of Missouri. Membership in the WLN network in the Pacific Northwest had increased to 60 members by 1980 and, as OCLC had done slightly more than two years before, WLN modified its government structure to reflect the expansion of its membership base beyond a single state.

UTLAS

Though its impact in the United States has been limited, the University of Toronto library Automated System (UTLAS) was a fourth major online bibliographic networking system to have emerged on the North American continent during the 1970s. Implemented in an online networking mode during the mid-1970s, UTLAS had increased its membership to more than 200 libraries by the end of the decade. UTLAS membership was limited primarily to Canadian libraries, with some important exceptions.

In 1980, the network signed its first member in the United States, the Rochester, New York, Institute of Technology. The following year, UTLAS signed a million-dollar agreement with a Japanese firm to broker UTLAS in Japan. The system did not make concerted efforts to expand into the United States, but it is noteworthy that in 1981, in a comprehensive comparison of the four major utilities, the University of California at Berkeley ranked UTLAS first in overall technical capability.

The University did not, however, opt for UTLAS. In 1984, UTLAS opened a U.S. branch office in New York, and it will be interesting to see what impact this will have on its position in the nation. Over the years, each of the four bibliographic utilities has strived to become more than simply a shared cataloguing database. Development efforts by one or more have gone into acquisitions subsystems, serials check-in capabilities, circulation systems, interlibrary loan communications, online union lists, provision of Computer Output Microform (COM) catalogues, and terminal compatibility for searching other databases.

WLN, OCLC, and RLIN made a tremendous impact on librarianship in the United States during the 1970s in terms of providing online cataloguing capabilities, but their impact in circulation control, acquisitions, and serials check-in was negligible. Some libraries continued to develop their own in-house systems to handle these functions. However, another alternative emerged, particularly in the area of online circulation, in the form of commercial vendors of automated library systems.

Copy Cataloguing Procedures

In speaking simple words, the purpose of copy cataloguing is to provide bibliographic access to books and other library materials and to get those materials to the shelves and available for use in a timely fashion. The final product of the copy cataloguing process is a bibliographic record, the final form of which is either a catalogue process is a bibliographic record, produced through the adaptation of an existing catalogue record ("copy") to local standards. Access to existing records is made possible through computer terminal connected to a bibliographic utility.

Records in these huge database may appear in various levels of completeness and are contributed through two primary source: (1) The Library of Congress ("LC copy"), and (2) individual libraries representing members of the bibliographic records through such utilities has made possible the practice of "shared cataloguing" and has made revolutionised cataloguing for an item is replaced with the more streamlined task if reviewing and modifying existing records. The typical copy cataloguing operation includes the following basic components:

(a) Staff copy cataloguers, supervisors, and so forth.

(b) Terminals for access to a bibliographic utility.

(c) Agreed upon criteria for judging acceptable or usable copy; that is, which types of catalogue records can be accepted without review and which require a more through review to verify the accuracy and appropriateness of the various record components.

(d) Procedures for searching and identifying the various types of copy.

(e) Policies and procedures for the dispensation of materials for which usable copy cannot be found: for example, route material for original cataloguing, or store material in holding are for processing at a later date.

(f) Optional procedures for simply copy cataloguing *(e.g.,* procedures for editing and adapting LC contributed copy) and complex copy cataloguing *(e.g.,* procedures for editing and adapting member contributed copy).

(g) Cataloguing priorities: which types of material will receive priority attention and which can be deferred until a later date. For example, materials destined for a course reserve or reference location are often catalogued before other material.

(h) Materials to be catalogued: Ihe copy cataloguing operation is supplied books and other materials from several source-new purchases, gift collections, temporary "holding areas" (materials awaiting the availability of catalogue copy), and backlogs.

(i) Cataloguing standards and others support documents: for example, Anglo American Cataloguing Rules-2nd edition (AACR2), international standard Book Description (ISBD), Library of Congress subject Heading (LCSH), Cataloguing service bulletin (CSB), training manuals. Local cataloguing practice manual, OCLC/LC MARC formats, Library of Congress (LC) class schedules, technical bulletins, and so forth.

Optional activities often associated with the copy cataloguing operation include: catalogue maintains; processing and final shelf preparation of materials *e.g.,* property stamping, call number labelling, etc.); and procedures for the processing of added copies, added, volumes, withdrawals, and transfers.

Typical Copy Cataloguing Workflow

Detailed procedures for recorded editing and criteria for evaluating acceptable or usable copy vary local policy and practice (for an excellent treatment of specific cataloguing procedures). While local variations exist, a typical workflow sequence for the copy cataloguing of library materials is as follows:

(a) Conduct search for copy on bibliographic utility. This step can be done at the library's options either in the acquisitions department (per-order searching) or the copy cataloguing unit at one of several points in the cataloguing workflow.

(b) Check local catalogue/shelflist, if necessary, to identify current holdings and to avoided call number duplication. (Checking for call number duplication is often not done when using LC copy; rather, bibliographic records are checked for duplicate numbers at the time of filing or during the loading of tapes in to the online catalogue.)

(c) Distribute materials to appropriate units and staff. The routing of materials is often based on the nature and complexity of the available copy.

(d) Check local authority file, if necessary to verify headings and access points.

(e) Edit record online: verify and/or complete descriptive cataloguing, subject cataloguing and classification, assign, accession numbers (e.g., OCRs barcodes), produce cards and/or machine readable records (distributed by the bibliographic utility).

(f) Route material to appropriate unit for physical processing and shelf preparation.

(g) Receive catalogue/shelf cards or machine-readable tapes from the bibliographic utility. Verify records against input records (e.g., purchase order, work form, tag-sheet) and spot-check for errors while filing in the catalogue/shelflist. Verify machine-readable records as they are loaded in to the online catalogue (generally-accomplished through a computer programme).

(h) Route material for which no usable record could be found to a temporary "holding area". Search one or more times, at predetermined intervals, for usable copy.

(i) If copy can still not be found after a predetermined interval, route the material on for original cataloguing.

Available Copy

On a procedural level identifying the type of copy becomes somewhat more complex. Examples of several basic type of catalogue copy include: LC/AACR2,LC/PreAACR2, CIP (LC Cataloguing in publication), member contributed, UK-MARC, minimal versus full level cataloguing, and similar edition ("close copy").

Copy cataloguers must be trained to recognize these and other variant forms of catalogue copy. Procedures are designed to handle general classes of copy based on the relative complexity of the editing process and degree of expertise required on the part of the cataloguer. Various criteria determine the. acceptability of each type of copy and prescribe the procedures for adapting the record for local use. For example, UK-MARC often requires more extensive verification and augmentation of headings, LC/CIP requires the completion of several fields within the record, and pre-AACR2 copy may require updating to AACR2 form.

The criteria which define "acceptable" or "usable" copy vary among libraries and are depend on local cataloguing standards/practice, online catalogue capabilities, and network regulations. Often, locally established criteria are a function of the library's perception of the relative quality (accuracy and completeness) reflected in records of different types and forms various sources. For example, full-Ievel/LC/AACR2 records are often accepted virtually as is, while member-contributed copy is subjected to closer scrutiny. The final judgment as to what constitutes acceptable copy often boils down to how much "quality" the library can afford; verification and editing of records increases both the time and cost associated with cataloguing materials and getting them to the shelves. While judgments concerning acceptable copy are often subjective, some libraries have taken a more empirical approach. For example, a list of likely source of copy is drawn up and a random sample of records from each source of copy is drawn up and a random sample both as to the type and number of cataloguing errors.

Each source is then ranked in order or overall record quality. Thus, copy from the high-ranking "reliable" source can be processed with minimal verification and editing, while those prone to error can be subjected to closer scrutiny. Although such statistical techniques offer useful objective data, the process of setting local policy continues to require considerable judgment and consideration of local needs and conditions. Particularly relevant are the capabilities of the local catalogue. Many online catalogues now offer a vast improvement in retrieval capabilities over the conventional card catalogue.

With such powerful features, as keyword searching, Boolean searching, and the ability to search virtual all components of a bibliographic records, errors or omissions that would have rendered the record irretrievable to the patron using, the card catalogue may be not at all critical in the online environment. Copy cataloguing policy should attempt to find the optimal balance 3 among cataloguing efficiency, retrieval capabilities, and the usefulness of the information contained in the bibliographic record. In addition to defending the criteria for usable copy, procedures must be implemented for handling materials for which no usable record can be found.

Among ARL libraries, holding periods of three to twelve months are typical. This is particularly true for non-English language material. The advantage of this practice is that expensive original cataloguing is avoided.

Major disadvantages are that the materials is not available for patron use until months later when it is eventually catalogued, and that material in holding areas must be balanced against the cost and the feasibility of performing original cataloguing. Libraries may choose to shelve metrical for which copy not be found by date of receipt and to retrieves such items from the holding areas upon patron request. This presumes that the patron has some way of determining that the library owns a particular item-perhaps through access to an automated acquisition system that identifies new receipts. Alternatively, brief bibliographic records can be keyed in to becomes available, a full-level record can be adapted and used to replace the interim record. The practice of creating less than full-level bibliographic records is fairly controversial. Proponents argue that materials can be made available to the patron via online access to minimal level records until such time as these records can be upgraded, generally through a machine match and overlay process typically possible with online catalogues.

Material Distribution

After materials are received from acquisitions and the search for usable copy has been performed, materials are distributed to the appropriate cataloguing units and staff. While the criteria for distribution vary among libraries, it is essentially the perceive level of cataloguing difficulty which determines the appropriate destination.

Copy Editing

Dowell's *Cataloguing With Copy* (1976) provides an indepth analysis of the process and can offer the reader complete coverage of this fine art. The basic steps in a typical copy editing process might be as follows. The item in hand is searched on a bibliographic utility *(e.g.,* OLC, RLIN) and a matching record displayed. This step may be simplified if the item has already been searched by acquisitions or a searching unit. In such cases, a numerical search key (LC card #, OCLC #) would have been recorded on any slips *(e.g.,* purchase order) accompanying the item. The record is examined carefully to verify.that the records does indeed match the item in hand and to item the source and type of record. For example, a full-level/AACR2/LC record can be identified by verifying that the fixed field element "encoding level"= "blank", the "description"= "a," and the 020 field = DLC/DLC.

Depending on the source and type of copy, and the local policies regarding such, a predetermined list of specific record fields and elements are examined for accuracy and completeness. For instance, if a full-level AACR2/LC record (not in series) is found, abbreviated procedures involving a minimum of checking can be followed. The copy cataloguer will quickly verify the fixed element "language code" and "date of publication" to ensure that they match the piece in hand. Next, the cataloguer will check the 050 (LC call number) for accuracy of format and then scan the IXX field (author), 245 field (title), 250 field (edition statement), and 260 fields (place and data of publication) for typographical errors, accuracy, and completeness. Any discrepancy in edition is detected at this point.

Finally, the 049 fields is edited to reflect local holding and, optionally, a 949 field added to provide item specific information such as OCRTbarcodes number (accession number for circulation), branch location, media code, price, and so on. The cataloguer completes the process by invoking the "produce" function. Shelf/catalogue cards and/or machine-readable tapes containing the edited records are sent by the bibliographic utility to the library generally more within a week or two. The process is generally more complex for member-contributed copy or less than full-level records.. For example, the 300 fields (physical description) must be completed for LC/CIP records; the subject heading fields (6XX) may need to be require additional attention, and so on. A question often asked is how much of a bibliographic record can be accepted without checking? There is no single answer to this. The answer depends on the source and type of copy, the library's perception judgment as to the accuracy and completeness of the copy, the level of staffing and other resources the library can afford to devote to copy cataloguing, the patron population served and their particular information needs, the library's definition of the minimal acceptable level of service and access to information, the storage and retrieval capabilities of the local catalogue, and the "local culture" and its philosophy regarding the broader issue of bibliographic control.

The subject remains a hotly debated issue and has led many to rethink conventional wisdom regarding traditional access points and record content.

Cataloguing Priorities

Cataloguing priorities may be based on such considerations as the following.

(a) Imprint *(i.e.,* the timeliness of the publication). New material is often given top priority. Material from backlogs may be done only after all other types of material have been catalogued.

(b) "Rush" materials, patron requests and "notifications", as well as cataloguing for a branch library or a reference location are often given special consideration.

(c) Relation of the item to the collection *(e.g.,* as determined by collection development subject specialists).

Whatever, the basis for the cataloguing priorities, they should be clear, will documented, and communicated to all interested individuals and departments that allows the copy cataloguers and other staff to easily recognize the treatment and priority that specific items should receive. This is typically achieved through the use of coloured 'flags" or specially designed forms that are clearly labelled as to the intended treatment and which include any additional information required to process the item accordingly.

A well documented and publicised policy regarding cataloguing priorities becomes critical when the volume of material exceeds the cataloguing capacity of the department. Under such conditions, the issues involved can become quite sensitive politically as various interest groups attempt to win priority attention for their materials; very few individuals want to see their new receipts relegated to a backlog. It becomes very important to negotiate mutually acceptable priorities which are perceived by all interest groups as being, if not ideal, at least rational and equitable. While well formed cataloguing priorities are important, one must guard against policies that are exceedingly rigid.

A certain amount of flexibility must be built in to the system in order to allow the copy cataloguing manager to adjust workflows around changing conditions. The inflow of materials will vary over time, not only in volume but in the relative composition of material type and the sources of cataloguing copy.

For example, a recently received collection donated as a gift may include many items for which only member contributed or pre-AACR2 copy is available. In order to avoid flooding the unit responsible for this type of material, items from the collection may have to be fed gradually in to the workflow while others remain in a temporary backlog. Last but not least, things should be kept simple. While it is tempting to try to accommodate all interests when negotiating priorities, too many exceptions and special treatments introduced in to the workflow can degrade the performance of the entire operation and, in the end, result in poor service for all parties involved.

Staffing and Training

Copy cataloguing is done by the full range of staffing levels ranging from student assistants and clerical staff to para professional and professional staff. As with other aspects of copy cataloguing, the level of staff deemed appropriate for a given level of cataloguing complexity varies among libraries. Generally, clerical staff and beginning level paraprofessionals are thought by most to be well equipped to handle abbreviated copy cataloguing procedures, such as those used in adapting LC copy. Intermediate and higher levels of paraprofessional staff are thought more appropriate for working with member contributed copy and with more complex problems of yet higher complexity, such as those associated with classification or the establishment of subject headings ate often reserved for professionals or the highest level paraprofessional staff.

In a typical arrangement, the copy cataloguing department is headed by a professional, with individual units supervised by high level para-professionals. Because the definition of staffing levels oil essentially an arbitrary local distinction, perhaps the more relevant issue concerns the level of knowledge and expertise required. Depending on the relative complexity of the cataloguing task at hand, staff require varying leave's of familiarity with such codes and standard as AACR2 (as-well-as earlier codes), International Standards Book De cription (ISBD), LC/MARC formats, library of Congress Subjects Headings. (LCSH), and LC classification schedules.

At the simplest levels, staff with little exposure to the full breadth of these codes may be able to do an acceptable job of copy cataloguing if provides with clear and simple decision rule-based instructions. These instructions allow minimal latitude for judgment on the part of the cataloguers and limits their actions to those prescribed by specific "if-then" rules.

Any situations that fall outside of the prescribed decision-rules are referred to staff members of higher expertise. As the level of cataloguing complexity increases, so too do the requirements for expertise and familiarity with the various code and standards. The managements challenge then is to match knowledge requirements with specific levels of task complexity. Dowell's *Cataloguing with Copy* (1976) includes a chart and checklist relating just such specific knowledge requirements with the various tasks associated with copy cataloguing.

The first chapter identifies the following task components of cataloguing: filing; filing to catch discrepancies; preliminary checking of entry points given on outside cataloguing matching description between item and outside copy; making simple corrections on outside copy or completing CIP; making major changes on outside copy; adding notes concerning contents and relation to other publications; making cross-reference for names, series, or local use; making additional added entries; adapting suggested classification numbers to local use; performing original descriptive cataloguing; assigning original subject heading and assigning original call numbers. Using the task components and suggested knowledge requirements as a guide, the manager must go on to fine-tune the training of copy cataloguers and adjust staffing levels to reflect local needs, quality standards, and policy of cataloguing.

Training

Most libraries employ a one-one training programme that moves from simple to more complex copy cataloguing over a period which varies from three to twelve months. Usually under the tutelage of a high-level paraprofessional or professional, the trainee is first'taught the basics of searching the bibliographic utility (e.g., OCLC, RLIN). After mastering the art of moving about in the database, the trainee is then taught to recognize the various types and sources of cataloguing copy-first and foremost, to recognize fulI-level/AACR2/LC copy. The next step is to begin to learn the steps in editing simple LC copy and saving the results in a "save" queue for review by the instructor at a later date (usually the end of the day). This process, known as "revision" continues until the instructor is confident that the trainee has mastered the concepts and procedures involved.

A similar process of training, practice, and revision is then followed for more complex cataloguing such as CIP, preAACR2 LC, and member-contributed copy. Such training is quite time consuming. Following periods of heavy staff turnover, the cataloguing instructors may find themselves doing nothing but training new staff, with little or no time to perform their own cataloguing. A few libraries have developed accelerated programmes for training a large number of new staff for such occasion or during the start-up of a new department. Pennsylvania state University Library, for example, has developed a training programme that is based on a combination of classroom course, computer assisted exercises, hands-on experience, and small group instruction.

Staff Requirement

Both the level and number of staff should be matched to local cataloguing volume and workflow patterns. Variables to consider include the relative frequency of various material types *(e.g.,* books, microfilms, serials), the ratio of acceptable copy to adaptable copy *(e.g.,* the percent of materials with full-level LC copy versus member contributed copy); the language of the material, the presence of any backlogs, the total volume of material to be catalogued, and the degree of fluctuation in the receipt of materials. For example, a department with a separate unit for cataloguing with LC copy and another for member-based cataloguing, will want to adjust staffing so that the capacity 'of each unit marches the relative proportions of LIC and member copy associated with incoming materials. If such coordination is not made, one unit is in danger of being overwhelmed while the other units is searching for materials to catalogue.

No doubt, the problem here is that non of these variables remain static-equation budgets fluctuate, spending on new receipts is generally heavier at the beginning of the fiscal year than at the end, backlogs shrink or are eliminated, unexpected gift collection may be donated, changes in approval plan profiles are made, a change in collection development emphasis may change the proportions of English and non-English receipts, and so forth. Such uncontrollable variables underscore the importance of building flexibility in to the organisation of the copy cataloguing department, the training of staff, and the design of workflow.

Organising the Copy Cataloguing Operation

Several basis choices are available for organising a copy cataloguing department or unit. Among ARL libraries, the following are the most common dimensions by which organisational structure vary.

(a) Centralisation or decentralisation of cataloguing operations.

(b) Organisation by either "form" (e.g., separate units for monographs and serials) or by "function" (e.g., acquisitions, cataloguing).

(c) Separate or integrated cataloguing operations. Original cataloguing and copy cataloguing can be combined into one department or organised separately.

(d) Separate or integrated procedures for variant types and sources of copy. Simple (e.g., LC copy) and complex (e.g., member copy) cataloguing can be integrated it, to one unit with each cataloguers performing both levels as required, or separate units can be established.

(e) Interface with other departments such as acquisitions, processing, original cataloguing, catalogue maintains. (Interdepartmental communication is important. For example, policies need to be coordinated with the circulation department regarding procedures such as catalogue before or after the binding process).

(f) Procedures for finding usable copy. For example, pre-order or post-receipt searching can be then be "flagged" to identity the matching record before reaching the copy cataloguing department, separate search and distribution units can be set up specifically for verifying the availability and identifying the nature of cataloguing copy.

A major that governs the choice regarding the letter dimension is to avoid duplication of effort in having to search and research the same item at multiple stages in the cataloguing of an item. A related workflow variable concerns the disposition of materials for which no usable copy can be found. A common practice is to send lower priority material to a backlog and routinely research them at periodic intervals. Such practice have involved out of the need to reduce the volume of material requiring original cataloguing.

(a) Authority work may be integrated in to normal copy cataloguing routines or handled by separate units (e.g., original cataloguing, catalogue maintenance, or an authority control unit).

(b) Input and edit. Some libraries prefer to separate the intellectual function of reviewing and adapting a catalogue record from the actual inputting and outline editing. Copy cataloguers will adapt usable copy and record the necessary changes on a workform which can then be passed on to clerical staff for input in to the database. Other libraries seek to avoid the redundancy inherent in this practice by having the record called up only once and edited immediately by the cataloguer.

The choice of organisational options discussed above will differ from library to library and is influenced by a variety of local needs, resources, and considerations. First among these variables is the library's definition of "copy". While variables such as library size, number of branches, number of volumes, staff size, and budget are often cited as bases for overall organisational design of cataloguing operations, the organisation workflows and individual processing units is influenced most by how a library defines the various types of copy and the relate complexity involved in adapting each type of copy to local standards. Typically, a distinction is made between LC and member contributed copy. Either separate procedures, or in some cases separate units are then designed to process each type of cataloguing one for processing LC-based copy, the other for adapting member contributed copy.

Establishing separate units has the advantage of allowing the less complex cataloguing to be done without delay; that is, materials for which LC copy is available is not held up by the more the time-consuming member-based cataloguing. This is consistent with the traditional productionline maxim the asserts that "the entire process can go only as the slowest step "By eliminating the bottlenecks created by the more time-consuming cataloguing, materials for which readily usable coy available can be catalogued and sent to the shelves with minimal delay. An additional advantage of establishing separate is that different staffing levels can be employed.

For example, entry level paraprofessionals may be trained to perform the LC-based cataloguing, while the more highly paid intermediate and upper level paraprofessionals are reserved for more complex cataloguing. Staffing costs, as well as training time, can be minimised. Such a separation of units, however, is not without certain drawbacks. The efficiency of this arrangement hold up as long as materials representing both types of copy (LC and member) are readily available and the cap of each unit is well matched to the existing workflow. (The existence of a large backlogs is ideal for this arrangement. As fluctuations in new recipes result in shortage of LC copy, the backlogs can be tapped to keep the units adequately supplied).

If either class of copy (usually LC) falls off, the result will be excess capacity and idle staff in one of the units. A single integrated unit, with each cataloguers doing all classes of copy, 'has the advantage of greater flexibility in adapting to fluctuations in the number and nature of incoming material.

Thus, if separate units are employed, it is important to build flexibility in to the procedures and to identify alternative activities for staff during such fluctuations. Other variables that come in to play when considering alternative organisational designs, staffing needs, and required resource include the following.

Library Collections: What special interest must be served? Will cataloguing be done for departments such as special collections, reference, or branch libraries? What special needs and turnaround times are involved?

Format of Material: Will the copy cataloguing department process only book-format monographs? Or, Online Technical Support Systems will the workflow include music. Audio-visual materials, microform, and so on?

Language or Alphabet of Material: Are non-English language or non-Roman aplhated materials catalogued or sent on to other special units? What priority do these materials receive?

Other Produces: Will the copy cataloguing department have to perform transfers, withdraws, added-copy or added-volume routines?

Subject of Materials: Should separate units or staff designated to handle ('different subject areas such as Humanities, Science, or Literature?

All of these variables must be considered in light of the availability of staff—staff competent and trained to work with foreign languages, specific areas, and the various MARC formats.

Productivity and Performance Standards

Automation offers the potential for improved statistical reporting function for better management decisions and control. Whether manually or through the local automated system, data should be collected and analysed as a means of providing the manager with relevant feedback on the efficiency of various operations. Data typically collected includes the total number of titles/volumes catalogued by each cataloguers, unit, department, and so forth.

The record count might also include a breakdown of materials catalogued by class number *(e.g.,* for collection development use). Online capabilities may also include a management report utility capable of generating a variety of statistical summaries and analyses. In addition to raw counts of performance data, the report may include various numerical analyse (e.g., the ratio or percentage of LC to member copy, average titles catalogued per full-time equivalent staff, average titles catalogued per hour, etc.). If the local online system cannot provide such management reports, data can be recorded on specially designed forms and later input in to a microcomputerbased speradsheet *(e.g.,* Lotus 1-2-3, Super Calc). Typically, individuals cataloguers record their production statistic at the end of each month.

Productivity Standards

A 1984 survey of 27 libraries (participants in meeting of the RTSD/ CCS copy Cataloguing Discussion Group) found that of the 13,000 to 96,000 titles catalogued annually, copy cataloguing (22,000 to 72,000 titles) accounted for approximately 64 percent of these totals (Hudson 1986). The survey also reports a range of 769 to 6,000 titles produced per copy cataloguer (FTE) per year. It is difficult to make any general statements concerning average productivity levels.

The actual productivity of individual cataloguers depends, among other things, on the level of cataloguing complexity. Production statistics gathered between 1986 and 1988 at Arizona State University Library, for example, show that cataloguers adapting LC copy can produce 500-700 titles per month (with five, four-hour cataloguing sessions at the terminal per week), whereas cataloguers working with member copy average about 300 titles per month (based on five, three-hour terminal sessions per week). These levels, however, will vary greatly with local practice, the number and length of terminal sessions, and the organisational structure of the copy cataloguing operation.

Quality Control

Performance is not measured only in terms of total titles catalogued. The accuracy and completeness ("quality") of the bibliographic record should also be of significant concern to the copy cataloguing manager. Finding and maintaining the optimal balance between cataloguing productivity and cataloguing quality is one of the more challenges aspects of maintaining the cataloguing operation. The means of monitoring cataloguing quality very among libraries. A typical methods is to match each newly produced shelflist card against the record of original input (e.g., purchase order, workform) and to revise (make corrections) during the filing of cards in the shelflist or catalogue.

In an automated environment, records can be reviewed online and on "error reports" produced during the loading of each new tape of catalogue records. These methods tend to be rather informal and focus primarily on catching highly noticeable errors. Libraries may also purse a more systematic approach to quality control. For example, libraries may require cataloguers to revise the filing in the public catalogue on a periodic basis (e.g., weekly). Other approaches involve taking periodic random sampling of the catalogues/shelfiists or of the records produced by individual cataloguers. The sampled records are then thoroughly reviewed for accuracy and completeness. These more systematic approach require a significant investment of time and expense. The costs involved should be weighed against the marginal increase in cataloguing quality.

Systems Analysis and Design

The copy cataloguing operation can be quite complex, making it difficult for the manager to identify ways in which procedures or workflows can be improved. While improvements can be made through a more intuitive approach, formal system analysis techniques can help identify bottlenecks radiance that might otherwise go undetected.

Among these techniques, flowcharting is perhaps the most popular and useful. Through the flowcharting process, each individual action (task) and decision is identified and placed in precise sequence to other steps in the process. The flowchart's graphic depiction of the steps in the cataloguing process make it easier for the manager to spot weakness in the workflow design. Systems analysis techniques such as flowcharting also offer an excellent way to document the copy cataloguing operation and should be included with any textual material such as procedure manuals. Training of new personnel can be enhanced through the clear picture of the cataloguing process that the flowchart provides. In addition to the finished product, the flowcharting process itself can be an invaluable exercise in that to forces one to thoroughly examine and understand each step in a process. Flowcharting enthusiasts, in fact, are found of claiming that "if you can't flowchart it, you don't understand it".

Copy Cataloguing Organisational Models

While the organisation of the copy cataloguing operation varies among libraries, the general components and principles involved can be seen in several variations on a common theme. Components of a typical organisational model appear below.

Search and Distribution Unit: Searches bibliographic utility for copy, identifies nature of copy *(e.g.,* LC/AACR2,CIP, member), and routes material to appropriate processing unit based on locally establishing criteria.

Copy Cataloguing Unit(s): Many libraries have their abbreviated procedures or separate units for cataloguing materials for which full level, AACR2 LC copy is available (typically called "fast" or" rapid" cataloguing).

Maintenance/Bibliographic Support: Performs support functions for the units such as typing and filling in the public catalogue, shelflist, and authority file; maintains the local catalogues and files (both online and manual) through the addition, deletion, and correction of bibliographic and authority records.

Added Copy/Added Volume, Withdrawals, Transfers: Often, performed either in the catalogue maintains unit or the copy cataloguing units.

Marketing and Physical Processing: Often part of or closely associated with the copy cataloguing units. (Error in call numbers are often detected during the marking process; this step may serve as an additional quality control mechanism for the copy cataloguing units).

Education Through Digital Libraries

Is there any one among us today who does not believe that education and learning are lifelong pursuits? As one of our hosts in Japan commented "They [education and learning] will be the huge market for digital libraries when distributed digital libraries and information work technologies are available to content creators." Distributed digital libraries also have the potential to revolutionize education and learning, so there is a healthy symbiotic relationship among education and learning and digital libraries, a relationship that is in its infancy.

Upon returning to the United States, after visiting Japan as a member of the WTEC panel, this author undertook a modest literature search to learn more about U.S. efforts in education using digital libraries. It was found that a lot is happening in the United States, whereas, based on the panel's trip to Japan, it seems that not as much is happening there.

Education Using Digital Libraries in the United States

This section summarizes what was found in the literature search, and in discussions with some educators at the University of Southern California, by answering the following questions:

1. What are the roles that digital libraries can play in education?
2. What are some unique characteristics of online materials and some important reasons for excitement about digital libraries and education?
3. Will digital libraries mean education and learning as usual; or, can digital libraries change the ways in which people are educated?
4. Are there fundamental questions regarding guidelines and design standards for teaching and learning materials to support inquiry using digital libraries, or through other online resources?
5. What are the technical problems that need to be overcome to make education using digital libraries a reality?
6. Are there any cautionary messages?

While some would argue that the Web is not equivalent to digital libraries, it is generally agreed that the Web is and will be the deliverer of digital libraries to people; hence, at some point the distinction between digital libraries and the Web blurs. This is especially true when the definition of digital libraries is broadened to include digitised materials not found in any "conventional" library, e.g., NASA's remote sensing records, student-generated articles that result from using already-existing digital libraries, etc. Hence, some of the following comments are taken from articles that focus a lot on the Web and digital libraries.

There seems to be general agreement that digital libraries can play three roles in education (e.g., Masullo and Mack 1996):

- as a resource for teaching (curriculum development)
- as an environment for learning (student experience)
- as an authoring space (again, in support of student experience).

Unique Characteristics of Online Materials

The University of Michigan Digital Library Web page (UMDL n.d.) and Wallace, et al. (1996) succinctly summarize the following six important features of digital libraries that make them significantly different from traditional libraries in ways which support student learners:

- content is current
- content can be from primary resources
- content is comprehensive

- resources are presented in various formats
- student can publish them online
- content is readily accessible.

To this list can be added re-use of teaching resources. This is the feature being focused on by the EduPort project, whose goal is to support re-use of teaching resources by reflecting teachers' experiences with materials acquired from digital libraries (Masullo and Mack 1996). Masullo and Mack maintain that "real value added comes from reuse. Teachers do excellent work of bridging materials to create rich learning experiences. It is very difficult, however, to share the results with other teachers, and only a handful of students receive the benefits of unique exemplary teaching in each case. Opened and networked digital libraries offer that opportunity."

Hoadley and Bell (1996) maintain that "... structuring Web pages based on 'content' (through keywords or topics) and 'context' (e.g., social group who produced it, discussion that gave rise to the ideas) may prove to be one of the most important features digital libraries could afford. Currently, traditional libraries and social networks coexist, but are not the same, intersecting primarily through authors' names. In the future, these information networks and social networks may be more deeply integrated, allowing us not only to follow our favourite author, but trace works that have influenced him or her, institutions that an individual participates in, and so on."

Edelson and Gordin (1996) mention that "NASA... has a number of ongoing efforts to make their extensive online databases of remote sensing data into a valuable resource available to education at all levels." They then ask the question, "*Why would* [this] *be good for education*?" Their answer includes:

- "Students could investigate authentic scientific questions using real, complex data.
- Students would have the opportunity to study their world in order to explore policy options.
- The activities that these resources support could help students to develop a view of science as inquiry unlike more conventional classroom activities.
- Resources such as this can provide students with a common ground that links them to the community of practicing scientists."

According to Edelson and Gordin, the "goal... of the adaptation of expert resources for learners is: *Take resources that enable experts to extend their knowledge and turn them into resources that enable learners to develop some of the knowledge possessed by experts by performing personally meaningful tasks*."

Digital Libraries Mean Education and Learning

The National Research Council's 1996 report, *National Science Education Standards*, states that "Inquiry into authentic questions generated from student experiences is [should be] the central strategy for teaching science." Constructivists (Honbein 1996) maintain that this should be the basis for teaching just about everything. Wallace et al. (1996) state: "Digital libraries offer a unique and unprecedented resource through which teachers can facilitate student inquiry." In the recent National Research Council publication quoted above, "... emphasis on inquiry is pervasive. Yet, when it comes to textbooks and curricula as they exist today, the clear emphasis is on learning science content disconnected from experience. Although digital libraries can't change pedagogy or textbooks, they can make it possible for students to have access to scientific information and data which interests them, a fundamental requirement for authentic inquiry. Digital libraries can provide teachers with a feasible way to let students pursue their own interests within the bounds of the curriculum and without creating an enormous amount of extra work in providing students with materials to support their investigations." The Wallace article explores the ways in which digital libraries can support inquiry learning. It concludes "... in themselves, digital libraries will not make a change in education without changes in the tasks students are asked to perform and in the support provided to students and teachers." The UMDL Web page (UMDL n.d.) also claims that online inquiry materials may also share the following important learning characteristics with inquiry based materials: authentic questions (i.e., the questions must be meaningful and important to the student for learning), flexible questions, and open-ended and divergent answers.

Soloway (1996) mentions that as of 1996, the National Research Council's new standards for science education resonate with those recently put forth by the American Association for the Advancement of Science, namely: "the emphasis in science classrooms needs to be on inquiry, rather than on didactic instruction and memorisation; rather than being exposed to a broad range of content materials, students need to pursue a few science topics in depth." He then goes on to say that "... the still evolving concept of a *digital library* may well be the missing piece [for accomplishing this], bringing networked collections of digital resources (e.g., primary sources, current information, multimedia formats) together within a coherent and accessible framework. Still further, unlike their physical cousins, *digital* libraries afford students the highly motivating opportunity to publish their findings for all to review."

Although a lot of research into how digital libraries can be used in education is directed at science, there is also a substantial effort directed towards the humanities. Tally (1996) states that "the Library [of Congress] has asked [the] CCT [Center for Children and Technology] researchers and curriculum designers to help them understand what roles these kinds of online resources can play in history and social studies classrooms, and what kinds of support teachers and students need to use them well." He notes that "On-line historical archives invite teachers and students to confront new kinds of materials, new perspectives on historical events, and a new need for historical context. Ultimately, using these resources to advance a more dynamic, inquiry-based approach to history teaching and learning will require creative teachers to collaborate with each other3/4perhaps using the Web itself3/4and share lesson plans, teaching approaches, and assessment methods."

Humanities Web sites have been collected (http://edsitement.neh.fed.us/) on "Top Humanities Web sites," where they are catalogued under four categories: literature, art history, foreign language, and history. Many of the Web sites that appear under each category are cross-listed in two or more categories. History, for example, had a list of 16 Web sites as of April 15, 1998, including one called *The Digital Classroom*, established by the National Archives and Records Administration (NARA). Its stated purpose is "to encourage teachers of students at all levels to use archival documents in the classroom." It "... provides materials from NARA, methods for teaching with primary sources, and sample lesson plans."

Design Standards for Teaching and Learning Materials

According to the UMDC Web site "The University of Michigan Digital Library (UMDL) Project provides guidelines and design standards for teaching and learning materials to support science inquiry through on-line resources." (For additional discussions on the UMDL approaches to inquiry-based learning see Atkins et al. 1996). Although their work seems directed at public schools and public libraries, and science education, they raise questions that are so fundamental that this author believes they are applicable to all levels and types of education (K-12, higher education, and continuing education) and all types of libraries. The questions are grouped into four categories: structure of the online materials, student learning, teacher use, and implementation issues. Because of the fundamental nature of these questions, they are repeated, slightly modified, here (as given in UDML n.d.). In some of the questions parentheses have been added around the word "science." Doing this does not seem to change the fundamental nature of these questions.

Structure of the Online Materials

Digital resources provide students with unprecedented access to information, but unstructured material may result in information overload; hence, these questions must be considered:

1. How are the large amounts of information structured in the digital library in order for students to take the most advantage of it?
2. How can information searching be embedded as part of a learning environment to promote inquiry?
3. What kind of information is best represented in various media?
4. How do the media complement each other to help students learn?
5. What are the types of scaffolding that are most appropriate for digital library technology?
6. What are the issues in developing interfaces that implement such scaffolding strategies?
7. When should scaffolding be folded as student expertise in using the digital library increases?
8. How does one avoid the exponential learning curve typical of technology?
9. Because the digital library will be used as an integral part of classroom activities, what scaffolds are needed to make this use effective?
10. How are students enabled to publish their own documents in the digital library and share them with others?

Student Learning

One needs to study carefully the influence of using the digital library on student learning; hence, the following questions:

1. Does the use of online teaching materials help students develop deep understanding of (science) content and process?
2. What understanding of (science) concepts do students develop by using the digital library?
3. How does student motivation toward learning (science) change by using the digital library?
4. How does student thoughtfulness change by using the digital library?
5. How do students use online learning materials?
6. What types of artifacts are created and published on a digital library?
7. What types of interactions occur as a result of online publishing and what types of changes result?

Teacher Use

The use of digital resources has the potential to change classroom practice and the way in which teachers go about the practice of teaching; hence, the following questions:

1. How do teachers use online teaching and learning materials?
2. How do teachers make use of the various media and different parts of the digital library?
3. How does the digital library influence practice?
4. How can online inquiry be embedded as part of inquiry-based learning?
5. How does the use of online projects impact teaching?

Implementation Issues

Although the use of digital resources has the potential to change classrooms, past experience and research has shown that just giving teachers access to the materials or telling them how to use them is not enough. Teachers, too, need to be active learners in the process; hence, the following questions:

1. What initial supports do teachers need to use online resources?
2. What continued support is necessary for teachers to effectively use online materials?
3. What types of hardware configurations allow for effective use of online resources?

Again, these 25 questions have been taken from UMDL Web page (n.d.).

Technical Problems that Need to be Overcome to Make Education Using Digital Libraries a Reality

According to Masullo and Mack (1996), "... key problems are capturing... material in digital form (e.g., digitised videos, scanned text, descriptions of videos and images), organising it so it can be found, and developing some level of tools for re-using this material in new pedagogically relevant ways." Wallace et al. (1996) note that, "Current search engines and Web browsing software are not adequate for learning environments. Web browsers encourage breadth-first searches, and are often extremely frustrating for students." Tally (1996) states that "The most commonly discussed challenges of teaching with online resources are practical3/4access to good quality information, speed of downloading, the time necessary to find and make good classroom use of the material. All of these hurdles must be faced with electronic primary source archives."

Other chapters in this report focus on all these technical issues, but do so outside of the context of what is probably the most important application for digital libraries: education. Education has its own special needs, as captured by the 25 UMDL questions just given. Technical solutions for scanning texts, describing videos and images, etc., must therefore be driven by educational requirements. Edelson and Gordin (1996) state that "The value of digital libraries is in the authentic activities that they can allow learners to engage in... To capitalize on their potential, these digital libraries need to be made accessible for learners through a variety of *bridging strategies*.... supportive interfaces, activities design, resource selection and organisation, and documentation... designed to provide learners with enough of the hidden context and knowledge that experts bring to their tasks to enable students to use the digital resources as learning resources.

These bridges require additional effort above and beyond the construction of experts' digital libraries, but they take the form of value-added support that leverages the initial investment. The addition of these bridges can transform these resources into invaluable resources for education, and can make digital libraries a common ground that provides a meaningful link between scientific researchers or other expert practitioners and the educational community. Creating such a common ground will increase the likelihood that the graduates of our educational system will be prepared to make sound decisions informed by results from the scientific community.... The key to adapting digital libraries designed for experts is creating a *bridge* between the learner's goals, abilities, and knowledge, and the requirements for productive use of the digital resources." Once again, the problems seem to involve a strong interplay between technology and education.

Any Cautionary Messages?

Wallace, et al. (1996) caution against using the digital libraries to answer very specific questions, because students become frustrated sifting through lots of material looking for a single piece of information; these can be answered more easily using an encyclopedia.

As an aside about encyclopedias, some are already available either online or in CD-ROMs, and incorporate text, audio, graphics and video. They serve a very useful purpose, in that they present "knowledge" as distinct from "information." They also come in different varieties for different age groups. Their possible drawback is that some group has made the decision about what is knowledge versus what is information, and the group's extracted knowledge may very well be presented from its biases or those of the publisher of the digital encyclopedia.

Digital libraries may someday contain source materials from which anyone could create a digital encyclopedia, although this may not be very practical. What may be more practical is for the companies that already have a digital encyclopedia to tap into the vast resources of digital libraries, making their existing products even better, by including links into television sound-bytes, news reports, journal articles, etc.

Hoadley and Bell (1996) note that "Multimedia representations did not lead students to cite more 'correct' scientific ideas, although it did encourage them to cite more ideas in general, which can be helpful in encouraging a group of students to brainstorm and consider alternative explanations for phenomenon."

No doubt, there are other cautionary messages that can be found in the literature, but the search performed did not find them. Certainly, one of the most important considerations is one already mentioned, this report by Raj Reddy: authenticity/veracity of material found on the Web.

Case Study of Japan

The panel did not meet with any Japanese K-12 educators, nor did it meet with any faculty from schools of education at Japanese universities. Also, no Japanese Web pages were checked to see if there are online journals comparable to *D-Lib Magazine*. Even if there were such journals, this author would not have been able to read them, since he does not read Japanese. So the reader of this chapter must take the comments made below, regarding the state of Japanese education and digital libraries, as perceptions of that state, perceptions gleaned from speaking with a very small number of people in Japan. To get a more thorough sense of education using digital libraries in Japan would require focusing on Japanese educators, either through another visit, or by collaboration with the most knowledgeable ones. In short, more work needs to be done.

In Japan the emphasis today appears to be in getting content online, with the main emphasis on rare books and manuscripts, theses and journal articles. University-level educational research is and will be possible, because university libraries will be the repositories of this information. Until sharing across digital libraries is possible, it is not likely that there will even be such research across universities. In the United States the concept of sharing is agreed upon; in Japan, it does not seem to be.

In the United States, there is also a big recognition of the interplay between education and the digital library. That same recognition does not appear to be so prevalent in Japan. Digital libraries do not appear to be making an impact in K-12 education. The Ministry of Education (MIE) is providing resources so that every elementary and middle school will have 20 computers, and every high school will have 40 computers; but the MIE is reluctant to provide resources for communications (e.g., Internet connections). This means that it is very problematic that students will be able to go online and make use of the digital libraries.

In Japan, it is very prestigious and important for a student to be admitted into an important university, such as Tokyo University or Kyoto University. So a market exists for companies to prepare students to take university entrance exams, for which students' parents will spend a lot of money. There is no market for K-12 students while they are in K-12, however, which is one of the reasons that Nikkei, a company that is very heavily involved with digital information, is not interested in this student population.

At Keio University, there is the Humanities Media Interface Project (HUMI project), which was launched in Spring 1996 with the aim, among others, of digitizing major rare books and manuscripts.... Western, Japanese and Chinese.... in the Keio collection, including the Keio Gutenberg Bible. The HUMI Project has been supported by the Ministry of Education, Science, Sports and Culture (*Monbusho*), the Information-Technology Promotion Agency (IPA), which is attached to the Ministry of International Trade and Industry, and Keio University. The library has a very large collection of rare books, including 8,000 Western rare books. The project managers seem to have a very progressive view of digitisation of books, namely that, once digitised, the books can be examined or reassembled any way a person wants. The Keio Gutenberg Bible has played a very important role in the HUMI Project. The Bible was acquired not just for possession of an important article of Western cultural heritage, but because Keio University believes that modern research libraries should possess works significant enough to be digitised for the benefit of today's scholars. The university also wishes to promote the greater goal of preserving these treasures for posterity without further decay.

The HUMI Project is a clear indication that some very serious work is indeed occurring in Japan regarding education and digital libraries, and suggests that much more may indeed be occurring than we had the opportunity to observe directly. Prof. Naohito Okude (Keio University) sent this author some important observations about the digital library in education, in an e-mail message. Professor Okude's comments are paraphrased below, because not only are they somewhat visionary, but because they are also very optimistic about education using digital libraries:

> *Contrary to the general assumption that hypermedia obliterates the past, digital technology is radically reconfiguring our understanding of history. Being digital in a research library requires designing a post-Gutenbergian research model for the humanities. Digital technology forces us to recognize that texts are not higher than images. Computers rid us of the assumption that sensory messages are incompatible with reflection. Once digitised, fleeting images become available to anyone who "reads" them on a graphics computer. Imaging becomes a rich and fascinating mode for communicating ideas. In order to conduct a*

> *professional image search within the humanities, serious training in visual proficiency is needed. The image search is an activity of focusing on cross-disciplinary problems in arts, graphics, film, video, media production and their different histories.*

Learning has always been a people-to-people process. Digital library technology will promote a computer-mediated people-to-people learning process. This technology will have to expand from its traditional areas, such as information retrieval and distance learning, to the new frontier of information work application to assist distributed learning and the process of inquiring using a networked system.

Computer-human interface should be a central research agenda item for digital libraries. In addition to keyboards and mice, trackballs and joysticks, as well as gloves, helmets, glasses and body-suits, move an object on a computer screen. These multi-modal interfaces are not only immature in their development status, but they also are not intelligent. Future interfaces will be intelligent and will mediate communication between the researcher and the distributed computer network to make the latter more responsive to the former's wants and needs. New multi-modal intelligent interfaces will let the researcher span the continuum from passive reception of research data to active creation of new research results.

Virtual reality (VR) technology is most appropriate for representation as well as research. Bit-mapped graphics-based supercomputers can run high-speed graphics and track human movements. Immersion, interactivity, and information intensity are the three main characteristics of VR technology. In the next ten years we can expect a widespread and growing experience of VR in a variety of everyday educational and learning environments.

The real market for digital technology is not the "information market" but the "information work" market. The technologies for information work let a person or a computer program take in information, transform it, and send it out. Today's content creation technologies do not yet fulfil these functions.

When people and organisations all have computers, and all these computers are interconnected, they will sell and freely exchange information and information services. The digital libraries will then take the role of information managers in the age of the convergence of communication and computation, and new distribution technologies will emerge to link one digital library with other digital libraries, in order to effect digital data assistance. The role of the nineteenth-century library as the custodian of physically printed materials will remain but the digital libraries will also become distributed information managers of the links to other digital libraries. A grand distributed global digital library is the dream and the final goal of the digital libraries endeavor.

Each library will someday offer its collection in electronic form. To users, the collection of worldwide distributed libraries will look like one uniform library. To achieve interoperability of digital data at this level, enhancements of networking capabilities, interface design, and object-oriented databases are needed. Without this open architecture and deployment of distributed object-oriented technology, there is no future for the digital library to scholars and other people who want to use the libraries for their creative activities. Every library around the world should communicate with each other so as to contribute a consolidation of diverse human knowledge and experience. Education and learning will be the huge market when the distributed digital libraries and the information work technologies are available to the content creators. Education and learning are lifelong pursuits. Within a few decades, people in Japan will come to the university at irregular times and will take more than four years to graduate. They will study for more years and will study more. This fragmented and discontinuous pattern is more of an expectation than the norm now, but students in the future will attend in broken times, and will often learn from more than one institution. This knowledge consumer market is the digital libraries' business domain.

Summing Up

Resources are needed to digitize vast amounts of materials. Hoadley and Bell (1996) state that "Education is often held up as a prime beneficiary of digital libraries. However, the obvious benefits, such as distance education or literally global text search, fall short of justifying either the lofty expectations for an educational revolution or the enormous cost of putting everything on-line." Perhaps, a demand-driven model should be used to establish priorities for what is digitised. These priorities could be established by professional educational societies and educational arms of technical societies. Then, educational representatives of higher-level National Academies could meet to prioritize across fields. Using this approach, there is a high likelihood that whatever is digitised would indeed be used by a large number of people, thereby justifying the large costs associated with digitisation.

Resources are also needed to solve the myriad of open technical problems that have been discussed in other chapters of this report, but subject to the constraints of education. This, of course, means that the educational constraints are known. Unfortunately, that is not the case today. One must work through the 25 UMDL questions in order to establish all of the constraints. Resources are therefore needed to develop effective ways for teaching and learning using the digital libraries. If such resources are not made available or found, then it is indeed foolhardy to believe that digital libraries will make much of an impact, if any at all, on education.

Without computers available to students, it will not be possible for the digital libraries to make a significant impact on education. Today in the United States only 35% of all college students own a computer, and only 50% of all faculty do (Market View 1998). No doubt, the numbers of K-12 students and their teachers who own a computer are much smaller. Resources must be found to bring these percentages up to much higher values, or else digital libraries will not benefit all students. Instead, they will be an important benefit only to those who can afford to own and maintain a computer. It seems that more resources are being directed at the myriad of problems associated with digital libraries in the United States than in Japan.

Telecataloging

The future of telecataloging may also be influenced by the appearance of more cataloguing tools in machine-readable form. Earlier, we alluded to the recently developed Cataloguer's Workstation, as being a single online source for numerous cataloguing tools. In response to a request on Autocat for opinions on this product, Piepenburg (1995) writes, "I cannot imagine my life without cataloguer's desktop. We have discontinued all of our printed materials... I use it primarily for country and geographic codes, subject construction, and USMARC Bibliographic and Authority work." The "On the MARC" program being developed by the Cataloguing Directorate staff at the Library of Congress allows for the capture of text in electronic form and the electronic conversion of that text into a MARC formatted record (Williamson 1995). Text can be captured from OPAC records retrieved through the Internet, electronic files or keyed in data. Indicators, subfield codes and delimiters are supplied by the program with the cataloguer inserting the ISBD punctuation. Although still in development and planned for use by LC, this product offers potential for use by other libraries. A machine-readable version of Anglo-American Cataloguing Rules, 2nd edition revised, is currently in the beta testing stage. "Results of these tests have been and will be valuable in ensuring that the AACR2-E files will be compatible with a wide variety of software formats to facilitate their use by vendors and access by catalogers in diverse computing environments" (ALCTS Network News 1996).

The degree to which telecataloging is used in the future may be dependent upon the success of other alternatives. Outsourcing certain types of materials may be seen as a solution to reallocate staff to other areas of the library or to other responsibilities viewed as having more immediate priority. Cooperative arrangements between OCLC, vendors and libraries, such as the OCLC PromptCat service, are altering the way in which libraries organise workflows and staff in cataloguing and acquisitions departments.

Perhaps another factor in a more wide-spread acceptance of telecataloging is the changing role of the cataloguer, especially in academic libraries. The cataloguer of the future may be balancing his/her cataloguing time between print and electronic resources, or there may be a new division of labor in cataloguing departments between those who catalogue print and those who catalogue electronic materials. As electronic resources proliferate, the prospects for telecataloging become enhanced. With the development of the core bibliographic record, enhancing records may receive more attention. We are already witnessing the addition of table of contents and subject headings for works of fiction. Catalogers are creating hooks to serial holdings from citation databases mounted on local systems and pointers to remote site resources. The OCLC Internet Cataloguing Project and discussion of the project on the Listserv list INTERCAT are providing catalogers with the means to learn the issues and guidelines for cataloguing electronic resources. As some catalogers may move farther away from cataloguing books and toward electronic resources, telecataloging becomes more an alternative to traditional cataloguing practice instead of primarily a means of addressing personnel issues.

The concept of remote site cataloguing or "telecataloging" (Hopkins 1994) follows more than three decades of technological developments in cataloguing. These developments began in the 1960's when MARC (machine-readable cataloguing) was established as the standard for coding bibliographic records to be read and interpreted by computers. The introduction of bibliographic databases, such as the OCLC Online Union Catalogue (OLUC) in 1971, allowed catalogers to share their work electronically with other libraries and users throughout the world. The Anglo-American Cataloguing Rules, 2nd edition, was published in 1978 (revised in 1988) in an effort to provide new standardisation of the bibliographic description of an item, including computer files.

In the 1980's another revolutionary technological development was the introduction of computerised library catalogues. Online public access catalogues (OPACS), containing bibliographic data in MARC format, facilitated retrieval of information in new ways and eliminated traditional card catalogue production. Software and hardware development advanced so that computers could communicate with each other. The cataloguer could catalogue materials on OCLC and then tape load or electronically transfer these records to an online catalogue or vice versa. Many libraries began a card catalogue conversion process to enlarge their database holdings of machine-readable records. OPAC vendors began to offer libraries other features such as authority files and database maintenance capabilities.

While the cataloguer's office of the 1980's and 1990's typically has had a personal computer to access the bibliographic utility and the OPAC, there still exists much printed documentation and manual files. Catalogers are still consulting printed bibliographic tools such as foreign language and subject-oriented dictionaries, Library of Congress Rule Interpretations, manuals of Library of Congress (LC) cataloguing practice, and "cheat sheets" lining their office walls. The library's shelflist may still be retained because conversion has not been completed or the library's OPAC does not have adequate shelflisting displays.

More recently, some new products and product developments are offering a change in the environment in which catalogers may work. The technology is either here, or in development, to allow catalogers to access bibliographic records, the Internet, and the primary bibliographic tools from a personal computer at a remote site. This introduces an exciting new concept for catalogers, that of "telecataloging", as evidenced by postings on the Listserv list "Autocat" and the recent article by Black and Hyslop (1995).

The remainder of this article will include an overview of the library literature published since 1993 which describes telecataloging practices, in hopes of synthesising the current interest in and implementation of remote site cataloguing as it has occurred primarily in academic libraries. Catalogers' postings to "Autocat" are the primary references throughout this review. In addition, factors such as employee attitudes and personal needs, the technology required for successful telecataloging, library administrative concerns, and the future of telecataloging will be discussed.

Who can Telecatalog?

A very important part of the telecataloging equation is selection of the person who will be able to catalogue from a remote site. A variety of factors must be considered in making a decision about whether a person could engage successfully in this activity.

The most obvious factor is the necessity for a well-trained, knowledgeable cataloguer. If efficiency is paramount, the remote cataloguer must be well versed in the traditional cataloguing rules, subject area(s) desired to be catalogued remotely, local policies and procedures. The characteristics of on-site cataloguing as being a self-driven, decision-laden activity are only enhanced at the remote site where collegial consultation is likely to be minimal.

Secondly, this well trained cataloguer must have sufficient technical skills with computer equipment. S/he must be comfortable with or at least have the confidence that s/he will be able to work through technical problems in a reasonable amount of time. A person who panics when the connection to the OPAC or bibliographic utility breaks down and runs for the local computer specialist is probably not well suited to this activity. A survey of the literature showed that librarians engaged in telecataloging most frequently owned and used their own personal equipment, implying a fairly high degree of computer knowledge.

Finally, the well-trained, technically-proficient cataloguer and his/her supervisor should assess, honestly, whether the necessary personality characteristics are present for telecataloging. This person needs to be a self manager with the ability to set priorities and to meet deadlines. "The worker who adapts best to at-home or work center telecommuting... is probably already working successfully in an occupation that requires independent organised operating methods and extended periods of concentrated effort. Such people are usually more achievement oriented, plan well, are persistent in their endeavors and self-directed. In addition they balance their time and can say "no" to intrusion. They are often among an organisation's highly motivated, disciplined, reliable staff" (Cross 1986).

The Autocat messages that were posted raised the issue of distraction. How this is perceived and dealt with has to be a major factor for success in remote site cataloguing. Leslie (1993) comments that "whether one finds more distractions at home or at work might depend quite a bit on the person involved." Some librarians felt that distractions at home were more manageable than at work. However, another questioned "the advisability of telecommuting for the purpose of solving child-care problems" with the ensuing distractions (Padley 1994). Obviously, a person who is easily distracted by other activities at home will find difficulty in performing cataloguing there.

Another psychological factor that needs to be considered is the possibility of the cataloguer feeling isolated from the work site and colleagues (Urbanski 1994). According to Manley (1996), "the lack of personal contact may be telecommuting's biggest inhibitor." This factor may be difficult to assess before the actual activity of remote cataloguing is attempted. Both the cataloguer and the library administration need to understand that not everyone is suited to working alone and that adjustment may need to be made in the work schedule over time if a feeling of isolation develops.

Tools and Resources Necessary at the Remote Site

The traditional approach to cataloguing in the technical services area of a library, with piece in hand and a multitude of print supporting tools close by, changes dramatically when one considers remote site cataloguing. Internet or dial-up access to OCLC and the library's OPAC, cataloguing software and CD-ROM or online cataloguing tools provide the technical applications needed to achieve this goal. Necessary are a personal computer with cataloguing software, a printer and a modem, with a separate modem line being desirable. One cataloguer reported the need of a fax machine (Elrod 1995). The literature showed a variety of customisation by catalogers using both Apple and IBM compatible PC's. Software reported in use included Apple Remote Access Protocol (ARAP) (Graham 1993), Cataloguing Microenhancer Plus (CATME+) (Pennell 1994; Black 1995), OCLC Passport (Pennell 1994; Sherman 1995), Bibliofile (Pennell 1994) and Symantec's PC Anywhere (Urbanski 1994).

The catalogers surveyed, in general, appeared satisfied with the quality and speed of their telecommunications links. However, "As a library's cataloguing tools are networked, access to them is a significant issue" (Morris 1996). For example, at Iowa State University, the Cataloguer's Workstation is accessible through the library's NOVELL network. Access to any NOVELL network off the ISU campus is not possible at this time, and remains a University issue to be resolved.

Other support tools required by telecatalogers were the Library of Congress or Dewey Decimal classification schedules, Library of Congress (or other) subject headings, LC Name Authority File, US MARC formats and Anglo American Cataloguing Rules. Traditionally available in print format, some of these tools are now available on CD-Rom or can be accessed remotely by Gopher or Telnet connections. The Cataloguer's Workstation developed recently by LC using Folio software puts numerous printed tools online and in one location. Some of the tools included on this workstation are LC Rule Interpretations, US MARC codes lists and formats, and three parts of the LC Subject Cataloguing Manual (subject headings, classification, and shelflisting). It also allows the cataloguer to add notes, bookmarks, or hypertext references. Classification Plus, a Windows-based CD-ROM product combining the LC classification schedules and subject headings, made its debut at the 1996 ALA Midwinter Meeting and is distributed by the LC Cataloguing Distribution Service. Depending upon a cataloguer's subject area, a variety of other tools such as encyclopedias, dictionaries, etc. may be necessary or at least useful. Other library OPACS, now available by remote access, are also proving to be valuable as a cataloguing resource.

No overwhelming barriers to the physical transport of materials to be catalogued remotely were mentioned by the catalogers who posted Autocat messages. They reported cataloguing books, music scores, microfilm/ fiche and videotapes, and doing retrospective conversion activities. Temporary removal of items from the library site did not appear to be a problem. The library will need to identify a system for notifying the cataloguer that an item in process is requested by a library user. The cataloguer may also need e-mail capabilities for general communication back and forth with staff at the library. Little description of the physical area where the cataloguing took place at the remote site was given by the catalogers surveyed. Ideally, a separate room or space away from dust, children and pets that may pull or chew on cords is necessary. Space for the support tools and the items to be catalogued needs to be provided. Hopefully, the area would be quiet and with a minimum of distractions.

Cataloguing Activities that can be Accomplished at a Remote Site

A variety of cataloguing activities were described as being accomplished at a remote site. Authority work included corrections to the local authorities file (Levy 1993); creation of new series authority records and revision of records (Vastine 1993); authority verification connected to new acquisitions (Urbanski 1994). Padley (1994) described resolving serials title change problems in connection with barcoding, ensuring that items were attached to the correct title. Database cleanup in the local online catalogue, revision, editing of others' cataloguing and retrospective conversion are other reported activities that can be accomplished from a remote site (Levy 1993; Gonzolez 1993).

Original cataloguing was accomplished in part by Black (Black & Hyslop 1995). She prepared draft cataloguing records at home, assigning tentative subject headings and call numbers by accessing her library's online catalogue. These records were uploaded into OCLC at the library. It is entirely possible today to complete original cataloguing from a remote site if a library OPAC and shelflist, bibliographic utility, and classification schedules and subject headings are available online, thus eliminating a physical need to be at the library.

There is practical value in allowing catalogers to choose a work option that may be potentially more compatible with their life style. Telecataloging would make good use of the technological advances available to libraries today (Black & Hyslop 1995). Richard (1995) feels that technical services master plans of the 1990's should include this concept as an alternative to traditional cataloguing practices.

Administrative Concerns with Telecataloging

The library administration needs to be involved with additional factors in developing a telecataloging program. Costs, improved efficiency, liability and security are all major concerns. Goals need to be established, explained to, and supported by the institution's administration and library staff. Bowen (1993) reported that a model for any telecataloging program should be written and disseminated. Obtaining suggestions from other telecataloging libraries or seeking advice from consultants may be beneficial where an extensive telecommuting program is planned.

Little information on costs of telecataloging was presented in the Autocat messages surveyed. There were no estimates comparing costs of cataloguing at home with cataloguing at the library. If a portion of the cataloguing work, such as shelflisting or use of more extensive reference tools, must be done at the library, this comparison may become more difficult to achieve. A library wishing to reduce its cost of cataloguing may turn to other measures such as outsourcing before it might consider telecataloging. Others may see telecataloging as an opportunity to reduce space and its associated costs for cataloguing activities at the library. Perhaps the telecatalogers might share a workspace on the days that they come into the library to work. Other staff may use the telecataloger's equipment on the days that they are away from the office. Catalogers who reported on Autocat that they telecataloged did so on a temporary or trial basis or no more than half of their normal work hours. Some libraries may see cataloguing in non-prime time as an advantage gained in allowing catalogers to work at home. However, Stankowski (1994) mentions that the cost of connect time may take away from the benefits of being able to work on non-prime hours.

As stated earlier, the catalogers used their own computer and modem. The library would generally be responsible for the cost of access to a bibliographic utility, such as OCLC, whether through dial access or the Internet and to the local OPAC. Some additional costs may be incurred for adding security devices at the remote work site. Costs for the purchase of software such as Bibliofile, Cataloguing Microenhancer Plus, and PC Anywhere by Symantec were mentioned as being the library's responsibility. Elrod (1994) cites $1500 additionally for book tools, some of which are now in electronic form. If the library purchases the equipment, maintenance costs for that equipment or for technical support staff will need to be considered unless the cataloguer is sufficiently technology savvy.

The advantages of telecommuting reported by supervisors of telecommuters in a recent survey of Fortune 1000 executives were higher morale, reduced costs/space needs, employee retention, reduced stress and absenteeism, and increased productivity (Hall 1995). Each library will want to decide whether improved efficiency is a goal of telecommuting. Support and mutual trust should be established between the telecataloger and his/her supervisor. Expectations need to be fair and clearly defined. Communications may be problematic because they do not fit into traditional established patterns. Padley (1994) expressed the view that work should be quantifiable with some measure of accountability. Traditional attitudes toward work and the work day may need to be changed. As Meglio (1991) stated, "if the corporate or library culture is too rigid or operates by the basic principle 'that an employee out of sight is an employee who is not working'", the program will be difficult to administer.

A definition of what constitutes the work day and workplace will need to be detailed, especially at institutions where union contracts may be involved. This factor may limit telecataloging to certain types of staff, such as those not under union contract. Eligibility requirements for this kind of work arrangement should be clear to all staff to avoid resentment by employees who may not be eligible or selected for this work arrangement. The cataloguer's supervisee(s) will need to know when the cataloguer will be working at the library and available for consultation and questions. Security and liability issues need to be specified in any policy for telecataloging. Library property, both the elements of the cataloguer's workstation and the materials to be catalogued, may need to be identified to satisfy requirements for insurance carriers. The cataloguer may be required to monitor or log the time on the personal computer and to separate the time spent on work-related activities and those of a personal nature. That portion of the home which is considered the work site may also need to be defined and examined for liability.

Thus, the telecataloging is being practiced as an alternative to traditional cataloguing. A variety of cataloguing activities, such as authority work, database clean-up, retrospective conversion, and original cataloguing were described as being accomplished at a remote site using the tools and resources currently available. An examination of library administrative concerns with telecataloging, including costs, goals, equipment, personnel, security and liability issues shows that each library will need to assess its individual situation while also considering future technological developments. Growth of bibliographic databases such as OCLC, the role that the Library of Congress and American Library Association continue to play in providing leadership and standards for cataloguing, the role of library vendors, and future nationwide trends will also influence a decision to adopt telecataloging.

9

Use of Computer in Libraries

Obviously that during 1960s computers were used in cataloguing but in batch processing system. In batch processing, catalogue data were punched in cards and then transformed in the paper tape or magnetic tape. In some machine, however data were directly input in the punched paper tape or recorded on the magnetic tape. Gradually, programmings were made on the magnetic tape or discs, which could be manipulated automatically. But in this period different libraries used different types of computers and there was no uniformity in the catalogue card format. The individual libraries had to spend a large sum on the custom-developed computer system in order to attain speed in work. This situation warranted the necessity for standardisation of catalogue data and shared cataloguing. As such the two aspects of cataloguing system developed during 1960s, became the most vital for computerised cataloguing.

These are the standardisation of the catalogue entry with the standard bibliographic description having unique identification mark for each document with the International Standard Book Number (ISBN) and shared cataloguing under a computerised library system using MARC format. Different ISBDs have been prepared by IFLA to attain uniformity through computer.

Uses of MARC

MARC tapes are being used for various purposes. Following are some of their important uses:

1. A centrally prepared catalogue can be distributed to the receiving libraries in a machine-readable form.
2. In spite of increasing acquisitions, the catalogue can be kept up-to-date without employing additional staff.
3. The MARC tapes can be utilised for acquisition functions *i.e.,* selecting, ordering and claiming unsupplied books without any

additional cost. They can be used to produced spine labels, book pockets etc.

4. The MARC tapes can be used for producing conventional card catalogue by the subscribing libraries, as demonstrated by the University of Toronto.
5. The production cost of card catalogue on the computer (MARC System) is lesser than that of purchasing the Library of Congress catalogue cards.
6. The MARC data can also be used for producing book catalogues as demonstrated by the Washington State Library.
7. It automatically performs resource-sharing functions.
8. The MARC tapes can be used for computerised SDI service.

Mini or Microcomputer-based MARC is commercially based cataloguing system. Practically a microcomputer is housed in the Library and a set of floppy disks is provided which contains the entire MARC database. It is then quickly retrieved and edited as needed. (J. Rice). Within the United States, the terms MARC, LC MARC and USMARC are interchangeable. The term do have slightly different meanings such as follow:

1. MARC is a generic term applied to the universe of MARC formats, including UKMARC, CANMARC, InterMARC, and so on;
2. LC MARC refers to the set of options and content designation called "MARC II";
3. USMARC is a new name of LC MARC, introduced in the Underlying Principles document in 1983. There is no sharp distinction in content between LC MARC and USMARC. The term USMARC or MARC are also applied to MARC extensions, formats such as OCLC MARC and RLIN MARC that include data in addition to USMARC data.

MARC I

MARC I pilot project began in April, 1966 in which sixteen libraries participated. By the year 1968, the Library of Congress had distributed over fifty thousand English language monographs records. The purpose of MARC I was the automation of cataloguing, indexing, searching and retrieval functions.

The participating libraries made better use of the MARC tapes distributed by L.C., in a variety of ways in producing catalogue cards, book form of union catalogues, specialised lists of materials under subjects, lists for acquisition on purposes and the like. The LC MARC database-the accumulation of Library of Congress cataloguing data in machine-readable form-now contains more than 2.5 million records.

MARC II

The MARC I format was based entirely on the structure of the L.C. catalogue cards and covered monographs only. Encouraged by the success of MARC I, staff of the L.C. started redesigning the procedures and programmes to cover material in other forms, and developed character set to include all the major Roman alphabet language as well as Romanised forms. Meanwhile the British National Bibliography (BNB) showed interest in the UK MARC Pilot Project. Similarly interest was also shown by many foreign libraries to design a standard communication format suitable for interchanging bibliographic data not only from one source organisation, the L.C., to many participating libraries, but also for exchanging information on cooperative basis among libraries at the international level. The US, the UK and other countries wanted a machine-readable catalogue format that would be a common one for international exchange of cataloguing and bibliographic data. Such an interchangeable record format was designed and was called MARC II. It was a one-format structure on the machine-readable medium capable of containing bibliographic data of all forms of library materials, such as books, monographs, serials, maps, music etc., and related records.

The structure or the physical representation of the machine-readable medium; the content designators, such as tags, indicators, and subfields codes used to identify the data elements; and the content or the data itself such as author, title and bibliographic descriptions are the three components of the LC MARC format. MARC II officially began in March, 1968. Distribution began for all English Language material providing a weekly magnetic tape of zonal 1000 records.

Thereafter, other documentation begain to be issued, including formats for other materials over the period 1970-73. In 1972 films records were distributed, by 1973 records for serials, maps and French books, by 1975 German Spanish and Portuguese materials. MARC II is a subscription service. By subscribing to this service a library can acquire, in machine readable form cataloguing data for American and other foreign publications as described above.

In fact the Library of Congress catalogues the documents *i.e.,* books and non-book materials, records the data on magnetic tape and supplies copies of the tapes to various interested libraries. The libraries which get the copy of magnetic tape, can then produce printed catalogues of their collections entries on cards and various kinds of bibliographies (author or subject etc.) by using a computer. Most libraries obtain access to MARC data, through products and services developed by publishers computer system developers, timesharing services and other intermediaries. MARCFICHE is the earliest of MARC-derivate products. At present a growing number of vendor supply the MARC database, on CD-ROM disks or digital optical videodiscs accompanied by software which supports the retrieval of specific cataloguing records and the printing of card sets.

Limitations

George Piternick points out the following few limitations of the Machine-Readable catalogue systems:

1. The MARC record for any title is almost similar to the conventional bibliographic record, as such it inherits all its limitations.
2. The MARC format will be limited, at least for the next few years, to the English language books because the MARC character set is severally limited in respect of special characters and diacritical marks.
3. Expenditure on account of machine time by the participating libraries will go on increasing in view of the weekly shipment of about 1,200 records or about 62,000 records annually requiring 15,000 feet of magnetic tape.
4. The time gap between the creation of MARC record and a catalogue record copy by the participating library, which is inherent at present in the existing card production methods of the Library of Congress, will not be removed until and unless both the cards and tapes are prepared from the same machine-readable record.

MARC records are no longer created only, by L.C. but also by many other agencies, and are available through bibliographic utilities and from commercial services.

Retrospective Conversion (RECON) in MARC

The MARC Distribution Service was enlarged and proved to be efficient in making conversion of all current intake into the machine-readable catalogue.

But all these were for the current holdings of libraries only. Librarians were interested to the preparation of machine-readable catalogue of their older holdings and to replace their card catalogues with machine readable catalogues. But it was realised that uncoordinated activities by individual libraries would entail expensive repetition of work in converting the existing catalogue into the machine-readable form.

Personalised efforts would also be devoid of uniformity in headings and forms. RECON Pilot Project was initiated in August 1969. It continued for two years and approximately 58000 records were converte. The most significant technical achievement of this project was the development and implementation of the format recognition process.

UNI MARC

The implementation of US MARC, UK MARC and ISBD, the increasing number of national MARC formats etc. created an environment for international cooperation in interchanging bibliographic data. The IFLA Working group discussed some of the problems encountered in the area of universal standardisation and agreement on content designators in machine-readable format.

The concept of SUPER MARC as an international system for exchange of information was agreed upon in principle. A draft of the international MARC format was made in 1975 for universal use. Finally, for international exchange of MARC records, a new machine-readable format was designed and is known as UNI MARC. It has been envisaged that the national organisations producing MARC records will produce them in the national standards for use within the country and will reformat them according to the UNI MARC format for international exchange. The international and universal MARC has become a reality.

Online Catalogues

The growth and development of MARC for machine-readable cataloguing of current materials and the retrospective conversion of manual catalogues to computerised ones represent the history of the offine computer system in library cataloguing. The process of creating and editing the records in the batch system through the offine computer was however labour intensive and time-consuming. The capabilities of the online computer system for random access and operation in "real time was realised by the library administrators. The libraries planned to use the online system for cataloguing.

During the early 1970s, the online system was used in its early phase. In the online system, the machine-readable files, either MARC or local were transferred from the magnetic tape to the magnetic disc or drum where random access was possible. Visual display units (VDU) or computer terminals were used for input and output operations, and these terminals were fitted with the line printers for the hard copy output.

What exactly constitutes an online catalogue is difficult to explain satisfactorily. A few important definitions are recorded hereunder. Library of Congress defined it as follows:

> *"An online catalogue is an access tool and resource guide to the collections of a library or libraries, which contains interrelated sets of bibliographic data in machine-readable form and which can be searched interactively on a terminal by users".*

National Library of Medicine gives a compact definition:

> *"[An online catalogue provides] online access to the complete bibliographic record of all the library's holdings with minimal access points being the same as these available in a card catalogue".*

Research Library Group (US) gave a characterised definition of online catalogue as follows:

An Online Catalogue

1. Provides the public with direct access to a library's bibliographic data base through the use of a terminal.
2. Is searchable through a variety of access points greater than those available through card form catalogue.
3. Retrieves information from a local library file, and if not successful locally, retrieves information from other libraries files.
4. Is searchable with a common command language which may be transferred when the public moves from one library to another.
5. Provides instructional help.
6. May be accessed remote from the Library's location.
7. Provides links to card form catalogues, reference help, circulation files, etc.
8. Displays such results in readily understandable form.

These definitions were written in 1980, but as of 1983, there was still little consensus as to what an online catalogue really is. James Rice attempts to feature online catalogue as under:

> *"An online catalogue is a fully interactive catalogue of holdings that has the potential of being accessible in any number of ways. It is by far the most dynamic form of catalogue because the user does not need to adapt to any physical limitations (e.g., dictionary listing, divided catalogue, or book pages). Users simply input a query such as an author's name, subject headings, or keyword from the title, and the computer responds with an answer that allows for further communications".*

An online catalogue is an organised, machin-ereadable accumulation of bibliographic records which are maintained on disks or other direct-access computer storage media for retrieval by library users and staff members working at interactive terminals or appropriately configured microcomputer workstations. In addition to saving space and automating file maintenance, online catalogue permit remote access by authorised persons equipped with compatible terminals, and they can support information retrieval operations such as keyword searching of titles and series names. (Saffady). Online catalogue may be custom-developed (inhouse) for specific library use or purchased as prewritten software packages or turnkey systems.

Examples of custom-developed online catalogues include the L.C. computerised catalogue, the MELVYL system at the University of California, the Library Computer System (LCS) at Ohio State University. Prewritten software packages suitable for online catalogue implementations include BRS/SEARCH from BRS Information Technologies, a powerful information retrieval programme that is available in mainframe, minicomputer, and microcomputer versions Besides this several vendors in U.S. and elsewhere offer turnkey information storage and retrieval systems which include preconfigure combinations of hardware and software components suitable for online catalogue implementations, STAR system is an example.

From the mid 1980s online catalogue practice has been dominated by integrated library systems which cdmbine database management and catalogue access capabilities with circulation control, acquisitions, serial control, and other operations. Such systems may be implemented as complete turnkey systems or as prewritten software packages designed to operate" on a library-owned mainframe, mini-computer, or microcomputer. Most recently for online catalogue implementation, large number of vendors in U.S. offer public access catalogue systems which employ CD-ROM storage technology. Examples include the IMPACT system from Autographies, THE INTELLIGENT CATALOGUE from the Library Corporation, and the LEPAC system from Brodart. In such implementations the library provides a machine-readable version of its catalogue typically consisting of MARC format records on magnetic tapes obtained from bibliographic utilities or other sources, to a CD-ROM system vendor who indexes and otherwise prepares it for onversion to one or more CD-ROM disks. CD-ROM catalogues are now increasingly mentioned as an alternative to COM for union catalogues and similar implementations.

Bibliographic Utilities

Many libraries in the United States, Canada and elsewhere, instead of developing their own inhouse systems prefer to obtain access to machine-readable cataloguing record through one of the bibliographic utilities, *i.e.,* organisations which maintain large databases of cataloguing records and offer online access and other services to subscribing libraries only. Examples include the Online Union Catalogue implemented by the Online Computer Library Center (OCLC), the Research Libraries Information Group (RLG), the cataloguing support service operated by the Western Library Network

(WLN), the Cataloguing Support System (CATSS) offered by Utlas International, Canada, the LIONS system operated by the New York Public Library and so on.

The British Library Automated Information Service (BLAISE) is also now one of the world's largest commercial services. Its catalogue production is made through LOCAS (Local Catalogue Service) which is an integral part of BLAISE. While these organisations differ in database size and composition, the number and nature of their subscribers and the specific capabilities they support, each maintain a database of L.C. MARC records, supplemented by original MARC-format cataloguing contributed by subscribing libraries. Working at local terminals, participating libraries can retrieve cataloguing copy, modify it to meet local needs, and order printed card sets, machine-readable cataloguing records on-magnetic tape, and other bibliographic products. Supporting thousands of online terminals, accessing millions of machine-readable records, the Bibliographic Utilities are among the world's largest and most intensively utilised computer-based information services.

Terminal

On-line cataloguing is performed on a terminal installed in member library. This terminal is connected to a central database subscribed by the Library. The terminal generally consists of two parts-a CRT (cathoderay tube) terminal, which looks like a television receiver, and an attached keyboard similar to that of a typewriter except that it contains special functions keys for system use and special library characters. terminals are accompanied by line printers.

Online Cataloguing with Bibliographic Utilities

Any library which is a member of centrally located database like OCLC or RLIN etc., is given facility for online processing off cataloguing records. By having access to a central database, an individual library can make use of the existing records in the most efficient and effective manner for a number of purposes. Following is a brief review of some of the key processes involved in online cataloguing.

Searching

Searching is generally performed by means of search keys. The search keys may consists of alphabetic characters, numeric characters, or both. The most commonly-used search keys are derived from the following elements in a record: name-title, name, title, subject entry, LC card number, ISBN, ISSN, and a special control number in the data base. The main purpose of searching is to ascertain whether a particular record is in the database.

Frequently, a particular search key may call up more than one record, because the computer will respond with all the records containing the same search key. In such a case, a list of the items containing only brief information will be displayed and the searcher then decides which particular record in the list is to be displayed in full. If the inhouse terminal reports that the record for the item in hand is already in the data base, it can then be used for any purpose.

From cataloguing standpoint, the cataloguer compares the item being catalogued with the record held in data base. If there is no variation, the record then can be processed for cataloguing purposes *i.e.,* card can be printed from the record; and the record can be added to the library's own tape for producing COM catalogues if required. However if the record varies in certain details from the item being catalogued, it can be modified or edited to suit individual purposes. If the item in hand is not held in data base, the cataloguer on his terminal keyboard, catalogues the item in accordance with the standardised entry format and then it is automatically added into" the central data base. One great advantage of on-line cataloguing is the instant feedback. In editing, the modification made to the information displayed on the screen, and the modified or edited record is shown instantly to ensure that all necessary modification have been correctly processed.

The inputting process is used to store cataloguing data in machine-readable form in a data base. After the cataloguing information has been identified and organised according to cataloguing rules, the subject headings and call number have been assigned, and the individual elements have been encoded or tagged according to the MARC format, the record is then ready to be input into the computerised data base.

The inputting process can also be performed in an online mode through the terminal. Results of input can be displayed immediately for proof reading and any necessary correction.

COM

COM (Computer Output Microfilm) catalogue developed as an outgrowth of book catalogue. COM recorder is a type of nonimpact computer printer which converts machine-readable data to microfilm or microfiche without creating an intervening paper copy. The process begins by first converting the catalogue into machine-readable form. The database is then stored on magnetic tape or disk or some other secondary storage medium; The microform output is usually on 105 x 148 mm. microfiche or 16 mm. microfilm. The COM format is getting popularity. Special Readers are required for the magnified display of COM generated images. Reader/ printers can be used to create paper copies. In US and UK several book jobbers and vendors have developed software capable of producing COM catalogue from library supplied, machine-readable bibliographic data. It eliminates the need for an in house COM recorder. Also several of the bibliographic utilities themselves offer COM catalogues as an output alternative. Firms such as Brodart, Blackwell North America etc. are active in this market.

COM catalogues offer several advantages. Some are outlined hereunder:

1. It is inexpensive to reproduce and can be placed in many locations inside and outside of a library.
2. There can be separate films for author entries, title entries, and subject entries.
3. Several records can be viewed at one time.
4. Entries can be easily copied if a microform reader/printer is available.
5. Equipment is relatively inexpensive. Some disadvantages of COM are:
   (a) Microforms are often not very readable compared to print.
   (b) It is not easily updated.
   (c) Updating is by supplements which may confuse the catalogue user.
   (d) The microfiche format may lead to interfiling of a base catalogue with supplements.
   (e) Deleted materials remain in the file until the next update.
   (f) Special microform reader/printers are expensive.

As COM catalogues gained popularity in the United States and elsewhere, several vendors attempted to introduce special readers for library applications. These readers can store upto 1200 feet of 16 mm. microfilm-the equivalent to twelve ordinary rolls on an internal reel. In most cases, the library's online COM catalogue can be contained in this reel which remains inside the reader and need not be handled by the user.

OPAC

Library automation has finally introduced online public access catalogue (OPAC). James Rice reports that at present more than 50 libraries in the United States are using this form of catalogue. Although most of these are in large libraries, a few are in medium-sized or even small libraries. Many more libraries are also trying to adopt OPAC. Such catalogues allow any member of the library community to search the catalogue data base in order to see if the library holds specific title of document to be informed of its location in the library, and if the catalogue system is linked to the circulation system, the enquirer be intimated whether the item is readily available or is on loan to other etc. It is stated that the availability of turnkey circulation systems have contributed to the development of OPACs and Geac turnkey system is getting much popularity in the libraries of UK and US.

In-house Automated Cataloguing

Library automated systems were first developed at local level in the United States. In fact some of the automated systems identified with vendors or bibliographic utilities were actually based on systems that first existed in individual libraries. Where in-house system is introduced, the libraries usually maintain a main file of catalogue records of the library's holdings. It is regularly updated and generally printed at periodic intervals. When in a library computerisation starts, there is every need to convert retrospective catalogue into machine readable form and add it to the main file to make it complete.

Following are the main processes involved in a cataloguing systems:

1. Preparing worksheet.
2. Generating machine-readable records.
3. Verification of the records and generation catalogue.
4. Generation of added entries.
5. Generation of indexes and cross-reference.
6. Printing the records.

Access Points

Before computer-based cataloguing starts, the library has to resolve many problems such as the actual and potential use of the library by the staff, students and other users; the length of data entry for various other usage within or without the institution etc.

Tedd referring to a research made at Bath University says that the following MARC fields can satisfy over 97 percent of readers requirements:

Tag Definition

Control Fields

001	Record Control number
050	LC call number
082	Dewey Decimal classification number

Main Entry Heading Fields

100	Personal name main entry heading
110	Corporate name main entry heading
111	Conference, congress, meeting etc., name entry heading

Title Fields

240 Uniform-title—excluding collective-title

245 Title and statement of responsibility area.

248 Second level and subsequent level title and statement of responsibility.

Edition Field

250 Edition area

Imprint Field

260 Publication, distribution, date, etc.

Notes Field

503 Edition and history note

Subject Heading Etc. Fields

600 Personal name subject heading

610 Corporate name subject heading

611 Conference, congress, meeting etc. subject heading

Added Entry Heading Fields

700 Personal name added entry heading

710 Corporate name added entry heading

711 Conference, congress, meetings, etc. name added entry heading

745 Title added entry heading-excluding uniform title

800 Series added entry (personal name-title)

840 Series added entry (title)

Automated Cataloguing Procedure

For designing in-house computerised cataloguing, the Librarian and the programmer should keep in view the length of information that could be expected from the catalogue. But it is not essential for local libraries in Pakistan to provide all the fields given in MARC record. The following fields can be sufficient in a medium-sized library:

1. Classification number
2. Main entry (personal or corporate)
3. Title
4. Imprint and collation
5. Series statement

6. Subject headings
7. Keyword entries
8. ISBN/ISSN/LC Card number.

Coding Structure

To evolve coding structure for codifying the fields (type of entry) is technically a part of system designing. A logical coding is required for developing inhouse software which is based on: (*l)* Overall system designed *(2)* type of computer language to be used for development of computerised system. However in some latest computer free format, pattern comprising all the parameters, has been developed.

Cataloguer can use and skip any field (access points) at one time depending upon the length of cataloguing data required without changing the entry codes every time.

This code identifies to the computer the type of data a record contains.

Type-of Entry-codes

If the practicing library is not using a standardised software, it can develop its own type-of-entry-code on such patterns.

Data Input

Records may be entered 'off-line' or 'on-line'. With the offline an input form is normally completed by the cataloguer which is then passed to a punch or other operator for 'translation' into a machine-readable form, *e.g.,* punched cards for inputting to the computer. With the on-line, records are entered direct into the computer via an on-line terminal keyboard.

1. *Computer Index Number. The* computer index number is consecutive (accession) number which has no intrinsic value. This number is assigned to every title in the library.
2. *Main Entry.* It is established according to AACR2 or name authority file for oriental names etc. Cataloguer using name entry code, types the name of the author on the keyboard of the computer. It appears on the screen. If the name of the author already exists in computer held record, it is skipped. Traditionally the author entry has been considered the "main entry". But with a computer system, there is no main entry in that sense. Author or title entries have no more importance as such. All entries in automated system stand equal.
3. *Title Entry.* Titles are entered into the record in the exact format and spacing in which they should appear in the printed catalogue cards.. Subtitle is entered in subfield. If software allows title can be permuted to offer more approaches to the important words in the title. Stop words are ignored.

4. *Imprint and Collation.* Imprint implies the place of publication, publisher and date. Publishers are entered under place, followed by publisher name. It follows title entry and then collation is recorded.
5. *Series Entry.* A name/title series entry is given if desired. Both name and title series are stored in name and title files respectively.
6. *Subject Headings.* L.C. or Sears' List of subject headings can be used for alphabetical subject access. Thesauri are used in specialised subject fields. Subject headings can be entered as required either in plain alphabetical language form or as a numerical subject entry code as are given in thesaurus etc. Subordinate subject headings can also be used if the system programme allows.
7. *Keyword Entries.* Keyword entries can be provided by permuting titles. This increases access points and strengthens subject approach in the catalogue.
8. *ISBN/ISSN and LC Cards Number.* The ISBN/ISSN access point file contains International Standard Book Numbers and International Standard Serial Number that may be used as access points when searching cataloguing database. Pakistan ISBN serves the same purpose. They all provide unique identification of an item and are convenient search keys. The LC Card number APF contains LC card numbers assigned by the Library of Congress. They may be from LC MARC cataloguing record or from the item in hand.

Merits

Most of the routine and repetitive jobs are done efficiently. Besides the catalogues, a variety of records is produced as byproducts. These are the catalogue cards or machine-readable records that serves as a basis for the production of COM or book catalogue, various printed records, book plates, book pockets, book cards, spine labels etc. It is also possible to use COM for the production of Union Catalogues, bibliographies, Reference tools. The computerised catalogue can be integrated into a total information system particularly in academic and special libraries. It encourages cooperative cataloguing and centralised cataloguing. In the on-line system direct input can be made through the terminals. It is also possible to correct, revise or amend the data on the existing record format required for new editions of the same titles.

Data Retrieval and Document Retrieval

The signals retrieved are data in one form or another. The distinction is sometimes made between data retrieval and document retrieval. A "data retrieval system" is one in which specific data are retrieved-the specific information requested in the inquiry. In fact, the term "document retrieval" is ambiguous. It can refer simply to systems in which a document is retrieved. Ordinarily, however, it is used to refer to a retrieval system in which the data retrieved are the description and address of one or more documents; and it is these documents that will contain the data desired. For example, suppose one wanted a list of strong and irregular German verbs.

A data retrieval system that enabled one to retrieve such a list directly would have to permit one to use a search command such that the list of strong and irregular verbs would appear. In a document retrieval system this would not happen. Instead, one would specify the need for a book on German grammar, specifying either a particular known work or any German grammar. This response does not, in itself, inform us about strong and irregular verbs. However, it is a reasonable assumption that, if we were to examine the book, it would contain a list of strong and irregular German verbs and their principal parts. In finding them, however, we may well use another information retrieval system, the index. Looking in the index under either "irregular" or "strong" indicates that, in this case, a list can be found starting on page 274.

There is, it would seem, a basic distinction between a data retrieval system designed to provide *directly* what one thinks one wants and a document retrieval—or, better, a "reference retrieval"—system that merely points one toward the desired data in one or more steps. However, difficulties arise. Suppose, for example, instead of wanting a list of strong and irregular German verbs, we had wanted to know the title of a German grammar by Luscher and Schapers— or, indeed, of any German grammar. The inquiry could have been formulated in the same way and posed to the same bibliographic retrieval system in the same way. The exact same response might well have been received as that given above. The difference is that the desired datum has been retrieved, without further searching being needed. In this example, the exact same system used in the same manner constitutes both a data retrieval system and a reference retrieval system. The only difference is in the intention of the user. This being so, we need to reexamine the distinction more closely. If it is not to be abandoned, then the following options remain:

(a) We can classify such a retrieval system as being a data retrieval system or a document retrieval system on the basis of the intention of the person using it; or

(b) We can define retrieval systems according to whether they are capable of functioning as a reference retrieval *as well as* a data retrieval system. This capability would appear to extend to any system in which the data stored are capable implicitly or explicitly of indicating further sources of data. From this perspective, we can consider data retrieval systems as a limited, primitive category within the larger class of retrieval systems.

Although the example used was bibliographical, other sorts are possible. The example, in museum documentation, the reference is likely to be to an actual artifact rather than to a book. More generally in data retrieval systems, the inclusion of some kind of reference to further documentation is likely to be provided whether explicitly or implicitly, even if only to indicate the source, authority, or definition of the data retrieved.

Retrieval Languages I: Notation

Describing things is a linguistic problem. Even concepts in formal logic have to be defined linguistically at some stage. One readily recognised distinction in descriptive labels is between "natural" language and "artificial" languages. For example, in a bookshop texts on economics are likely to be shelved by a sign bearing the label "ECONOMICS." The very same books in a public library might bear the sign "330," the symbol denoting Economics in the artificial notation of the Dewey Decimal Classification.

From the point of view of achieving an acceptable *address,* the labelling doesn't matter very much so long as it is intelligible and accurate. Also, from the point of view of achieving acceptable *definition,* the choice of notation, language, or meta-language doesn't matter very much as long as the description is sufficiently precise and intelligible for the purposes intended. It is common for a major distinction to be made between "classification schemes" based on artificial notations (such as Dewey) and natural language indexes. Both will be reviewed.'

Natural Language Systems

In natural language indexing systems, words or terms from the language of choice are used as descriptors. The simplicity is highly attractive. However, as increasing numbers of terms are used, various problems emerge. Since terms in natural languages overlap in meaning and in appearance, some kind of control is usually imposed. Examples of these include homographs: two or more words spelled the same way but different in meaning. For example, the word CHARACTER means different things to a playwright, a typewriter mechanic, a theologian, and an architect. Similarly, information about a TANK that would interest a general would not necessarily help a plumber. In these cases, the terms need to be expanded or differentiated in some way, or else inappropriate signals are likely to be retrieved.

Different words for the same concept or entity (synonyms) cause other problems. A retrieval system with information under AGRICULTURE might yield nothing in a search under FARMING. Straightforward one-to-one relationships can be handled by imposing further control. Typically, one term becomes the "preferred" term and the other term is used only for redirection. "For FARMING see AGRICULTURE." In practice, more difficult to handle are near-synonyms where the overlap is incomplete, e.g., AGRICULTURE and LAND USE. A list of subject headings, or thesaurus, enumerating terms and relationships between them and other terms is used. The process of control is usually known as vocabulary control or authority control.

Another complexity has to do with hierarchical relationships where material on a topic, such as dairying, can be found not only in books specifically on dairying listed under the heading DAIRYING, but also within more general books on agriculture listed under AGRICULTURE. Alternatively, there might be no general work on agriculture but books dealing with aspects of agriculture such as dairying, horticulture, aquaculture, and so on. Retrieval systems vary in the extent and manner in which they contain references to narrower (more specific) topics and to broader (more general) ones.

So far, only simple definitions have been considered. In practice, the topics of inquiry often require some complexity in description. Consider, for example, "TEACHING METHODS IN AUSTRIAN UNIVERSITIES FROM 1918 TO 1939." Natural language indexing systems can handle such combinations ("coordinations") of concepts in either of two ways. In a manual system, it is convenient to compose ("precoordinate") a single (but complex) entry following agreed conventions concerning the order of the aspects (more technically "facets") of the concept. In a traditional library subject catalogue one would expect to find a book on this topic listed under a heading of the following form "AUSTRIA, *Higher education,* 1918-1939. Teaching methods" and probably only under that heading.

If this precoordination were not done, one would need to look at each item listed under AUSTRIA, under *higher education*, under 1918-1939, and under *teaching methods* and select only those items which had been entered under *all* those labels. Technically, this is known as "postcoordination" since the expression of the relationship the coordination—is done at the time of the inquiry, after the time of indexing. It is obviously laborious.

In computer-based systems, where the computer can take on the chore of doing the "coordinating," it is customary not to express the coordination at the time of indexing. Various appropriate index terms would be assigned. In a postcoordinate search, the searcher enumerates the index terms that are expected to be helpful in identifying desired material, and the computer assumes the task of finding the books which have been assigned whatever combination of terms the searcher has specified.

One might also be able to specify the historical period though, in this case, it would probably be quite convenient to browse among the items retrieved by the above terms. These coordinate relationships can be ambiguous, since the mere occurrence of words may be insufficient to define the topic. A textbook example is the difference between a "venetian blind" and a "blind Venetian." Similarly with the three words "bites," "dog," and "man"—"dog bites man" is not the same syntactical relationship or meaning, nor is it as newsworthy, as "man bites dog."

These relationships can properly be described as syntactical in exactly the same way that syntax denotes grammatical relationships. On the whole, syntactical relationships tend to be ignored in indexing languages, but there are notable exceptions, such as relational indexing.

An often overlooked attribute of natural language indexing systems is that each system is natural to a particular time, place, and cultural environment. Subject headings used in the *British National Bibliography* are different from those assigned for a comparable purpose by the U.S. Library of Congress. Special groups of any kind—professional, social, technical, cultural, regional—will tend to use their own particular vocabularies. A natural language indexing system appropriate to one group is likely to be more or less unnatural and inappropriate to another. This limited applicability is also true to a lesser degree in the case of indexing languages with artificial notation in that they too reflect the conceptual arrangements (even though not the language) of a particular group.

Classification Schemes with Artificial Notation

Since they are intended to perform a similar role, it is not surprising that classification schemes with artificial notation tend to have characteristics similar to those of "natural" language systems.

1. Synonyms should also be avoided since, having established a label for a concept, subsequent labels for the same concept need not be created.
2. Homographs (words with identical spelling but different meaning) are avoided since the concepts are identified and distinguished prior to the assignment of the labels.
3. Hierarchical relationships need to be handled in the same sort of way. The relationships are typically embodied in the notation, e.g.,
   - 942 History of England
   - 942.7 History of Northwestern England
   - 942.76 History of Lancashire
   - 942.769 History of Lancaster

4. With complex topics such as "teaching methods in Austrian Universities, 1918-1939," the same solutions are available as with "natural" language, e.g. 378.1709436 in the Dewey Decimal Classification. Since most existing classification schemes are designed for human rather than computer use, complex precoordinate labels are used.

Precoordination, however, is not a necessary characteristic of classification schemes with artificial notation any more than it is with natural language indexing schemes. It is true that most existing schemes *are* precoordinate, but in recent decades most thinking about classification has been based on analysis into a number of "facets," which, in combination, define the topic concerned.

This faceted approach, which is detectable in revisions to existing schemes such as the Universal Decimal Classification (UDC), lends itself to postcordinate searching by computer, because the elements which have been "precoordinated" remain identifiable could, therefore, be used for a postcoordinate search also.

Similarities and Dissimilarities

As the foregoing discussion illustrates, natural language indexing systems and classification schemes with artificial notation are substantially similar in structure, controls, and uses. A natural language indexing system with a fully worked-out relationship between topics will require the same degree of analysis and control as a classification scheme for the same range of topics. From this perspective, it seems helpful to regard them both as part of the generic category of indexing systems. The difference in notation is just one of the differences between them and not necessarily the most important.

Other diferences are as follows:

1. Since the construction of a classification scheme with an artificial notation implies analysis of the relationships between topics, such schemes ordinarily have a great deal of "syndetic" control, i.e., rules concerning the preferred choice of indexing term and the relationships between terms. The development of syndetic control is not a necessary part of using natural language indexing systems, although it may be desirable. Consequently, the amount of syndetic control varies in practice from essentially none to very detailed control. Intuitively, it seems needed; in practice, there is some question as to whether the benefits justify the costs.
2. A classification scheme with artificial notation will need a natural language index to it—a "relative index"—if it is to be conveniently used.

3. Classification schemes with artificial notation permit the designer to arrange topics that are similar or related to be collocated. In natural language indexing systems, the juxtaposition of concepts will depend on accidents of spelling in the language concerned.
4. The labels used in classification schemes with artificial notation tend to be shorter, though there can be considerable variations in this. For example, "Bibliography of the Economic History of Hungary" would be "330.9439016" in the Dewey Decimal Classification but "ML,E2" in the Bliss Bibliographic Classification.

The foregoing discussion indicates that indexing systems vary in several ways: in fineness of detail; in degree of vocabulary control; in syndetic structure; and in choice between pre-and postcoordination. The principal conclusions from tests of retrieval systems are that, despite these variations and the ingenuity of their designers, there is little difference between them in effectiveness, even though they tend to retrieve different material even when the same inquiries are posed in identical circumstances.

Multiple Retrieval Systems

The ability of a retrieval system to retrieve signals (which, according to the intentions of the user, can be regarded either as the data desired or pointers toward the data desired) can be illustrated by considering some the many examples of retrieval mechanisms in a library.

One user might treat the subject arrangement of the documents on the shelves (arranged according to the Dewey Decimal Classification, perhaps) as a retrieval mechanism and go directly to the shelves associated with the Dewey number(s) expected to contain the signals (books) desired.

A second user might approach the library catalogue and examine subject headings and note the bibliographical data recorded on the cards there. That may be all that the user wanted if verifying a bibliographical citation and willing to rely on card catalogue data instead of inspecting the documents themselves.

A third user might do exactly the same as the second user but the data recorded on the cards do not constitute the goal, only the directions to the document on the shelves.

A fourth user might go to the librarian and express the inquiry verbally. The librarian, acting as a retrieval system, would endeavor to convert the inquiry into the terms of the library system and deliver the data required, whether this is a whole document or merely a mention of specific data from within a book. When a document is found, further retrieval mechanisms—index, table of contents—may be used to identify more specifically what is wanted. Dictionaries, encyclopedias, and bibliographies—all examples of retrieval mechanisms—may well be used independently or in conjunction with other means of searching. It is clear that many examples of retrieval systems occur in libraries and that they can be used independently or sequentially.

Retrieval Languages

In the previous sections we restricted our attention to subject indexes using natural languages or artificial notation. This provided a convenient introduction to some semantic and syntactical aspects. However, it is important to emphasize that "subject" access is only one example of retrieval. Documents and data can have "contextual" attributes assigned to them for the purpose of retrieval, such as author, publisher, and date of creation. Indeed, in academic libraries, more use is made of author entries in the catalogues than of subject entries. The principal means of arrangement and approach for archival materials is their administrative provenance. As noted, attributes of authorship and provenance can also have connotations of subject content.

A citation, by means of which an author refers in one document to another document, implies a relationship between the two and constitutes *prima facie* evidence that if one document is relevant to an inquiry, so might the other be. Citation indexes can be viewed as a form of subject index even though the attribute that forms the basis for retrieval is citedness rather than a description of what the document is about. The argument is that the usual custom in scholarly research is to cite closely related work. Such citation is, therefore, indicative of a close relationship, usually in subject matter. Hence, the citation of one article by another generally implies similar subject matter. Since the description is in the form of a citation, not in the inconstant terminology of subject indexes, a citation index has some advantages when it comes to the use of articles in foreign languages or on subjects without standardised terminology. This is reminiscent of our argument, that a document description can be a surrogate description of a subject inquiry.

This point has been stressed because of our assertion that retrieval is primarily a linguistic process, drawing on:

(a) *semantics:* the study of the elements of a language from the point of view of meaning;

(b) *syntax:* the study of the formal interactions that exist between the elements of language; and

(c) *pragmatics:* the study of the relationships between signs of linguistic expressions and their uses.

Since retrieval systems are based on indexing "languages" which share (more or less) the attributes of ordinary languages, they derive from the culture of their context and their study can be asserted to be a form of linguistic study. We can note that this assertion assumes that linguistics does or can include the study of "artificial" languages. How far this assertion can be pushed is a matter for debate. It is suggested that all retrieval systems could be included on the grounds that all depend on indexing "languages," that all indexing languages depend on the assignment of attributes and on the labelling of these attributes, and that a proper understanding of these systems depends on semantic, syntactical, and pragmatic analysis. This is more easily understood in the case of "word"-based subject indexes than in others, but we speculate that it is also true of all "non-word" indexes using artificial notation, all contextual indexes, all citation indexes, and even systems based on the statistical association of attributes of data or documents.

Concepts, Objects and Definability

So far, we have simply assumed that a "descriptor," whether drawn from natural language or concocted in some artificial notation, can suffice to describe concepts. This is not the case. A descriptor can act as a label. It may also serve as an address. It may define the topic, more or less, but it is unlikely in all cases to provide sufficient definition to describe completely the topic in relation to other topics. The extent to which definition is needed will vary with respect to at least two considerations:

1. The number of different entities to be described. In a trivial example of an information retrieval system that retrieves data concerning only two or three items (e.g., the number of chairs, tables, and lamps in a warehouse), the need to define will be trivial. In contrast, a chain of furniture shops or a large furniture museum will need detailed definitions to distinguish one type from another.
2. The definability of the entities concerned. It is clear that not all concepts are equally easily defined. Consider the following sequence of concepts:
   (a) Seat 34C on flight PA 6 from San Francisco airport on January 29, 1980.
   (b) An elephant
   (c) Heat
   (d) Lassitude.

The airline seat is easily unambiguously defined. An elephant is quite difficult to describe but can be recognised from pictures. Once one knows what an elephant looks like, there is usually little doubt as to whether a particular object is an elephant or not. Heat can only be indirectly illustrated. It cannot be seen directly, though sometimes its causes or effects can be. It can be sensed, however, if one is close enough and it can be defined and measured in physical terms. Lassitude can be sensed and symptoms of lassitude can be observed. Not at all clear, however, is the relationship between lassitude and related concepts such as ennui, tiredness, weariness, exhaustion, boredom, etc. Unlike the aircraft seat, the elephant, and heat, there would appear to be no precise accepted definition of lassitude. If one were to search in an information retrieval system for material about "lassitude" one would probably have to try a variety of search terms, and the items retrieved as a result of the search would probably vary in the extent to which they were about lassitude.

Areas of study appear to vary in the extent to which the concepts they deal with are definable. Physical sciences tend to have "hard," i.e., relatively definable concepts such as temperature, molecular weight, size, velocity, etc. This is reasonable since the physical sciences deal with physical objects and the physical relationships between them. The "hardness" of these properties permits relatively easy measurement and calculation. One development can build upon another because the earlier achievements are clearly defined. The progress in achievement in the hard sciences is, in consequence, more palpable than in other areas of activity such as education, literature, political science, or social welfare.

The "softer" areas tend to be those which deal with human behaviour and social values. Each area of study appears to have a characteristic degree of intellectual hardness/softness. There seems to be variation within areas (e.g., welfare economics seems "softer" than econometrics) and subjects may change in hardness/softness over time. In other words, definability does not appear to be itself a linguistic problem. If it were, then coining new words might solve many difficulties. Rather, there appears to be something more basic that has effects which are difficult to handle linguistically. Bunge comments that "vagueness or blurredness has no positive aspect and is a conceptual rather than a linguistic disease, hence it is rather more difficult to cure.

The extent to which formal, logical notation and quantification are used is an indicator of hardness. It is an imperfect one since the use of such notation and quantification is not necessarily appropriate or well rooted in realistic definitions. The terminology of hardness and softness is potentially misleading. One of the meanings of the word "hard" signifies a firm consistency and its opposite is "soft." In that sense, the imagery of *intellectual* hardness and softness is appropriate. A different meaning of the word "hard" is "difficult." For that meaning, the proper opposite is "easy" rather than "soft."

It is in the second connotation of hardness as an indicator of difficulty that this imagery is misleading with respect to *intellectual* hardness and softness. The pages of formal notation and algebra which characterize writings in physics and chemistry look particularly unintelligible to the lay person. However, in an important sense it is even more difficult to make progress in fields where definitions are "soft" and unreliable, than when they are relatively "hard" and dependable. The foundations built by previous scholars cannot so easily be taken on trust but may need redefinition. New work may need to be built into rather than *onto* prior work. However one may view *difficulty,* let us simply accept that the definability of concepts—the intellectual "hardness" and " softness"—varies from one field of discourse to another.

To the extent to which terms are relatively low in definability, information retrieval is likely to be less satisfactory since retrieval, being a linguistic process, depends heavily on definitions.

In view of the importance of definition in communication, one would expect definability to emerge as fundamental in information studies in general and information retrieval in particular. Storer has referred to the distinction between hard and soft sciences as being possibly "the most powerful single variable in explaining disciplinary differences in the cultural realm." So far, however, research appears to have been limited. Studies of the information gathering habits of social scientists indicate a general similarity with the habits of physical scientists. Hindle has suggested that in patterns in use of books and journals, "softer" subject areas are characterised by much more diffuse reading than "harder subjects." In other words, the use of documents is more widely spread over different titles and over materials of a wider range of ages.

Signaling Through Time

Robert Fairthorne's delightful description of information retrieval as "marking" and "parking" catches nicely the expectation that what is marked and parked may be retrieved after some lapse of time. If that were not the case, then "discarding" or "dumping" would be more appropriate. The same emphasis on the elapse of time as a feature of information retrieval was made more explicitly by Calvin Mooers in a short paper that is said to contain the first use of the term "information retrieval." Mooers describes information retrieval as "communication through time."

The image of information retrieval as communication through time helps explain the lack of direct link between the originator of the message and the recipient. One can readily imagine messages (data, documents) as having hooks (tags, labels, or descriptors) attached to them and then being placed in some timeless void where they remain until an inquiry in the form of a set of one or more hooks reaches into the same void and pulls back any messages which have one or more hooks coinciding with those of the inquiry. However, as one starts to work around the edges of this definition it becomes a little frayed. In one special case of information retrieval, there is an attempt to minimize the lapse of time. This occurs when every new batch of marked and parked information is automatically searched for material pertaining to specific inquiries. In professional jargon, a standing profile of reader's searches is routinely searched against a file in order to provide S.D.I. (selective dissemination of information). One might regard this as a sort of preemptive information retrieval, although the notion of a standing order would seem closer.

Yet even here, some delay, even if minimised, is necessarily present because each of these processes of acquiring, marking, parking, and retrieving must take some time. Even in prompt on-line processing, the indirectness and sequential, discontinuous, two-stage nature of the process necessarily involves some time—even though it might be very little. A different sort of problem emerges from other examples of communication which take time and which do not easily fit accepted definitions of informal retrieval.

A letter sent through the mail will take time to arrive. (Strictly, all communication processes must take *some* time even though they may be trivial.) A notice that is posted on a fence, such as "Trespassers will be prosecuted," or on a refrigerator, "Don't drink all the milk," will continue to inform people for as long as it remains posted. A documentary article in a newspaper may consciously be intended to inform readers in posterity.

The simplest conclusion from all this would seem to be that, although information retrieval can properly be regarded as communication through time, it is not the only form of communication in which time may be significant. Delay, one could conclude, is a necessary attribute of information retrieval but not exclusive to it. In information retrieval, the indirectness or discontinuity of communication permits and, indeed, *ensures* delay over and above the time required for communication itself. Both time and indirectness would seem to be significant in information retrieval and will be considered.

Indirectness

By the "indirectness" of information retrieval systems, we refer to the characteristic that the designers and operators do not know who will seek the indirect communication that the information retrieval system provides. Not only does one not know *who,* one also does not know *why* they will seek to use it or what perspectives and vocabulary they will have when they seek to use it. To some extent, this lack of prior knowledge is shared by other communication systems, notably in mass communication. One is, in general, unable to predict or later ascertain who heard a radio broadcast, read a newspaper, or heard a speech to a crowd—or how much of it they understood—or how beneficial the message was to them. In information retrieval situations, however, there is a further problem and that is that the user—with or without someone else acting as a mediator—needs to define what it is that needs to be retrieved. The vocabulary of the would-be user is necessarily somewhat different from that of the designer of the retrieval system, since no two persons' vocabularies are exactly alike, and may be substantially different especially if the designer (a category within which we include the indexer for present purposes) is distant in time, education, and culture from the would-be user. This problem of predicting rather than knowing what each future user of the system is likely to ask for and how he or she is likely to ask for it has long been recognised. Indexing and cataloguing are, in part, predictive pastimes since the formal description of what data represent and what documents are about has to be modified by estimation of the probability that they will be sought and of the probable ways in which they will be sought. For the most part, this seems to have been assumed more or less implicitly. In analysis, it has been described in terms of "thought experiments." The importance in practice of this indirectness varies according to the circumstances and, we suspect, with the degree of definability. Previously, we have noted three factors as affecting definability:

(a) The range of choices available: limited in most management information systems; unlimited in general libraries and archives.

(b) The definability of the things that might be retrieved: from specific aircraft seats to vague cultural concepts.

(c) The extent to which the individual seeking to use the system can describe what he or she needs to reduce distressing ignorance: from a telephone number to, say, background material on stoicism in modern Western culture.

Time and indirectness would both seem to reduce the closeness of match between the designer and the user in terms of approach to description and definition. Both, therefore, would seem to exacerbate the problems of matching characterised by these three dimensions. Strictly speaking, it is the fact of indirectness which *permits* the matching of definitions and it is the fact of time which inhibits adaptation of the system to the user. The user can, heuristicly, learn to understand the system better and the system, if computer-based, might be programmed to facilitate this heuristic learning. With either manual or computerbased systems, other humans can, and often do, play a mediating role, as, for example, in doing a literature search on behalf of someone else who is too busy or less familiar with the retrieval systems available. Significantly, ascertaining what the user wants and translating it into a form suitable for the system(s) to be used are both regarded as important processes which not only take time but require special training. We conclude that:

- information retrieval involves communication through time, although not all communication through time is information retrieval;
- information retrieval is necessarily indirect communication;
- both the delay and the indirectness are liable to exacerbate existing difficulties caused by problems of definability.

Time

In some cases, library catalogues compiled more than a century ago are still in active use. The disadvantage of old catalogues is that older cataloguing practice differs from contemporary cataloguing in two ways. Descriptive cataloguing (choice of form of entry for author, title, etc.) has evolved over the years. An extreme example-found in an ancient English library in a book-form catalogue printed in 1790 and still in use-is the entry of books by the author, “Smith,” under the letter F— because the genitive case of the Latin word for a smith (*faber*) begins with an F. Those whose work requires them to use old catalogues tend to learn how to allow for some of these vagaries. More serious is the shift in terminology for describing things over the years.

In all aspects of human activity, new terms are coined and existing words change their meaning. Language evolves. Objects themselves may evolve. Consider, for example, the computer. Its appearance, power, and function have all changed radically in less than half a century. Finding antiquated terminology in library and other sorts of catalogues can be a source of amusement, of irritation, and of failure to retrieve. Inevitably, the use of words reflects the parlance and perspectives of the day. For example, Berman has drawn attention to the use of indexing terms which reflect sexist and racist attitudes which are now less acceptable in the United States than they used to be. From the point of view of information retrieval, the shifting of word usage over time and the evolving of new concepts, objects, and terms (which seem inevitable and behind which retrieval systems seem bound to lag) will mean that the retrieval system itself tends to become less accurate and less effective over time. The already imperfect description and definition, which are pivotal to effective retrieval, get worse.

Of course, the books should be recatalogued continually according to contemporary cataloguing practice, especially with respect to the subject headings used to describe what they are about. This requires, however, relatively expensive intellectual labor and the cost and benefits need to be weighed against the alternative uses of such money as is available. Most library users would be properly upset if their librarians ceased to buy new books of current interest in order to divert resources to the recataloguing of old books which may be of limited interest.

Retrieval, Responsiveness & Relatedness

The design, use, and evaluation of retrieval systems depend heavily on various sorts of relatedness. There have been two problems in discussions of this area: (1) the elements and relationships have not always been analysed in enough detail; and (2) terminology has not always been clear and consistent. In particular, the *utilisation of retrieved data* has not always been adequately distinguished from the *retrieval process* and the term "relevance" has been loosely used for more than one sort of relatedness. An attempt will be made to clarify the concepts and terminology involved.

The mechanism by which retrieval systems operate is the association (usually but not necessarily the matching) of arbitrarily chosen but predetermined attributes of the set of data that is to be susceptible to retrieval. The attributes that are used include authorship (as in a library catalogue), date of publication (as, sometimes, in bibliographies), age (as in museum documentation), occurrence of words (as in the searching of texts), and so on. The list of possible attributes that could be used seems endless: location, size, chemical process, origin, etc. Nor need attributes be used alone: systems retrieving bibliographical data, for example, commonly operate on two or more attributes in combination, e.g., authorship, date of publication, language, and subject matter. The retrieval system responds to an inquiry by yielding such data as it finds that are highly associated with the attributes specified in the inquiry.

Retrieval Elements

We have defined the use of retrieval systems as including three distinguishable stages: the *formulation* of an inquiry; the *retrieval* of signals; the *utilisation* of what has been retrieved. The effectiveness of each process can vary:

- The *formulation* of the inquiry may be more or less appropriate to the choice of attributes in the retrieval system. Much depends on the extent to which the person doing the formulation has an understanding of the data sought and of the characteristics of the retrieval system. The phrasing of the inquiry may be unskillful.
- Aside from mechanical failures, the *retrieval* process may be ineffective in two ways: it may respond with data that has been incorrectly retrieved; or it may fail to yield data that should have been retrieved. In conventional terms, these would be referred to as failures in precision and in recall, respectively, For example, using authorship as the attribute for retrieval, "Mark Twain" might be used as the inquiry. The retrieval system might correctly respond with data concerning works written by Mark Twain but fail to retrieve those written by Samuel Clemens—or, if it did, it might

also wrongly include data concerning works by Severus Clemens or Susie Clemens.

- *Utilisation* might be impaired if the inquirer did not have the necessary abilities (e.g., knowledge, cognitive skills) to become informed by the data retrieved.

From the analysis thus far there emerge several possibilities for things to be related to each other—or to have degrees of relatedness. These include but are not limited to:

1. the inquiry as formulated for the retrieval system;
2. any of a seemingly unlimited range of attributes;
3. data retrieved; and
4. benefit to the user.

Before considering sorts of relatedness, it is important to emphasize again the separateness of the retrieval process from the processes of formulation and of utilisation. The difference between retrieval and utilisation can be conveniently illustrated by what we might call the case of the disappearing user. Let us imagine that someone formulated and posed an inquiry concerning chocolate, cholesterol, and heart disease to a computer-based retrieval system. The retrieval system responds by yielding a set of data. The user becomes better informed as a result of perusing the data and benefits from a changed state of knowledge. Let us now imagine that, having posed the inquiry, the inquirer loses interest, is unable to await the response, or dies from a heart attack. In this latter scenario, there is no opportunity for utilisation of the data, nor, therefore, for benefit to the user. Yet the retrieval system has performed in exactly the same way. The process of retrieval and the data retrieved are indistinguishable, in fact unchanged, from one scenario to another.

We can clarify the distinction between formulation and retrieval by extending this simple case. In some circumstances, the user may modify the formulation of the inquiry if it is thought that the data yielded would not be what is desired. In this case, what has happened is that a *different* search has been formulated, however slight the modification has been. Commonly, the user's knowledge has changed as a result of preliminary indications concerning the set of data that would be yielded. The response by the retrieval system to any given formulated search will not have been changed unless the retrieval system itself has also been altered in some way, e.g., new data added or the indexing modified.

Relatedness

In the evaluation of information retrieval systems, the term "relevance" has been loosely used to denote differing forms of relatedness. A practical approach is to define the most useful relationships and degrees of relatedness first and then give them distinctive names. We shall consider three different relationships for each of which the terms "relevant" or "relevance" has been used.

Responsiveness

Responsiveness refers to relatedness of the data retrieved to the inquiry as posed in terms of the attributes used as the basis for retrieval. To what extent *did* the system retrieve all and only the works that it contains by Mark Twain? The quality of the response to the inquiry by the retrieval system will be affected by several factors including the appropriateness and completeness of the data base, the suitability of the attribute(s) used as the basis for retrieval (in this case authorship), and the ability of the retrieval system to identify those data that fit the description offered by the inquiry—or fit it to the desired degree. If one wished to avoid talking of the "relevance" of the retrieved data to the inquiry, one might speak of the responsiveness of the system.

Utility

"Utility," is defined following usage in economics, as benefit accruing. If reading a document and being informed by it leads to an enhanced state of knowledge which enables one to achieve some goal, then we can describe that process as having been beneficial or useful—as having utility.

We need to note two other outcomes: having a harmful effect, sometimes referred to awkwardly as a "negative utility," "disutility," or "disbenefit;" and having no known effect that could be regarded as useful or harmful—no utility or benefit.

Utility is meaningful only in terms of some objective, explicit or implicit. Giving somebody money has the property of utility if becoming wealthy or purchasing things are goals for that person; if that person were trying to achieve spiritual growth through poverty, then the gift of money would be unhelpful—of negative utility. Utility, then, is in all cases dependent on an objective. People have objectives. Inanimate objects do not. Organisations have objectives only to the extent to which individuals and groups have objectives which they seek to achieve through the organisation. Hence, utility is dependent not only on an objective but on the objective of one or more persons. Further, objectives imply values. There are values, implicit or explicit, which make one decide that it is desirable to pursue an objective, and a particular objective in preference over other objectives. Utility and objectives both derive from human values.

We are concerned here with information retrieval and the manner in which it might have utility. In principle, it would seem that being informed might assist in any of the objectives that one or more individuals might have: spiritual, physical, intellectual, professional, or social. These objectives might also be hindered. An obvious example of harmful information would be information that was, in fact, misinformation. The objective of getting from San Francisco to New York is likely to be hindered if one receives inaccurate information about the departure time of the airline flight and, as a result, misses the plane. Even so, although inaccurate information is likely to be the major cause of disutility associated with information retrieval, it is not necessary or proper to equate disutility with inaccuracy since it can happen that accurate information can also hinder the achievement of objectives. It is, after all, not absurd for someone to state honestly: "I would never have undertaken that task had I known more about what was involved, but I am glad that I did it!" Further, it is important to remember that if the utility derived from information retrieval can pertain to any human objective, then it is only to be expected that some of these objectives will appear obscure. They might seem irrational to other people. They might be kept a secret. They might lie deep in the subconscious and not be recognised even by the individuals concerned. They can be expected to reflect values of a very private nature as well as publicly proclaimed ones. There may be inconsistencies between professed objectives and those actually pursued. There will probably be conflicting objectives even for one individual.

Aboutness

Writings about retrieval and especially about the evaluation of information retrieval systems have been dominated by just one of the apparently unlimited range of attributes: subject matter, i.e., what documents are about. The term "aboutness" can be conveniently defined as referring to a coincidence of concepts, that is to say, if a book is "about" Australia, we infer that the book contains concepts that we associate with the subject "Australia." If it did not do so, we should deny that the book is "about" Australia. This is not entirely an objective matter since concepts have to be perceived and there may be some scope for disagreement in the perceptions by different people as to the concepts they perceive in a book and even in the concepts they associate with the subject "Australia" Hence, there is scope for honest difference of opinion as to what a book is about.

Consider, for example, an allegory. A person who fails to perceive the allegorical symbols will have a different opinion concerning what the text is "about" than someone who does perceive them. In an extreme case, most persons who saw a book on Buddhist mythology written in Tibetan would be able to perceive so little of the concepts that they would, if honest, have to say that they did not know what the book was about. This is a matter of conceptual perception as well as a linguistic problem. If the book on

Buddhist mythology were translated into a language they could understand, then, if the concepts were unfamiliar, they would probably still understand little of what the book was about. It is unwise to assume that a document has a single subject matter.

It would seem more sensible to recognize that a document may, by general consensus, be concerned with a particular topic and yet have quite different meanings for particular individuals on particular occasions. In addition to the problems of the recognition of the concepts, there is also the problem of the definability of the concepts. Even with accurate perception, if there is not a rigorous, exclusive, unambiguous use of terms, the defining of the concepts perceived in the book may vary from one reader to another.

This might simply be a matter of using alternative and equivalent synonyms. However, to the extent that concepts are not susceptible to description in unambiguous terms—they are vague or "soft"—then it is to be expected that statements by different individuals as to what a book is about, i.e., which set of concepts they perceive to be represented, will vary. Different people will state different nonequivalent definitions as to what the book is about. The scope for honest disagreement concerning what something is about is important. However, in any given point in linguistic and cultural time and space, there is likely to be a great deal of agreement.

If there were not, then subject indexes would not work. On the assumption that indexes are expected to indicate what things are about, one can state that the effectiveness of indexes depends on and is determined, in part, by the degree of uniformity in perception of concepts, and common definition and labelling of those concepts. Retrieval using the attribute of what documents are about has been and can be expected to be of primary importance since subject access is difficult, useful, and technically interesting.

It has dominated so much that it has, perhaps, hindered clarity of thought about the foundations of information retrieval theory. Retrieval by "aboutness" has to be seen as the use of one attribute among many. Our conceptual framework and definitions should be broad enough to include all attributes not just one.

Pertinence

In Relatedness I above, we were concerned with the general term: the relatedness of the retrieval system's response to the inquiry regardless of the attribute(s) being used as a basis for retrieval. We now consider one special case within the general class: when the attribute used as the basis for retrieval is topicality—the subject matter of the data. In ordinary speech one might well speak of one topic as being relevant to another topic.

Such relationships (e.g., general to specific, overlap) can be difficult to understand or to define. For example, when retrieving by the attribute of topicality, data on “Freud” are related (relevant) but not identical to the topic of psychoanalysis. We might term this relatedness “pertinence “ This sort of relatedness between properties of data within a given attribute could exist with other attributes than topicality.

Berieficiality

A relationship that is entirely different from either of the above is that between the retrieved data and the benefit of the user. It is in this sense, for example, that Wilson has sought to limit the use of the term “relevance” in *Two Kinds of Power* and it is implicit in all discussions of utility-theoretic indexing. Stated simply, it is assumed that retrieval systems are provided and used in order that their utilisation will have beneficial effects. Social values are implied.

This raises two questions: (1) Whose values? The users’ or those of the providers of the service? and (2) Are we referring to actual benefits or expected benefits? These are critical questions. However, whatever answers are given, it is clear that the relationship is different in kind from both responsiveness and pertinence because factors external to the retrieval system affect the outcome: social values and the knowledge and cognitive skills of the users.

Implications for Information Retrieval

We have defined responsiveness as signifying the extent to which the retrieval system yields data associated with the attribute(s) specified in the formulated inquiry. We have defined beneficiality as the property of assisting in the achievement of objectives. We have noted that these objectives are necessarily the objectives of human beings and relate to human values even though they may sometimes be obscure and even seem irrational to other people. From this discussion the following conclusions would seem to follow.

An ideal information retrieval system would retrieve data and documents that would assist individuals in the pursuit of their objectives, i.e., values. This implies that the information retrieval system should be concerned with the utility of what is retrieved rather than what it is about, since utility, not aboutness, is the goal. In order to achieve utility, the ideal information retrieval system would need to know the objective(s) and value(s) of each user.

Since redundant information does not help achieve goals and may hinder their achievement, the information retrieval system would, ideally, also have to know the state of knowledge of the inquirer—both its extent and its limitations. Avoiding the retrieval of unneeded and unusable data is, after all, a major purpose of information retrieval systems. If a researcher sought material relevant to an inquiry concerning Freud, it is unlikely that it would be helpful to retrieve a document that had been written by that same researcher, even though it may be related to the subject of the inquiry. It is not practical by any known technique to expect to know all of the objectives of people currently using an information retrieval system. It is still less reasonable to expect to be able to predict what future users' objectives and values might be. Even if one could, the most useful set of retrieved documents is likely to be unique for each inquiry. Further, since each person's mind is unique, even objectives that are ostensibly the same for different people may be different in practice. What is more, since redundant information is to be avoided, subsequent inquiries concerned with the same person's objective would call for different responses since the individual's state of knowledge will probably have changed in the meanwhile.

Some things will have been learned, others forgotten. Therefore, an ideal information retrieval system based on utility would have a formidable set of design requirements. It would need to understand objectives that present inquirers might not be willing to admit to or might not consciously understand fully themselves; it would need to predict which persons might use the system in the future and what their objectives might be in that future; and it would in each case need to know not only what the individual's objective is but also that same individual's state of knowledge not at the point in time that the inquiry was made but at the point in time that the data are retrieved. This would have to be true for each and every individual who may come to use the system. What should be retrieved should vary even for different posings of the same question by the same person. All this is quite apart from the fact that the concepts and definitions used may be more or less ambiguous.

Although such an ideal system would seem to be what is needed, the compounding of inherently improbable achievements one upon another means that this ideal system is most likely to remain an inspiring but unrealised achievement. (Not that this might not be helpful. Witness the repeated homage to the inspirational role played by Vannevar Bush's seminal essay, "As We May Think," published in 1945.

The notion of imagining what future inquiries might be posed may very well be a useful device (*cf.* W. Cooper), but the combination of needing to know objectives, values, and future states of knowledge—including knowledge not yet known to anybody—casts grave doubt on the achievability of such an ideal system.

In the discussion of "aboutness" above, reasons were adduced as to why complete agreement is not to be expected concerning what documents are about. Nevertheless, within a given cultural and linguistic context, considerable consensus is likely. Indexing and retrieving books according to what they are currently perceived to be about is, therefore, a more practical matter than indexing them in relation to potential future inquiries.

If indexing and retrieval based on aboutness is more practical than indexing with respect to predictions of future inquiries and future knowledge, how does aboutness relate to utility? The answer would appear to be two-fold:

1. If we hold relentlessly to the importance of utility—of being beneficially informed—we can still regard aboutness as a sensible *predictor* of utility to the inquirer. If we seek to reduce our ignorance *about* Freud, a document about Freud is likely to make us more fully informed about Freud. Further, although this process does nothing to minimize the retrieval of knowledge that we already know, this redundancy is at worst inefficient rather than misleading since we can, presumably, ourselves filter out subsequently that which is already known to us.
2. in our discussion, we have tended to assume that the attribute used as a basis for retrieval would be its subject aboutness. Although a subject retrieval system could operate in isolation, this is a singularly unrealistic and unnecessary assumption, since constant use is in fact made of other attributes of identifying documents which might be useful. A few examples will demonstrate: Contextual attributes such as author, origin, date of creation, and extensions of these can be helpful. Indeed, in the case of archives, the principal means of arrangement and approach for documents is their administrative provenance. In libraries, a common mode of approach is to use the author's name as a means of identifying books on a subject on which it is thought that person might have written. Citations, by means of which an author refers in a document to another document, imply a relationship between the documents—a prima facie indicator that if one document is related to an inquiry, so might the other. The success of the various citation indexes is clear evidence of their value in supplementing subject indexes. Further, a part of the formal information system is the information specialist who operates and may have designed it. Users of archives depend heavily on the archivist for guidance. Librarians have always included in their role the drawing on their experience with bibliography, with their collections and with their users in order to assist users (*cf.* the "reference interview"). In addition, it is foolish not to include as part of this picture the informal assistance played by friends and colleagues who can and do play a significant role in scholarship and in bureaucracies, to give but two examples.

Briefly, information retrieval based on what documents are deemed to be about (as opposed to prediction of what is unknown in relation to future enquiries) can be expected to work moderately well in practice because there is more or less consensus on what documents are about, because "aboutness" can plausibly be regarded as predictive of utility, and because, in practice, subject indexing is supplemented by other indicators of probable utility.

Information retrieval based on "aboutness" lends itself to automatic indexing since the occurrence and more especially the co-occurrence of terms in the text can indicate the apparent subject content of the document. This may be expensive and error-prone, but results likely to be of some use can be achieved.

The very same reasons which make the ideal information retrieval system unlikely also make implausible the concept of an "information counselor" in any sophisticated sense. Any person knowledgeable about sources of information can, in general, be helpful. However, the notion of an information counselor based on an analogy with a dietician, who can diagnose and prescribe information like a change of diet, would have to cope with the same problems as would the ideal information system: in addition to understanding objectives which the inquirer may imperfectly comprehend, the counselor would also need to understand the extent and nature of the inquirer's knowledge, and presumably be able to identify the point at which the inquirer has been beneficially informed to a sufficient extent. The analog of a dietician would be more apt if states of knowledge could be objectively assessed by blood count, encephalograms, and the like.

Competence to Use Retrieval Systems

Those who would use retrieval systems are fully competent to do so. This is a most unwise assumption for the following reasons:

(a) There are many different retrieval systems. Consider the fact that Sheehy's *Guide to Reference Books* describes more than 10,000 different bibliographies and other works of reference.

(b) Typically, several retrieval systems are likely to contain material about a given topic, and many others may well contain at least a little material relating to that topic.

(c) Each system is more or less different from the others, even though the differences may sometimes be small and subtle. Further, retrieval systems commonly change. Published works may have new editions and computer-based retrieval systems are continuously being modified.

These are the reasons why a good reference librarian not only knows many reference sources, but also has the familiarity and understanding that come from frequent use, and keeps up-to-date. It is inconceivable that one could know too many sources, could be too familiar with them, or would be unnecessarily up-to-date. This is clearly a major challenge even for the dedicated professional information specialist. What, then, of the user who is not a professional reference librarian or information specialist? There are, of course, some exceptional individuals, but the general situation is entirely predictable:

(a) There is some vague (but generally incomplete) awareness that libraries have considerable potential for the retrieval of information.

(b) The number of retrieval systems known to any given user is likely to be small.

(c) The expertise that can come only from conscious attention to the complexities of the system is likely to be lacking in most cases.

It is difficult and unreasonable to imagine any circumstances in which this situation could be expected to be otherwise, since such expertise requires opportunity, time, and effort—and not just once but on a continuing basis. It is not at all clear that for everyone the benefits involved in being expert justify paying the price. The consequence is that the use of retrieval systems is bound to be far less in both frequency and effectiveness of use than is possible and beneficial. But to assert that this is "wrong" would be to forget the price involved (mostly nonmonetary) and to overlook the fact that the use of retrieval systems is a means, not an end. More use of libraries can sensibly be expected to follow—and only to follow—changes in the perceived benefits and perceived costs. What then could or should be done? Three sorts of practical activities would seem sensible:

(a) Greater awareness of the existence and of the potential usefulness of retrieval systems would permit *consideration* by the user of more use of them.

(b) A lower price—primarily, greater ease of use—can be expected to result in an increase of use.

(c) More effectiveness in retrieval systems should also help since that should increase the benefit. Yet, caution is in order since use will follow perceptions of cost-effectiveness as perceived by the user. (Because we are discussing use, we deliberately listed ease ahead of effectiveness.)

Some of the price (effort) can be reduced by using a competent intermediary (a reference librarian or information specialist). However, it is easily overlooked that using an intermediary may increase the price somewhat unless the user trusts and is accustomed to using the intermediary. Otherwise, for most people, a psychological effort and a change of habit—hence, a price—may be involved in asking for help. The style and demeanour of the reference librarian can increase or decrease the perceived price involved. In this rather intangible area, the interpersonal skills of librarians become important. So also is instruction (formal or otherwise) in library skills.

Major problems include the providing of motivation and the development of good enough instruction. In a university context, a favourable attitude by faculty in the students' area of study and arrangements for credit for bibliographical instruction to count toward their degree both help. Pitching the instruction at the correct level and relating the learning experience to the user's personal interest both appear to be important. Unfortunately, skill as a librarian does not, in and of itself, guarantee skill as an instructor.

9

Online Information Retrieval

Basically, concept of using machines for storage and processing of information can be traced as far back as 1960's. In late 1960's online bibliographic databases were made available as a by-product of primary printed publications.

The world's first computer produced periodical-*Chemical Titles*-was introduced by Chemical Abstracts Service (CAS) in 1961. It has covered 750 chemically oriented journals. Each article was indexed by author and keywords with a reference to the journal in which it has appeared. The computers were used for typesetting. Use of computers for typesetting made it possible to accommodate more material in a machine readable form. The creation of machine readable databases helped in providing alerting services. This was beginning of a significant change in information retrieval.

The machine readable databases were manipulated further to produce a variety of products such as indexes in printed forms for manual searching. The 1970's witnessed the extensive use of computers in information handling. The creation of machine readable databases like Chemical Abstracts, Biological Abstracts, Index Medicus by secondary information services coincided with the development of long distance telecommunication networks like Tymnet and Telenet in USA. The online search concept as an industry started when two organisations viz. M/s. Lockheed under M/s. Dialog Information Services in 1972 and M/s System Development Corporation (SDC) in 1973 provided softwares and necessary computing facilities to enable the databases to be sorted and searched interactively in batch mode through telecommunication networks.

Information is a commercially exploitable commodity. It has to be produced/generated, communicated and used properly. It is "unscare" resource and continues to grow at an explosive rate.

The tasks of locating and communicating information presents the following problems:

(i) Large volume of information causes overload at the processing end.

(ii) Increasing time lag between generating and publishing information.

(iii) Interdisciplinary nature of growth in science possesses problems in locating the desired information.

(iv) Proliferation in the growth of primary and secondary journals presents problems in bibliographic control.

(v) Language and other communication barriers.

A vast array of electronic gadgets have been produced to store, organize and communicate the information world wide at a very fast speed. The rapid advancement in computers, storage media and software packages for processing information have eased the situation considerably. It has been possible to convert large volumes of information and data available in abstracting and indexing services in science and technology into machine readable from called databases. At present there are over 7000 such products available for commercial exploitation through over 600 vendors world wide.

Computerised Databases

Extensive use of computers for information storage and processing resulted in creation of computerised databases covering all area of science and technology.

These databases are of two major varieties viz. (1) Reference Databases and (2) Source Databases. Reference databases are of two categories such as *(a)* Bibliographic and *(b)* Referral. Records in bibliographic databases contain clues to the intellectual content and physical characteristics of pieces of the graphic or printed record of humanity such as journal article, research report, conference proceedings, book or patent etc.

The referral databases contain directory type information such as list of persons, organisations, research projects etc.

Source databases are primary sources of information or data composed of the full texts of the information in question and including materials prepared specifically for distribution by electronic means.

These databases could be further subdivided into (a) Full Text, (b) Numeric and (c) A combination of the two—textual numeric.

Full text database contain original textual material belonging to primary sources such as encyclopedia, newspaper, court decisions, journals etc.

Numeric database contains original numeric or statistical data such as financial, census, production trade data.

Textual numeric databases contains fields of mixed textual and numeric data and includes dictionary or handbooks.

Here it is pertinent to furnish information on some important databases in science and technology.

Reference Databases

Bibliographic Databases

(1) *Biosis Previews:* Producer: Biosciences Information Service, USA. Contains Over seven million records.1969 to present.

(2) *CA Search:* Producer: Chemical Abstracts Service, USA. Contain over nine million records. 1967 to present.

(3) *Compendex Plus:* Producer: Institute for Scientific Information (ISI), USA. Contain over two million records. 1970 to present.

Referral Databases

(1) *American Library Directory:* Producer: R.R. Bowker, USA. Contain over thirty six thousand records. Current.

(2) *American men and Women of Science:* Producer: R.R. Bowker, USA Contains over one lakh records. Current.

(3) *Books In Print:* Producer: Thomas Publishing Company Inc., USA. Contains over one lakh fifty thousand records. Current.

Source Databases

Fulltext Databases

(1) *Harvard Business Review:* Producer: John Wiley & Sons Inc., USA. Contains over two thousand five hundred records. 1971 to present.

(2) *Kirk Othmer Online:* Producer: Wiley Electronic Publishing, USA. Contains over thirty three thousand records. 3rd Edition.

(3) *Martindale Online:* Producer: The Pharmaceutical Society of Great Britain, UK. Over forty three thousand records. Current edition.

(4) *PTS Newsletter Database:* Producer: Predicast, USA. Contains over four lakh records. January 1988 to present.

Numeric Databases

(1) *Cendata:* Producer: US Bureau of the Census, USA. Contains over fifty two thousand records current.

(2) *Mediai General Plus:* Producer: Media General Financial Services Inc., USA Contains over seven thousand records. Current.

(3) *D&B Donneley Demographies:* Producer: Donnelley Marketing Services, USA Contains over sixty two thousand records. Current.

(4) *D&B Duns Financial Records Plus:* Producer: Duns and Bradstreet Credit Services, USA Contains over Twenty lakh records. Current.

Textual/Numeric Databases

(1) *ICC International Annual Reports:* Producer: ICC Online Ltd. UK, contains over ninety seven thousand records. Current.

(2) *Extel International News Cards:* Producer: Extel Financial Ltd. UK. Contains over twenty one thousand records. October 1989 to present.

(3) *Investext:* Producer: Technical Data International Inc., USA. Contains over fourteen lakh records. July 1982 to present.

(4) *Moody's Corporate News:* Producer: Moody's Investor Services Inc., USA. Contains over three lakh seventy thousand records, 1988 to present.

Telesearching

Telecommunication Modes

Since 1970 there have been considerable growth in the production of computer readable databases. As on today there are over seven thousand publically available machine readable databases as compared to few hundreds at the beginning.

These are marketed through over eight hundred search services providers popularly known as vendors. Improvements in telecommunication system, satellite links and modems transmitting at 2400 baud or higher speeds are commonly used for online searching. The advancements in computer technology and telecommunication systems have also brought down the searching costs considerably.

In case of India, the following are the three modes of telecommunication available for accessing computerised databases:

Telex Mode

Most of the institutes/organisations possess a telex terminal as a means of communication. This system can be used for conducting online searches too. Advancements in telex machines from electrical telex to computerized Message Communication Terminals (MCT) to PC Telex cards have made the transmission more easy. The transmission speed of this system is 50 bauds per seconds. This slow speed makes online searching more costlier as compared to other modes.

Dialup Data Service (PSTN)

Under this mode two computers are connected through telephone lines to transmit data. It is called Dialup Data Service (PSTN). Here modems to inter phase the computer and telephones lines are used at both the ends. The speed of transmission are 300 or 1200 bauds.

GPSS/PAD Mode

With the introduction of Gateway Packet Switching Service (GPSS) and Packet Assembler Disassembler (PAD), data can be transmitted at a rate of 1200 bauds, 2400 bauds and 4800 bauds. This mode is still cheaper for online searching. Average telecommunication cost for a search duration of five minutes will be around Rs. 60 whereas with Dialup data services it will be around Rs. 1200 and telex mode is still costlier.

Vendors

Databases are produced by various organisations, in very few cases the producer of the database provide access to database. It is very common for the database producer to load the database with an online host. The online host provides the computer for storage of database, software to search the database with back-up services to maintain, market and provide documentation for searching the database. They also update the databases periodically. They have developed a powerful computer system to store large volume of information. These online hosts are known as system suppliers of online service or vendors. As on today there are over eight hundred vendors in the world.

Interactive Searching

Search Strategy

The term strategy has been used in different ways in the information retrieval literature. It is commonly referred to as a command put to a search system. Some have referred to as search formulation. Sometimes it is used in the literature to refer to one's action at a particular point in search execution, a decision about what might be the best way to proceed, a methodology to serve an immediate objective. In a broader sense the strategy can be defined as an overall plan for getting the desired results formulated considering the facilities available with the database searched, structure of database and the topic to be searched. The result of the online search depends on the formulation of strategy best suited. It is a skill and can be developed by experience and detailed study of databases.

Preparation of search strategy comprises the following points:

(i) To identify concepts.

(ii) To ascertain index terms, synonyms etc. of these concepts.

(iii) To identify proper databases.

(iv) To study indexing features of the database.

(v) To formulate the query.

Output

The cost structure of database has three cost components viz. (1) connect charges, (2) database use charges or hit charges and *(3)* telecommunication charges. Costs at serial number one and two varies from database to database and also on format of output and option offline or online. For getting the output these cost factors play important role.

Online: Obtaining the output of the search results is the final stage in information retrieval online. Databases offer different formats for outputting the results. The results can be obtained either online or offline. Online results became available to the requestor immediately after the search in other words the results are downloaded to the hard disc, before disconnecting the call. Costwise, getting results online is expensive as the connect charges and telecommunication cost is added till the typing or displaying is in progress.

There is also possibility of loosing the communication link and interrupting the type or display transaction. In this case one has to repeat the type or display command which results increase in search cost. If the number of records are more the time taken for downloading will be more and cost will be also more. In such cases it is advisable to have offline print option.

Offline: Getting offline output of search results means one has ordered the host computer to print the search results in a desired format and then the call is disconnected. Here the printing is done after the call is disconnected and then the results are mailed to requestor by air. In this option connect charges and telecommunication charges are levied upto the point of disconnecting the call or logoff. Getting the search results offline is economical. Normally the printouts are received with in ten days time.

As of now India has gained a reputation of having advanced information and communication technology all over the world. India is not behind in adopting new technologies in information handling. Dialog in 1972 and Orbit in 1973 introduced computerised information retrieval on commercial basis. In India INSDOC under NISSAT project arranged a demonstration of online access to the ESA/IRS database from terminals installed in Bombay in November 1976. Encouraged with this successful demonstration, INSDOC submitted a proposal to the Government of India for setting up ESA/IRS terminals in India. However, this proposal could not be implemented. During 1979-80 an experimental project was undertaken by the Information Centre for Aeronautics in NAL Bangalore to access ESA/IRS databases in online mode between Paris-Frascati and offline between Paris-Bangalore: In 1985 NISSAT launched a feasibility study for establishing online information retrieval centres in the country. This was entrusted, to CMC.

Some other institutions also started using ordinary telex machines for information retrieval. Informatics (India) Pvt. Ltd., Bangalore, an Indian party was instrumental in setting up online access centres in several institutions/concerns. Some of them were BHEL, DESIDOC, CFTRI, NCL etc.

NCL established contacts with one of the largest database vendor viz., M/S. DIALOG Information Services, Palo Alto California, USA, for interactive searching of international databases in 1984. The mode of access was telex. One year later similar arrangements were made with M/S. STN International, a subsidiary of Chemical Abstracts Service, Washington, USA. Upto June 1988 this facility was for R&D work of NCL only.

National Centres

Government of India under Department of Scientific and Industrial Research (DSIR) has initiated to set up five online access centres to search computerised databases. These centres are called NISSAT Access Centres for International Data Centres (NACID) and are situated at the following places:

(1) INSDOC, New Delhi

(2) NAL, Bangalore

(3) NCL, Pune

(4) CLRI, Chennai

(5) IACS, Kolkata.

The functions of these centres have been identified as:

(i) To maintain the facility for online access to international data centres.

(ii) To assist the users in formulation of queries and actual conduct of the search.

(iii) To conduct training courses and user orientation programmes in query formulation and search techniques.

(iv) To collect interest profiles from potential users and provide SDI services.

(v) To promote use of online interactive facilities and therefore to promote and communicate relevant publicity materials.

(vi) To recover costs from the users as per the policy laid down for the centre.

(vii) The centre at NCL will cater to the needs of Western Region comprising Gujarat, Madhya Pradesh, Maharashtra, Dadra and Nagar Haveli, Goa, Daman and Diu.

Experiment at NCL: Online search facility was introduced in NCL from 1984 for inhouse user, with access facility to M/S. Dialog Information Services, USA. The mode of access was telex. With the establishment of NACID Centre, this facility was extended to outside users in 1988. The centre has created the following facilities:

Terminals

Telex Mode

Under this mode the databases are accessed through telex line using the under mentioned equipments.

— Message Communication Terminal (MCT)

— Dot Matrix Printer.

The data transmission speed is 50 bauds per second.

Dialup Data Service (PSTN) Telephone Mode

Under this mode telephone channels are used to transmit the data. The speed of transmission varies from 300 bauds per second. The following equipment have been procured for this mode.

— PC/AT with 20MB Hard disc, colour monitor, two serial and two parallel ports

— One dot matrix printer

— One modem (300-1200 bps)

— Telephone line with ISTD facility

— Communication Softwares: *(a)* Procomm, *(b)* Dialog link.

Gateway Packet Switched Services (GPSS)/Packet Assembler/ Disassember (PAD)

Videsh Sanchar Nigam Ltd. (VSNL) has extended the facility of data transmission from Pune through PAD in 1989. NCL has acquired this facility to conduct online searches of international databases. The equipment procured for PSTN mode are used for this mode also. The only additional facility created was to obtain a nodal point from VSNL for GPSS access. The speed of transmission is 1200 bauds per second.

Database Vendors

NCL has established contacts with (i) Dialog Information Services, USA; (ii) STN International, USA and *(iii)* Easynet. Over six hundred databases are available for online search through these vendors.

Search Tools

Computerised database producers use different technique of indexing and organising the records. Users are to know these techniques for retrieving the desired record effectively. Datacentres has installed mostly mainframe computers to manage the files using their own softwares. Users have to know the searching facilities provided in these softwares. A number of search aids for online accessing are circulated by the database vendors and database producers. These are known as searching manuals and database chapters.

Manpower

Sufficient manpower with proper training and expertise has also been created at the centre.

Cost Effectiveness

In fact, the cost in interactive searching of computerised databases consists of the following components.

(i) *Hit charges:* This is the charge levied on the references selected for a given topic. This varies according to details copied or printed minimum for the record number and maximum for the full details. The cost can be controlled by selecting the proper details/format of output and also the relevant records.

(ii) *Computer connect charge:* This is the charge database vendor levy on the use of their system. It is dependent on the database to be searched and is measured on connect time basis. To economize this cost the search strategy must be well defined, short and properly structured.

(iii) *Telecommunication Charges:* This is the charge levied by the agencies providing telecommunication facilities and is dependent on volume of data transferred or duration of connection. Thus if the system is slow, the searching cost will be higher. Even the computer connect charge will also go up, hence effort should be made to use faster transmission media. First preference should be given to GPSS, there after PSTN and lastly Telex mode.

(iv) *Terms used:* Some database vendors levy charges on the number of index terms used in searching. This can be economized through judicious selection of index terms and structuring of search strategy.

Further the undermentioned points may be adopted to economize the search cost.

(i) To define the search topic precisely.

(ii) To select proper index terms by consulting database chapters and thesaurus.

(iii) To prepare search strategy before logging in and store it in the computer in advance.

(iv) To use special features of databases e.g. use registry number while searching Chemical Abstracts database, which is faster and precise as compared to index terms.

(v) To use faster mode of communication preferably GPSS if available.

Digital Library: Elements, Concepts and Scope

The idea of easy, finger-tip access to information-what we conceptualize as digital libraries today-began with Vannenar Bush's Memex machine (Bush, 1945) and has continued to evolve with each advance in information technology. With the arrival of computers, the concept centred on large bibliographic databases, the now familiar online retrieval and public access systems that are part of any contemporary library. When computers were connected into large networks forming the Internet, the concept evolved again, and research turned to creating libraries of digital information that could be accessed by anyone from anywhere in the world.

Phrases like "virtual library," "electronic library," "library without walls" and, most recently, "digital library," all have been used interchangeably to describe this broad concept. But what does this phrase mean? What is digital library? And what are the issues and challenges in creating them? Moreover, what are the issues involved in creating a coordinated scheme of digital libraries? It has been suggested that digital libraries will only be viable within such a scheme.

Of course, the concept of digital library has multiple senses that one might invoke in various contexts. For example, the concept may refer simply to the notion of collection without reference to organization, intellectual accessibility or service attributes. This extended sense seems to be in play, for example, when we hear the World Wide Web described as a digital library.

The concept might also refer to the organization underlying the collection, or even more specifically to the computer-based system in which the collection resides.

The latter sense seems to be most operative in the NSF digital library initiative programme. Digital *libraries* might also be distinguished from digital *archives* to emphasize the nature of the works collected or, as in *Preserving Digital Information: Report of the Task Force on the Archiving of Digital Information*, to stress the preservation function.

One could, of course, revise, refine, and otherwise improve this comprehensive definition. However, it is meant here mainly to suggest that there is a set of attributes that gives coherence to the concept of digital libraries.

These attributes include functions of collection, organization, preservation, access and economy. A programme for the development of "federated" digital libraries needs to be defined and measured in terms of the development of these attributes.

However, the proposed definition also emphasizes that "digital libraries" need to be defined and measured in relation to the communities they serve. Thus, the DLF programme aims to situate the development of digital libraries in a larger context of service.

Main Elements

Digitizing

Digitizing or digitization is representing an object, image, document or a signal (usually an analog signal) by a discrete set of its points or samples.

The result is called "digital representation" or, more specifically, a "digital image", for the object, and "digital form", for the signal. McQuail identifies the process of digitalization having immense significance to the computing ideals as it "allows information of all kinds in all formats to be carried with the same efficiency and also intermingled". (2000: 28)

Analog signals are continuously variable, both in the number of possible values of the signal *at* a given time, as well as in the number of points in the signal *in* a given period of time.

However, digital signals are discrete in both of those respects, and so a digitization can only ever be an approximation of the signal it represents.

A digital signal may be represented by a sequence of integers. Digitization is performed by reading an analog signal A, and, at regular time intervals (sampling frequency), representing the value of A at that point by an integer.

Each such reading is called a sample. A series of integers can be transformed back into an analog signal that approximates the original analog signal. Such a transformation is called DA conversion. There are two factors determining how close such an approximation to an analog signal A a digitization D can be, namely the sampling rate and the number of bits used to represent the integers.

The term digitization is often used when diverse forms of information, including text, sound, image and voice, are encoded in a single 0-1 binary code. Digital information exists in only one of two forms-0 or 1-which are called bits (a contraction of 'binary digits'), and the sequences of 0s and 1s that constitute information are called bytes. The term is often used for the scanning of analog sources, such as printed photos or taped videos into computers for editing, but it also can refer to audio (where sampling rate is often measured in kilohertz) and textures map transformation. In this last case, as in normal photos, sampling rate refers to the resolution of the image (often measured in pixel per inch). Digitizing is the primary way of storing images in a form suitable for transmission and computer processing.

Digitizing is making a digital representation of geographical features within a raster image or vector using a geographic information system, i.e, the creation of electronic maps, either from various geographical imagery or by digitizing the traditional paper maps. Since the advent of digital video the term continues to be frequently used, as of 2005, to refer to the process of importing footage into a computer via a FireWire cable. But this is not technically accurate, as the footage is already digital, so it is not really being digitized, but rather encoded into whatever format the non-linear video editing software uses.

"Digitization" is also used to describe the process of populating databases with files or data. While this usage is technically inaccurate, it originates for the previously-proper use of the term to describe the part of the process which involved converting the analog sources (printed pictures, printed brochures, etc.) into the digital representation before uploading to the target database(s). Digitizing is also used in the field of apparel where an image is recreated by artists with the help of embroidery digitizing software tools and saved as embroidery machine code. This machine code is fed into an embroidery machine and embroidered onto apparels. The most supported format is DST file. Digitizing also refers to the process of acquiring precise dimensions from a real world object, such as a car, using a CMM (Computer-Aided Manufacturing Measurement) device. Common digitization methods include optical 3d (laser) scanners as well.

Analog to Digital

Analog signals are continuous electrical signals. Digital signals are non-continuous. Nearly all recorded music has been digitized. About 12 percent of the 500,000+ movies listed on the Internet Movie Database are digitized on DVD.

Processes

The broad use of internet and the increasing popularity of Lean philosophy has also increased the use and meaning of "digitalizing". It is now often used in order to describe the work of improving organizational processes. This will often involve some kind of a Lean process in order to simplify process activities. In many organization this will be followed up with an effort of improving the efficiency in the new "lean and mean" process by digitalizing data and activities. There are no doubt that internet technology have improved many valuechains and also shifted the focus on organizational cooperation into the "battlefield" of value chain cooperation and competition.

Analog Texts to Digital

About 5 percent of texts have been digitized as of 2006. Older print books are being scanned and optical character recognition technologies applied by academic and public libraries, foundations, and private companies like Google. Unpublished text documents on paper which have some enduring historical or research value are being digitized by libraries and archives, though frequently at a much slower rate than for books. In many cases, archives have replaced microfilming with digitization as a means of preserving and providing access to unique documents.

Implications of Digitalisation

This shift to digitalisation in the contemporary media world has created implications for traditional mass media products, however these "limitations are still very unclear" (McQuial, 2000: 28). The more technology advances, the more converged the realm of mass media will become with less need for traditional communication technologies.

For example, the Internet has transformed many communication norms, creating more efficiency for not only individuals, businesses also. However, McQuail suggests traditional media have also benefited greatly from new media, allowing more effective and efficient resources available (2000: 28).

Collaborative Digitization Projects

There are many collaborative digitization projects throughout the United States. Two of the earliest projects were the Collaborative Digitization Project in Colorado and NC ECHO-North Carolina Exploring Cultural Heritage Online, based at the State Library of North Carolina.

These projects establish and publish best practices for digitization and work with regional partners to digitize cultural heritage materials. Additional criteria for best practice have more recently been established in the UK, Australia and the European Union. Wisconsin Heritage Online is a collaborative digitization project modeled after the Colorado Collaborative Digitization Project. Wisconsin uses a wiki to build and distribute collaborative documentation. Georgia's collaborative digitization programme, the Digital Library of Georgia, presents a seamless virtual library on the state's history and life, including more than a hundred digital collections from 60 institutions and 100 agencies of government. The Digital Library of Georgia is a GALILEO initiative based at the University of Georgia Libraries.

In South-Asia Nanakshahi trust is digitizing manuscripts of Gurmukhi Script.

Library Preservation

Digital preservation at its most basic definition is a series of activities aimed towards ensuring access to digital materials over time. Digitization is a means of creating digital surrogates of analog materials such as books, newspapers, microfilm, and videotapes. Digitization can provide a means of preserving the content of the materials by creating an accessible facsimile of the object in order to put less strain on already fragile originals.

The prevalent Brittle Books issue facing libraries across the world is looking towards a digital solution in long term preservation. For centuries, books were printed on wood-pulp paper, which turns acidic over the period of its decay. As the paper ages, it deteriorates to a point of being completely unusable. In theory, if these widely circulated titles are not treated with de-acidification processes, the materials upon those acid pages will be lost forever. As technology evolves, it is increasingly becoming a preferred method of preserving these materials-mainly because it can provide easier access points and significantly reduced amounts of physical storage space.

Google, Inc. has taken steps towards attempting to digitize every title with "Google Book Search". While some academic libraries are in contract with the service, issues of copyright law violations threaten to derail the project. However, it does provide-at the very least-an online consortium for libraries to exchange information and for researchers to search for titles as well as review the materials.

Fiction

Works of science-fiction often include the term digitize as the act of transforming people into digital signals and sending them into a computer. When that happens, the people disappear from the real world and appear in a computer world (as featured in the cult film *Tron*, the animated series *Code: Lyoko*, or the late 1980s live-action series *Captain Power and the Soldiers of the Future*). In the video game Beyond Good and Evil the protagonists holographic friend digitizes the players inventory items.

Book Scanning

In fact, Book scanning is the process of converting physical books into digital images or electronic books (e-books) via image scanning. This is a much less time-intensive method than re-typing all of the text; before scanning became feasible, re-typing was generally the only option. Once a book has been digitally scanned, the images are available for rapid distribution, reproduction, and on-screen reading. Such book images are commonly stored in a DjVu, Portable Document Format (PDF), or Tagged Image File Format (TIFF). One can reap additional benefits by using optical character recognition (OCR) to convert images of book pages into a machine-processable encoding of the book's text, dramatically reducing the storage needed for the book and allowing the text to be reformatted, searched, or used as input for text processing applications such as natural language processing.

Commercial Book Scanners

Commercial book scanners are not like normal scanners; these book scanners are usually a high quality digital camera with light sources on either side of the camera mounted on some sort of frame to provide easy access for a person or machine to flip the pages of the book. Some models involve V-shaped book cradles, which provide support for book spines and also center book position automatically.

The advantage of this type of scanner is that it is very fast, compared to the productivity of overhead scanners. Compared with traditional overhead scanners whose prices normally start from US$10,000 upwards, this type of digital camera-based book scanner is much more cost-effective.

Projects like Project Gutenberg, Google Book Search, and the Open Content Alliance scan books on a large scale. One of the main challenges to this is the sheer volume of books that must be scanned, expected to be in the tens of millions. All of these must be scanned and then made searchable online for the public to use as a universal library. Currently, there are 3 main ways that large organizations are relying on: outsourcing, scanning in house using commercial book scanners, and scanning in house using robotic scanning solutions. As for outsourcing, books are often shipped to be scanned by low-cost sources such as India or China. Alternatively, due to convenience, safety and technology improvement, many organizations choose to scan in-house by using either overhead scanners which are time-consuming, or digital camera-based scanning solutions which are substantially faster, and is a method employed by Internet Archive as well as Google.

Traditional methods have included cutting off the book's spine and scanning the pages in a scanner with automatic page-feeding capability, with rebinding of the loose pages occurring afterwards. Once the page is scanned, the data is either entered manually or via OCR, another major cost of the book scanning projects. Due to copyright issues, most scanned books are those that are out of copyright; however, Google Book Search is known to scan books still protected under copyright unless the publisher specifically excludes them.

Destructive Scanning

For book scanning on a low budget, the least expensive method to scan a book or magazine is to cut off the binding. This converts the book or magazine into a sheaf of looseleaf papers, which can then be loaded into a standard automatic document feeder and scanned using inexpensive and common scanning technology. While this is definitely not a desirable solution for very old and uncommon books, it is a useful tool for book and magazine scanning where the book is not an expensive collector's item and replacement of the scanned content is easy. There are two technical difficulties with this process, first with the cutting and second with the scanning.

Cutting: The proper method of cutting a stack of 500 to 1000 pages in one pass is accomplished with a guillotine paper cutter. This is a large steel table with a paper vise that screws down onto the stack and firmly secures it before cutting. The cut is accomplished with a large sharpened steel blade which moves straight down and cuts the entire length of each sheet all at once. A lever on the blade permits several hundred pounds of force to be applied to the blade for a quick one-pass cut. A clean cut through a thick stack of paper cannot be done with a traditional inexpensive sickle-shaped hinged paper cutter.

These cutters are only intended for a few sheets, with up to ten sheets being the practical cutting limit. A large stack of paper applies torsional forces on the hinge, pulling the blade away from the cutting edge on the table. The cut becomes more inaccurate as the cut moves away from the hinge, and the force required to hold the blade against the cutting edge increases as the cut moves away from the hinge.

The guillotine cutting process dulls the blade over time and which must be resharpened. Coated paper such as slick magazine paper dulls the blade more rapidly than plain book paper, due to the kaolinite clay coating. Additionally, knifing an entire hardcover book causes excessive wear due to cutting through the hardcover backing. Instead the outer cover is removed and just the internal bound paper stack is cut.

Scanning: Once the paper is liberated from the spine, it can be singly scanned one sheet at a time in a traditional flatbed scanner. However this is a slow and laborious process. It is instead much easier to use an automatic document feeder (ADF) to scan the material. Some types of books can be difficult to scan in an ADF due to the book having a decorative riffled edging or curving in an arc due to a non-flat binding. An ADF is intended to scan pages which are all of uniform shape and size, and this nonuniform sizing can lead to improper scanning. For these books, the riffled edges or curved edge is guillotined off to render the outer edges flat and smooth before the binding is cut.

The coated paper slickness of magazines and bound textbooks can make them difficult for the rollers in an ADF to pick up and guide along the paper path. An ADF which uses a series of rollers and channels to flip sheets over may be subject to many jams and misfeeds. Generally there are fewer problems by using as straight of a paper path as is possible, with few bends and curves. The clay can also rub off the paper over time and coat sticky pickup rollers, making them loosely grip the paper. The ADF rollers may need periodic cleaning to prevent this slipping.

Magazines can pose a bulk-scanning challenge due to small nonuniform sheets of paper in the stack, such as magazine subscription cards and fold out pages. These need to be removed before the bulk scan begins, and are either scanned separately if they include worthwhile content, or are simply left out of the scan process.

Non-Destructive Scanning

In recent years, software driven machines and robots have been developed to scan books without the need of disbinding them in order to preserve both the contents of the document and a digital photo archive of its current state. This recent trend has been due in part to ever improving imaging technologies that allow a high quality digital archive image to be captured with little or no damage to a rare or fragile book in a reasonably short period of time. Some high-end scanning systems employ vacuum and air and static charges to turn pages while imaging is performed automatically, usually from a high resolution camera located over an adjustable v-shaped cradle. Images are then shuttled from the imaging device into various editing suites which can further process the images for either an archival-quality file such as TIFF or JPEG 2000, or a web-friendly output such as JPEG or PDF.

Digital Preservation

In fact, Digital preservation is the management of digital information over time. Preservation of digital information is widely considered to require more constant and ongoing attention than preservation of other media. This constant input of effort, time, and money to handle rapid technological and organizational advance is considered the main stumbling block for preserving digital information. Indeed, while we are still able to read our written heritage from several thousand years ago, the digital information created merely a decade ago is in serious danger of being lost, creating a digital Dark Age.

Digital preservation can therefore be seen as the set of processes and activities that ensure continued access to information and all kinds of records, scientific and cultural heritage existing in digital formats. This includes the preservation of materials resulting from digital reformatting, but particularly information that is born-digital and has no analog counterpart. In the language of digital imaging and electronic resources, preservation is no longer just the product of a programme but an ongoing process. In this regard the way digital information is stored is important in ensuring their longevity. The long-term storage of digital information is assisted by the inclusion of preservation metadata. Digital preservation is defined as: long-term, error-free storage of digital information, with means for retrieval and interpretation, for the entire time span the information is required for.

Long-term is defined as "long enough to be concerned with the impacts of changing technologies, including support for new media and data formats, or with a changing user community. Long Term may extend indefinitely". "Retrieval" means obtaining needed digital files from the long-term, error-free digital storage, without possibility of corrupting the continued error-free storage of the digital files. "Interpretation" means that the retrieved digital files, files that, for example, are of texts, charts, images or sounds, are decoded and transformed into usable representations. This is often interpreted as "rendering", i.e. making it available for a human to access. However, in many cases it will mean able to be processed by computational means.

Remarkably, Society's heritage has been presented on many different materials, including stone, vellum, bamboo, silk, paper and etc. Now a large quantity of information exists in digital forms, including emails, blogs, social networking websites, national elections websites, web photo albums, and sites which change their content over time. According to a report by the US Library of Congress, 44 percent of the sites available on the internet in 1998 had vanished one year later. The unique characteristic of digital forms makes it easy to create content and keep it up-to-date, but at the same time brings many difficulties in the preservation of this content. Margaret Hedstrom points out that "digital preservation raises challenges of a fundamentally different nature which are added to the problems of preserving traditional format materials."

Physical Deterioration

The first challenge digital preservation faces is that the media on which digital contents stand are more vulnerable to deterioration and catastrophic loss. While acid paper are prone to deterioration in terms of brittleness and yellowness, the deterioration does not become apparent in at least six decades; and when the deterioration really happens, it happens over decades too. It is also highly possible to retrieve all information without loss *after* deterioration is spotted. The recording media for digital data deteriorate at a much more rapid pace, and once the deterioration starts, in most cases there is already data loss. This characteristic of digital forms leaves a very short time frame for preservation decisions and actions.

Digital Obsolescence

Another challenge, perhaps a more serious and important one, is the problem of long-term access. Digital technology is developing extremely fast, and one retrieval and playback technology can become obsolete in a matter of years. When faster, more capable and cheaper storage and processing devices are developed, the older version gets replaced almost immediately. When a software or decoding technology is abandoned, or a hardware device is no longer in production, records created under the environment of such technologies are at great risk of loss, simply because they are not tangible any more.

This process is known as digital obsolescence. This challenge is exacerbated by the lack of established standards, protocols, and proven methods for preserving digital information. We used to save copies of data on tapes, but media standards for tapes have changed considerably over the last five to ten years, and there is no guarantee that tapes will be readable in the future.

Hedstrom further explained that almost all digital library researches have been focused on "architectures and systems for information organization and retrieval, presentation and visualization, and administration of intellectual property rights" and that "digital preservation remains largely experimental and replete with the risks associated with untested methods". While the rapid advance of technology threats access of digital contents in length, the lack of digitizing standards affects the issue in width.

In 2006, the Online Computer Library Center developed a four-point strategy for the long-term preservation of digital objects that consisted of:

(i) Assessing the risks for loss of content posed by technology variables such as commonly used proprietary file formats and software applications.

(ii) Evaluating the digital content objects to determine what type and degree of format conversion or other preservation actions should be applied.

(iii) Providing access to the content.

(iv) Determining the appropriate metadata needed for each object type and how it is associated with the objects.

Notably, there are several additional strategies that individuals and organizations may use to actively combat the loss of digital information.

Migration

Migration is the transferring of data to newer system environments (Garrett et al., 1996). This may include conversion of resources from one file format to another (e.g., conversion of Microsoft Word to PDF or OpenDocument), from one operating system to another (e.g., Windows to Linux) or from one programming language to another (e.g., C to Java) so the resource remains fully accessible and functional. Resources that are migrated run the risk of losing some type of functionality since newer formats may be incapable of capturing all the functionality of the original format, or the converter itself may be unable to interpret all the nuances of the original format. The latter is often a concern with proprietary data formats. The National Archives Electronic Records Archives and Lockheed Martin are jointly developing a migration system that will preserve any type of document, created on any application or platform, and delivered to the archives on any type of digital media (Reagan, 2006).

In the system, files are translated into flexible formats, such as XML; they will therefore be accessible by technologies in the future (Reagan, 2006). Lockheed Martin argues that it would be impossible to develop an emulation system for the National Archives ERA because the volume of records and cost would be prohibitive (Reagan, 2006).

Emulation

Emulation is the replicating of functionality of an obsolete system (Rothenberg, 1998). For example, emulating an Atari 2600 on a Windows system or emulating WordPerfect 1.0 on a Macintosh. Emulators may be built for applications, operating systems, or hardware platforms. Emulation has been a popular strategy for retaining the functionality of old video game systems, such as with the MAME project. The feasibility of emulation as a catch-all solution has been debated in the academic community (Granger, 2000).

Raymond A. Lorie has suggested a Universal Virtual Computer (UVC) could be used to run any software in the future on a yet unknown platform (Lorie, 2001). The UVC strategy uses a combination of emulation and migration. The UVC strategy has not yet been widely adopted by the digital preservation community. Jeff Rothenberg, a major proponent of Emulation for digital preservation in libraries, working in partnership with Koninklijke Bibliotheek and National Archief of the Netherlands, has recently helped launch Dioscuri, a modular emulator that succeeds in running MS-DOS, WordPerfect 5.1, DOS games, and more (Hoeven, 2007).

Refreshing

Refreshing is the transfer of data between two types of the same storage medium so there are no bitrate changes or alteration of data. For example, transferring census data from a gold preservation CD to a new one. This strategy may need to be combined with migration when the software or hardware required to read the data is no longer available or is unable to understand the format of the data. Refreshing will likely always be necessary due to the deterioration of physical media.

Replication

Creating duplicate copies of data on one or more systems is called *replication*. Data that exists as a single copy in only one location is highly vulnerable to software or hardware failure, intentional or accidental alteration, and environmental catastrophes like fire, flooding, etc. Digital data is more likely to survive if it is replicated in several locations. Replicated data may introduce difficulties in refreshing, migration, versioning, and access control since the data is located in multiple places.

Trustworthy Digital Objects

Digital objects that can speak to their own authenticity are called *trustworthy digital objects* (TDOs). TDOs were proposed by Henry M. Gladney to enable digital objects to maintain a record of their change history so future users can know with certainty that the contents of the object are authentic (Gladney, 2004). Other preservation strategies like replication and migration are necessary for the long-term preservation of TDOs.

Metadata Attachment

Metadata is data on a digital file that includes information on creation, access rights, restrictions, preservation history, and rights management. Metadata attached to digital files may be affected by file format obsolescence. ASCII is considered to be the most durable format for metadata because it is widespread, backwards compatible when used with Unicode, and utilizes human-readable characters, not numeric codes.

It retains information, but not the structure information it is presented in. For higher functionality, SGML or XML should be used. Both markup languages are stored in ASCII format, but contain tags that denote structure and format.

Sustainability

Digital sustainability encompasses a range of issues and concerns that contribute to the longevity of digital information. Unlike traditional, temporary strategies and more permanent solutions, digital sustainability implies a more active and continuous process. Digital sustainability concentrates less on the solution and technology and more on building an infrastructure and approach that is flexible with an emphasis on interoperability, continued maintenance and continuous development. Digital sustainability incorporates activities in the present that will facilitate access and availability in the future.

Standards

To standardize digital preservation practice and provide a set of recommendations for preservation programme implementation, the Reference Model for an Open Archival Information System (OAIS) was developed.

The reference model (ISO 14721: 2003) includes the following responsibilities that an OAIS archive must abide by:

(i) Negotiate for and accept appropriate information from information Producers.

(ii) Obtain sufficient control of the information provided to the level needed to ensure Long-Term Preservation.

(iii) Determine, either by itself or in conjunction with other parties, which communities should become the Designated Community and, therefore, should be able to understand the information provided.

(iv) Ensure that the information to be preserved is Independently Understandable to the Designated Community. In other words, the community should be able to understand the information without needing the assistance of the experts who produced the information.

(v) Follow documented policies and procedures which ensure that the information is preserved against all reasonable contingencies, and which enable the information to be disseminated as authenticated copies of the original, or as traceable to the original.

(vi) Make the preserved information available to the Designated Community.

Basically, OAIS is concerned with all technical aspects of a digital object's life cycle: ingest into and storage in a preservation infrastructure, data management, accessibility, and distribution. The model also addresses metadata issues and recommends that five types of metadata be attached to a digital object: reference (identification) information, provenance (including preservation history), context, fixity (authenticity indicators), and representation (formatting, file structure, and what "imparts meaning to an object's bitstream". Prior to Gladney's proposal of TDOs was the Research Library Group's (RLG) development of "attributes and responsibilities" that denote the practices of a "Trusted Digital Repository" (TDR).

The seven attributes of a TDR are: "compliance with the Reference Model for an Open Archival Information System (OAIS), Administrative responsibility, Organizational viability, Financial sustainability, Technological and procedural suitability, System security, Procedural accountability." Among RLG's attributes and responsibilities were recommendations calling for the collaborative development of digital repository certifications, models for cooperative networks, and sharing of research and information on digital preservation with regards to intellectual property rights.

Digital Sound Preservation Standards

In January 2004, the Council on Library and Information Resources (CLIR) hosted a roundtable meeting of audio experts discussing best practices, which culminated in a report delivered March 2006.

This report investigated procedures for reformatting sound from analog to digital, summarizing discussions and recommendations for best practices for digital preservation. Participants made a series of 15 recommendations for improving the practice of analog audio transfer for archiving:

1. Develop core competencies in audio preservation engineering. Participants noted with concern that the number of experts qualified to transfer older recordings is shrinking and emphasized the need to find a way to ensure that the technical knowledge of these experts can be passed on.
2. Develop arrangements among smaller institutions that allow for cooperative buying of esoteric materials and supplies.
3. Pursue a research agenda for magnetic-tape problems that focuses on a less destructive solution for hydrolysis than baking, relubrication of acetate tapes, and curing of cupping.
4. Develop guidelines for the use of automated transfer of analog audio to digital preservation copies.
5. Develop a web-based clearinghouse for sharing information on how archives can develop digital preservation transfer programmes.
6. Develop a list of music experts who could be consulted for advice on transfer of specific types of musical content (e.g., determining the proper key so that correct playback speed can be established).

7. Research safe and effective methods for cleaning analog tapes and discs.
8. Collate relevant audio engineering standards from organizations.
9. Develop a reference chart of problematic media issues.
10. Develop a flowchart for identifying the composition of various types of audio discs and tapes.
11. Carry out further research into nondestructive playback of broken audio discs.
12. Investigate the transfer of technology from such fields as chemistry and materials science to various problems in audio preservation.
13. Cooperate to develop a common vocabulary within the field of audio preservation.
14. Establish regional digital audio repositories.
15. Research the life expectancy of various audio formats.

Some examples of digital preservation initiatives are as follows:

(a) DSpace is open source software that is available to anyone who has the World Wide Web. DSpace takes data in multiple formats (text, video, audio, or data), distributes it over the web, indexes the data (for easy retrieval), and preserves the data over time.

(b) The British Library is responsible for several programmes in the area of digital preservation. The National Archives of the United Kingdom have also pioneered various initiatives in the field of digital preservation. Both use the Safety Deposit Box software from Tessella.

(c) PADI is a comprehensive archive of information on the topic of digital preservation from the National Library of Australia.

Large-Scale Digital Preservation Initiatives

It is pertinent to note here that many research libraries and archives have begun or are about to begin Large-Scale digital preservation initiatives (LSDI's). The main players in LSDIs are cultural institutions, commercial companies such as Google and Microsoft, and non-profit groups including the Open Content Alliance (OCA), the Million Book Project (MBP), and HathiTrust. The primary motivation of these groups is to expand access to scholarly resources.

LSDIs: Library Perspective

Approximately 30 cultural entities, including the 12-member Committee on Institutional Cooperation (CIC), have signed digitization agreements with either Google or Microsoft. Several of these cultural entities are participating in the Open Content Alliance (OCA) and the Million Book Project (MBP). Some libraries are involved in only one initiative and others have diversified their digitization strategies through participation in multiple initiatives.

The three main reasons for library participation in LSDIs are: Access, Preservation and Research and Development. It is hoped that digital preservation will ensure that library materials remain accessible for future generations. Libraries have a perpetual responsibility for their materials and a commitment to archive their digital materials. Libraries plan to use digitized copies as backups for works in case they go out of print, deteriorate, or are lost and damaged.

As is obvious from the previous discussion, the first use of the term *digital library* in print may have been in a 1988 report to the Corporation for National Research Initiatives The term *digital libraries* was first popularized by the NSF/DARPA/NASA Digital Libraries Initiative in 1994. The older names electronic library or virtual library are also occasionally used, though *electronic library* nowadays more often refers to portals, often provided by government agencies.

Types of Digital Libraries

The term digital library is diffuse enough to be applied to a wide range of collections and organizations, but, to be considered a digital library, an online collection of information must be managed by and made accessible to a community of users. Thus, some web sites can be considered digital libraries, but far from all. Many of the best known digital libraries are older than the web including Project Perseus, Project Gutenberg, and ibiblio. Nevertheless, as a result of the development of the internet and its search potential, digital libraries such as the European Library and the Library of Congress are now developing in a Web-based environment. Public, school and college libraries are also able to develop digital download websites, featuring eBooks, audiobooks, music and video.

A distinction is often made between content that was created in a digital format, known as born-digital, and information that has been converted from a physical medium, e.g., paper, by digitizing. The term *hybrid library* is sometimes used for libraries that have both physical collections and digital collections. For example, American Memory is a digital library within the Library of Congress. Some important digital libraries also serve as long term archives, for example, the ePrint arXiv, and the Internet Archive.

Digital Archives

Archives differ from libraries in several ways. Traditionally, archives were defined as:

1. Containing primary sources of information (typically letters and papers directly produced by an individual or organization) rather than the secondary sources found in a library (books, etc.);
2. Having their contents organized in groups rather than individual items;
3. Having unique contents.

The technology used to create digital libraries has been even more revolutionary for archives since it breaks down the second and third of these general rules. The Oxford Text Archive is generally considered to be the oldest digital archive of academic physical primary source materials.

Academic Repositories

Many academic libraries are actively involved in building institutional repositories of the institution's books, papers, theses, and other works which can be digitized or were 'born digital'.

Many of these repositories are made available to the general public with few restrictions, in accordance with the goals of open access, in contrast to the publication of research in commercial journals, where the publishers often limit access rights.

Institutional, truly free, and corporate repositories are sometimes referred to as digital libraries.

Digital Preservation

Project Gutenberg, Google Book Search, Windows Live Search Books, Internet Archive, Cornell University, The Library of Congress World Digital Library, The Digital Library at the University of Michigan, and Carnegie Mellon University's Million Book Project are considered leaders in the field of digital library creation and management.

Large scale digitization projects are underway at Google, the Million Book Project, MSN, and Yahoo!. With continued improvements in book handling and presentation technologies such as optical character recognition and ebooks, and development of alternative depositories and business models, digital libraries are rapidly growing in popularity as demonstrated by Google, Yahoo!, and MSN's efforts. Just as libraries have ventured into audio and video collections, so have digital libraries such as the Internet Archive.

Searching

Most digital libraries provide a search interface which allows resources to be found. These resources are typically deep web (or invisible web) resources since they frequently cannot be located by search engine crawlers.

Some digital libraries create special pages or sitemaps to allow search engines to find all their resources. Digital libraries frequently use the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) to expose their metadata to other digital libraries, and search engines like Google Scholar, Google, Yahoo! and Scirus can also use OAI-PMH to find these deep web resources. There are two general strategies for searching a federation of digital libraries:

(i) distributed searching, and

(ii) searching previously harvested metadata.

Distributed searching typically involves a client sending multiple search requests in parallel to a number of servers in the federation. The results are gathered, duplicates are eliminated or clustered, and the remaining items are sorted and presented back to the client. Protocols like Z39.50 are frequently used in distributed searching. A benefit to this approach is that the resource-intensive tasks of indexing and storage are left to the respective servers in the federation.

A drawback to this approach is that the search mechanism is limited by the different indexing and ranking capabilities of each database, making it difficult to assemble a combined result consisting of the most relevant found items. Searching over previously harvested metadata involves searching a locally stored index of information that has previously been collected from the libraries in the federation. When a search is performed, the search mechanism does not need to make connections with the digital libraries it is searching — it already has a local representation of the information.

This approach requires the creation of an indexing and harvesting mechanism which operates regularly, connecting to all the digital libraries and querying the whole collection in order to discover new and updated resources. OAI-PMH is frequently used by digital libraries for allowing metadata to be harvested. A benefit to this approach is that the search mechanism has full control over indexing and ranking algorithms, possibly allowing more consistent results. A drawback is that harvesting and indexing systems are more resource-intensive and therefore expensive.

Frameworks

A digital library can be built around specific repository software. The best known examples of this are DSpace, Eprints, Fedora, dLibra (Poland), and Greenstone Digital Library Software. The Reference Model for an Open Archival Information System (OAIS) provides a framework to address Digital preservation. Other formal frameworks include the DELOS Reference Model(Agosti, et al., 2006) and the Streams, Structures, Spaces, Scenarios, Societies (5S) formal framework.

Merits

In fact, the advantages of digital libraries as a means of easily and rapidly accessing books, archives and images of various types are now widely recognized by commercial interests and public bodies alike. Traditional libraries are limited by storage space; digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain it. As such, the cost of maintaining a digital library is much lower than that of a traditional library.

A traditional library must spend large sums of money paying for staff, book maintenance, rent, and additional books. Digital libraries do away with these fees. Both types of library require cataloguing input to allow users to locate and retrieve material. Digital libraries may be more willing to adopt innovations in technology providing users with improvements in electronic and audio book technology as well as presenting new forms of communication such as wikis and blogs; convetional libraries may consider that providing online access to their OPAC catalogue is sufficient. An important advantage to digital conversion is increased accessibility to users.

There in also availability to individuals who may not be traditional patrons of a library, due to geographic location or organizational affiliation.

1. *Round the clock availability.* A major advantage of digital libraries is that people can gain access to the information at any time, night or day.
2. *No physical boundary.* The user of a digital library need not to go to the library physically; people from all over the world can gain access to the same information, as long as an Internet connection is available.
3. *Multiple access.* The same resources can be used simultaneously by a number of institutions and patrons
4. *Information retrieval.* The user is able to use any search term (word, phrase, title, name, subject) to search the entire collection. Digital libraries can provide very user-friendly interfaces, giving clickable access to its resources.
5. *Added value.* Certain characteristics of objects, primarily the quality of images, may be improved. Digitization can enhance legibility and remove visible flaws such as stains and discoloration.
6. *Preservation and conservation.* Digitization is not a long-term preservation solution for physical collections, but does succeed in providing access copies for materials that would otherwise fall to degradation from repeated use. Digitized collections and born-

digital objects pose many preservation and conservation concerns that analog materials do not.

7. *Space.* Whereas traditional libraries are limited by storage space, digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain them and media storage technologies are more affordable than ever before.

Main Hurdles

Digital Preservation

The work needed to ensure that digital content is maintained and accessible into the future is beginning to be addressed: see digital preservation. Technological standards change over time and forward migration must be a constant consideration of every library. Migration is a means of transferring an unstable digital object to another more stable format, operating system, or programming language. Migration allows the ability to retrieve and display digital objects that are in danger of becoming extinct. This is a rather successful short-term solution for the problem of aging and obsolete digital formats, but with the ever-changing nature of computer technologies, migration becomes this never-ending race to transfer digital objects to new and more stable formats. Migration is also flawed in the sense that when the digital files are being transferred, the new platform may not be able to capture the full integrity of the original object.

There are countless artifacts sitting in libraries all over the world that are essentially useless because the technology required to access the source is obsolete. In addition to obsolescence, there are rising costs that result from continually replacing the older technologies. This issue can dominate preservation policy and may put more focus on instant user access in place of physical preservation.

Copyright and Licensing

It is remarkable that, some people have criticized that digital libraries are hampered by copyright law, because works cannot be shared over different periods of time in the manner of a traditional library. The republication of material on the Web by libraries may require permission from rights holders, and there is a conflict of interest between them and publishers who may wish to create Wenb versions of their content for commercial purposes. There is a dilution of responsibility that occurs as a result of the spread-out nature of digital resources.

Complex intellectual property matters may become involved since digital material isn't always owned by a library. The content is, in many cases, public domain or self-generated content only. Some digital libraries, such as Project Gutenberg, work to digitize out-of-copyright works and make them freely available to the public. An estimate of the number of distinct books still existent in library catalogues from 2000BC to 1960, has been made. Other digital libraries accommodate copyright concerns by licensing content and distributing it on a commercial basis, which allows for better management of the content's reproduction and the payment (if required) of royalties.

The Fair Use Provisions (17 USC § 107) under copyright law provide specific guidelines under which circumstances libraries are allowed to copy digital resources. Four factors that constitute fair use are purpose of use, nature of the work, market impact, and amount or substantiality used.

Scope

It is remarkably that at the kickoff meeting of the DLib Working Group on Digital Library Metrics (WG), held January 7-8, 1998, at Stanford University, some discussion was held as to what did we mean by the term "digital library". We concluded that it would be valuable for our own deliberations to document a common understanding of the term, but agreed that such an understanding could only be for the purposes of our deliberations, i.e. we could not and would not aim for a general consensus. This document is intended for that purpose, and this draft is intended to start the discussions. The term "Digital Library" has a variety of potential meanings, ranging from a digitized collection of material that one might find in a traditional library through to the collection of all digital information along with the services that make that information useful to all possible users. As the WG discussed possible scenarios and challenge problems to drive our discussion of metrics, we found the need to come to at least a loose agreement on the scope of the digital library. This document is intended to serve that purpose. Much of the question about the scope of the term is how broad a view should be taken of the digital library.

Does it encompass all of information management or is a more tightly constrained view appropriate? In this document, and for the purposes of the deliberations of the WG, we choose to take a very broad view. This is driven by the recognition that to do otherwise would require setting boundaries that are fairly artificial. The structure of this document is as follows. In the first section, a brief definition of the term "digital library" is given, as a set of characteristics. The remainder of the document elaborates each of those characteristics. At the kickoff meeting of the WG (held January 7-8, 1998 at Stanford University), the following definition was proposed: The Digital Library is:

1. Via electronic/digital means.
2. Available directly or indirectly

3. The collection of services
4. And the collection of information objects
5. That support users in dealing with information objects
6. And the organization and presentation of those objects.

Collection of Services & Information Objects

A digital library is much more than just the collection of material in its repositories. It provides a variety of services to all of its users (both humans and machines, and producers, managers, and consumers of information). Thus we start our definition with the notion of the collection of services that the digital library represents.

There are a large and varied set of such services, including services to support management of collections, services to provide replicated and reliable storage, services to aid in query formulation and execution, services to assist in name resolution and location, etc. The basis for a digital library, however, must be the information objects that provide the content. A basic characteristic of the digital library is that the information objects are found in collections with associated management and support functions. The types of information objects vary from traditional "documents" through to live objects or dynamic query results.

Supporting Users Deal with Information Objects

The goal of the digital library is to assist users by satisfying their needs and requirements for management, access, storage, and manipulation of the variety of information stored in the collection of material that represents the "holdings" of the library. Users may be humans or they may be automated processes acting on behalf of or in support of human needs. Users also vary and include those who are "end" users (those not involved in the management and operation of the library but rather are the customers), library operators, and information "producers" who want their material available through the library.

The key to effective collections management is to implement simple structural organizations and be able to present those organizations in a way that library users find useful and can understand easily. In traditional libraries, books are primarily stored by subject, title, author, and date, and accessed by following signs to the appropriate floor, room, bookcase, shelf, and spine-labelled book.

The size and relative celebration of each portion of the collection gives patrons information about the collection and can reveal the library's collection management objectives as well. A library is created to serve a community of users. Users who participate in the digital library should be aware of its design and be able collectively to refine that design to better serve their own information needs. Therefore, the ongoing human usability of a digital library depends on the clear and unobtrusive exposure of the library's design, its near-term goals, and its overall objectives. Furthermore, digital libraries should continue the ongoing tradition of coupling utility with aesthetics in the organization and presentation of materials.

These information objects may be digital objects or they may be in other media (e.g. paper) but represented in the library via digital means (e.g. metadata). They may be available directly over the network (e.g., using a query service of the library to find and then retrieve electronically the information object) or indirectly (e.g., the result of the query may give instructions on how to obtain the object, but that is done outside the scope of the library itself.)

Electronic/Digital Availability

Although the objects may not even be electronic, and although the objects themselves may not be available directly over the network, the objects must be represented electronically in some manner through, e.g., metadata or catalogues. Otherwise, we would not consider the objects to be part of the *digital* library.

Some Examples

World Digital Library

The World Digital Library is a project of the Library of Congress to make available on the Internet, free of charge and in multilingual format, significant primary materials from cultures around the world, including manuscripts, maps, rare books, musical scores, recordings, films, prints, photographs, architectural drawings, and other significant cultural materials. The objectives of the World Digital Library are to promote international and inter-cultural understanding and awareness, provide resources to educators, expand non-English and non-Western content on the Internet, and contribute to scholarly research.

After almost 20 years of absence, the United States re-established its permanent delegation to the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2003. Dr. James H. Billington, Librarian of Congress, was nominated as a Commissioner of the U.S. National Commission to UNESCO and was invited to give a plenary speech at its first annual conference in June 2005.

His speech, titled *A View of the Digital World Library,* described a vision in which the rich collections that "institutions, libraries, and museums have preserved could be given back to the world free of charge and in a new form far more universally accessible than any forms that have preceded it." Google Inc. became the first partner of this public-private partnership and in 2005 donated $3 million to support development of the World Digital Library.

Planning Stage

At the National Commission's 2006 annual conference, Dr. John Van Oudenaren, Senior Advisor for the World Digital Library at the Library of Congress, outlined a project plan for bringing Dr. Billington's vision to fruition. Foremost was the belief that the World Digital Library should engage partners in planning the four main projects areas: technical architecture, selection, governance, and funding. This was achieved in December 2006, when 45 national library directors, library technical directors, and cultural and educational representatives from UNESCO met in Paris to discuss the development of the World Digital Library. The participants formed working groups to address the special challenges of each of the four project areas.

Remarkably, the planning process continues. The working groups met in the first half of 2007 and included professionals in the field of digital libraries – including but not limited to computer science, library and information science, Web development, and fundraising. The working groups presented their findings to the larger WDL group in July 2007. Findings from this planning process were presented at the 34th session of the UNESCO General Conference in October 2007 in Paris, France. In early September 2008 the Organization of American States (OAS) agreed to join with the Library of Congress in developing the World Digital Library. Secretary General José Miguel Insulza signed the "Contributor Agreement" with Librarian of Congress, Dr. James Billington, at an OAS headquarters ceremony.

DELOS

DELOS is a Network of Excellence (NoE) on Digital Libraries partially funded until the end of 2007 by the European Commission Sixth Framework Programme within the Information Society Technologies Programme (IST). As a matter of fact, the activities of DELOS started with the DELOS Working Group (late 1990s) and the DELOS Thematic Network (2001-2003, under the Fifth Framework Program). The main objectives of DELOS are research, whose results are in the public domain, and technology transfer, through cooperation with interested parties.

Vision

That all citizens, anywhere, anytime, should have access to Internet-connected digital devices to search all of human knowledge, regardless of barriers of time, place, culture or language has been a vision of DELOS since its inception. DELOS believes that, in the near future, networked virtual libraries will enable anyone from their home, school or office to access the knowledge contained in the digital collections created by traditional libraries, museums, archives, universities, governmental agencies, specialised organizations, and individuals around the world. These new libraries not only will offer digital versions of traditional library, museum and archive holdings including text, documents, video, sound and images, but they will also provide powerful new technological capabilities that will enable users to work collaboratively through annotations and sharing of resources, to refine their requests, analyse the results and access collections in other languages.

Mission

DELOS conducts a joint programme of activities aimed at integrating and coordinating the ongoing research efforts of several major European teams working in digital library-related areas. Its main objective and goal is to develop the next generation of digital library technologies by:

- defining unifying and comprehensive theories and frameworks over the life-cycle of digital library information;
- building interoperable multimodal/multilingual services and integrated content management ranging from the personal to the global for the specialist and the general population;
- developing generic Digital Library technology to be incorporated into industrial-strength Digital Library Management Systems (DLMSs), offering advanced functionality through reliable and extensible services;
- networking and structuring European research on digital libraries to consolidate an emerging community;
- supporting an exchange programme of researchers;
- providing a forum where researchers, practitioners, and representatives of the application communities can exchange ideas and experiences;
- promoting cooperation between European and national digital library initiatives;
- improving international cooperation in digital library research areas.

Organization

Research Activities

Digital libraries support the specialized needs of very diverse technologies and applications, from cultural heritage to general science, health, government, and education. The potential exists for digital libraries to become the universal knowledge repositories and communication conduits of the future, a common vehicle through which information in all forms can be accessed, discussed, and enhanced. In order to fulfil their new roles as universal knowledge infrastructures, digital libraries require research in several key areas pointing to the development of:

(i) user-centred system design methodology;

(ii) pro-active systems with functionality that facilitates collaboration, communication, and information creation;

(iii) generic Digital Library Management Systems that provide basic system infrastructures that can be used to implement application specific digital libraries incorporating context-specific services.

Towards this end, DELOS coordinates a Joint Programme of Activities (JPA) of several major European teams working in digital libraries related areas. The objective is to develop dynamic ubiquitous knowledge environments, which will transform research and education at all levels by collecting, organizing and making publicly accessible on-line vast quantities of information. The ultimate goal is to provide access to human knowledge from anywhere and any time and in an efficient and user-friendly fashion. DELOS also aims at disseminating knowledge of digital library technologies to many diverse application domains, by providing access to technological know-how, services, test-beds, and the necessary expertise to facilitate their take-up. The Joint Programme of Activities (JPA) is organized into the following seven clusters of integration and research activities:

- *Information Access and Personalization.* It aims at developing a uniform understanding among researchers concerning available practices in the fields of information access and personalization in digital libraries, by building and promoting a common and comprehensive framework to serve as a reference point and to stimulate research.
- *Digital Library Architecture.* The main objective of this research cluster is the conceptual and experimental evaluation of the impact of peer-to-peer data management, grid computing middleware and service-oriented architectures on a digital library architecture in order to reveal the advantages and disadvantages of either approach.
- *Audio/Visual and Non-traditional Objects.* The objectives of this research cluster are to establish a common ground of knowledge for European researchers about the state of the art, the research directions and important new applications for digital libraries with audio-visual and non-traditional objects, as well as to advance the state of the art in these areas.

- *User Interfaces and Visualization.* It aims at developing methodologies, techniques and tools to enable future digital libraries designers and developers to meet not only the technological, but also the user-oriented requirements in a balanced way.
- *Knowledge Extraction and Semantic Interoperability.* It aims at exploring the potential of new models, algorithms, methodologies and processes in a variety of technical applications, institutional frameworks and cross-sectoral environments, which will lead to the creation of guidelines and recommendations of best practice concerning knowledge extraction and semantic interoperability.
- *Preservation.* It aims at providing the methodological framework and theory for ensuring that digital libraries research addresses preservation issues and digital libraries incorporate preservation elements in their designs.
- *Evaluation.* It aims at developing a comprehensive theoretical framework for digital libraries evaluation, by researching on new methodologies and corresponding toolkits and test-beds in order to enable new evaluations and to ease the application of standard evaluation methods.

Among its cross-cluster activities, DELOS is working on the development of a Digital Library Reference Model aimimg at providing a conceptual framework for the new research field laying at the intersection of the many diverse disciplines involved in digital libraries (data management, information retrieval, document management system, information systems, the web, image processing, artificial intelligence, human-computer interaction, mass-storage systems, etc.), and on a globally integrated prototype implementation of a Digital Library Management System (DelosDLMS), which will serve as a concrete partial implementation of the reference model and will encompass many software components developed by DELOS partners.

10

Evaluation of the Current Operating System and Report of Findings

Application of Management Concepts

With completion of the analysis phase the analyst is prepared to proceed with the second phase of the systems study—evaluation of how well the current operating system fulfils the demands placed on it. Based on a thorough understanding of present methods and procedures used in the current system, supported by the survey worksheets of requirements, personnel, equipment, the outputs and inputs of the system, together with completed sample copies of all forms used and records produced, the analyst is prepared to evaluate the system to determine how effectively, efficiently, timely, how accurately, and at what cost, the present system meets the requirements of each operation.

It is in this phase of the systems study that flow-charting seriously comes into play.

Other techniques of scientific management applicable in library systems study are discussed in this chapter—the "management by exception" concept and the preparation of reports and recommendations in a persuasive manner and cogent form for consideration by managements statistical sampling and job analysis for developing work standard connection with the analysis and understanding of current procedures.

The evaluation phase culminates in a report of findings including recommendations for maintaining the status, quo, eliminating or transferring certain operations to another system, reorganising given operations, combining operations, increasing or decreasing staff, recasting the functions and responsibility of professional personnel, or designing a completely new system. The analyst should be aware of the options open to management on its receipt of the evaluation report. He should anticipate such contingencies as that management will give full acceptance to his recommendations, requiring the analyst to be prepared to proceed with the final phase of designing a new system or modifying the present one; that management may give initial disapproval of the recommendations, asking for further substantiation of them; or that management may place certain restrictions on the operations of the system, calling for review of the original recommendations for possible accommodation to such restrictions. These restrictions may arise from a need to economize, a change in management's goals, the elimination of one or more previously stated requirements of the system, or the abrogation of decision on the type of system (computer based or non-computer based) originally opted for by management.

In any event the adequacy of present procedures cannot be evaluated without thorough knowledge of what management expects the system to do, such as attaining maximum efficiency, highest productivity, maximum accuracy, and least operating cost. Because the confluence of these four factors, however acceptable and laudable as goals, is unlikely if not impossible, management is compelled to specify the primary goal. For example, if it is highest productivity management desires, it likely that lower operating costs and maximum accuracy cannot be antici-pated. Conversely, least cost is not entirely compatible with the goals of maximum efficiency, productivity, and maximum accuracy.

In the evaluation of current methods and procedures the analyst's report of findings and recommendations for revision, elimination, or maintenance of existing methods and procedures is based on specific determinants.

There are requirements placed on the system that are germane to the successful operation and management of the system and of the total system of the library including those requirements logically contributing to the meeting of the requirements of related systems. To cite an example of the interrelationship of requirements among systems, a requirement of the preorder search subsystem of the acquisitions system is the supply of bibliographic information needed for ordering a title. In satisfying this requirement more frequently than not the searcher uses a source containing additional bibliographic data also needed in the cataloguing system. The preorder search requirement should include the capturing of this data needed in the cataloguing system in order to eliminate the costly, time-consuming repetition of the search.

There are inputs/outputs and controls of the system that adequately fulfil its requirements within the total system. Evaluation of the system's inputs/outputs is : (i) to determine that information is received when needed for timely decision and action and (ii) to eliminate in production and supply of information serving little, or no purpose in meeting the demands placed on the system. The matter of balances in book fund accounts is taken as an example. Without accurate and timely reports of the status of accounts, control of expenditures in an orderly and equable manner throughout the budget year cannot be maintained. Similarly overexpenditure in given accounts can be discovered too late for any corrective action, leading to, disruption of the system's functions and effective administration and planning. Obviously in the latter case the report management needs is one that indicates what and when individual accounts reach predetermined minimums for exercise of decisional control at the proper time. In further illustration book purchase requests submitted in variant form unrelated to the logical arrangement of bibliographic data best suited to searching and ordering procedures can only result in slowed and inefficient manipulation. What is needed here is submission of the book request in standard format.

Further determinants are those current methods and procedures judged adequate for processing the work loads. Again using the acquisitions system as an example management's goal is to attain a processing rate of 200 orders per week, which is at present not being achieved by current procedures and staff. The existing procedures must be evaluated with respect to their applicability and need in meeting the stated goal. On the one hand certain methods and procedures found unnecessary can be eliminated, thereby allowing the current staff to satisfy the desired processing rate; on the other hand, with present methods and procedures judged to be valid, additional personnel is indicated in order to reach management's objective.

The staff must be capable of fulfilling the system's requirements under the currently applied methods and procedures. Involved here are size of the staff and the capabilities, capacities, and skills or special training of individual workers. Depending on the results of staff evaluation additional workers with the necessary skills may be needed or perhaps workers should be reassigned to jobs fitting their levels of competency.

The equipment available must allow application of efficient methods. Changing, replacing, or adding a piece of equipment frequently leads to greater efficiency and improved productivity of a system. The application of efficient methods to required cataloguing procedures by the addition of a simple piece of equipment is illustrated. Instead of manually copying cataloguing data from the *National Union Catalogue* to produce needed cards for the library's catalogue, a quick-printing enlarging camera can be procured to produce a near-standard image of the *National Union Catalogue* entry which in turn can be used as master copy to produce the number of copies of the card needed in cataloguing by copying equipment.

The addition of clerical help may be avoided by the increased productivity of the current staff through more efficient methods made possible by introducing one piece of relatively inexpensive equipment.

In arriving at the foregoing determinants the analyst uses the following "tools' obtained in the planning stage and analysis phase of the systems study: (i) managerial statement of goals enunciated in the planning stage of the study; (ii) existing procedural manuals including job analyses and work samplings; (iii) the worksheet prepared on each requirement; (iv) preliminary survey worksheet; (v) worksheet prepared for each output; (vi) summary worksheet prepared for all requirements and their associated outputs; (vii) the worksheet prepared for each input; and (viii) the summary worksheet summarizing all inputs.

When completely executed, the worksheet contain all the data the analyst needs for the evaluation of current procedures. It remains for him prior to submitting his report of evaluation, to summarize systematically this mass of data supported by flow charts of existing operations.

Having come to some conclusion about the adequacy of the present system, the analyst should. (i) compute the cost of processing a unit of material through the system; (ii) measure the productivity of the system; (iii) determine whether the system provides data promptly for timely action; and (iv) evaluate the accuracy of information supplied.

During evaluation the analyst reviews the answer he has received in the analysis phase of the study and considers additional questions arising in his mind in the course of arriving at his initial conclusions. In testing his findings and conclusions the analyst may use the slow chart as a simulator of the system and its components. By following the flow of work through its associated functions, decisions, and actions he verifies or disproves the results that can be obtained under various operating conditions. This process, with examples, is now given.

Each component, as well as the overall system, should be appraised under increasingly stepped-up workloads to determine the maximum capacity of the system at which it can continue to fulfil its requirements. Does the present workload and accompanying cost meet management's goals? In the acquisitions system three factors patently affect the workload—the number of requests received, the number of orders processed, and the number of books received. The magnitude of workloads throughout the system depends on the volume of book purchase requests. By varying the number of requests entered into the system the ability of the subsystems (preorder searching, ordering, receiving, accounting, and reporting) can be evaluated and their maximum capacities estimated. In the circulation system two factors affect the workload here-the number of books charged out and the number of books returned. The magnitude of the workload throughout the system depends essentially on the volume of books loaned. By increasing this number and noting its corresponding effect on the operations of the circulation system, such as the sending of overdues or shelving of books, the ability of the subsystems to meet the increased volume can be evaluated.

Current reporting requirements should be appraised to determine whether they stipulate statistical or other informational detail pertinent to the needs of management at various levels. Does management need all such reports or can the principle of management by exception be applied so that it receives only the information required for decision making or taking justified action? For example, in the cataloguing system the supervising librarian need not be given a report on the size of the backlog of books to be catalogued so long as the size of the backlog stays beneath a predetermined level. As soon as the backlog has reached the problem zone management is notified.

Each input/output should be appraised for sufficiency in meeting the internal and external requirements placed on it. Do the outputs of a comptroller's office furnish sufficient financial data to satisfy the requirements of the acquisitions system? If not, what recommendations should be made to correct this? If a total system is one of management's goals, do the present outputs of the preorder search subsystem furnish the necessary bibliographic data required by the cataloguing system and are the data furnished in ready-to-use form? If not, what modifications can be made in the form of the outputs of the preorder search subsystem; what effect would such modifications have on efficiency, capacity, and cost of the preorder search subsystem's operations; what effect would such modifications have on the number and kind of staff needed in the subsystem?

Management by Exception

Management by exception is a technique of scientific management broadly applied in industry and business but generally not so consistently or consciously applied in the management of libraries. The technique is applicable at all levels of responsible action within the library's organization. It is the principle whereby management receives only that information on which action is indicated. To apply this principle it is necessary for management to be able to specify the information required for taking action and to set the point at which such action may be taken.

The timely supply of information about what *has not* happened under stated conditions rather than information on all that *has* happened necessitates a sifting out of the "exceptional" data from the mass of data not requiring action. Only that information signalling the need for corrective action, adjustment, and decision is supplied. Before management by exception can be applied, the conditions or parameters of control actually required for the exercise of assigned responsibilities and decision making should be precisely delineated.

The technique can find only limited application in manual procedures because of the inordinate consumption of time in manually reviewing data files item by item, However, the extent to which this technique can be used in computer-based system is limited only by ability and imagination in defining the parameters of operational control needed. Among the following examples the objectives are not new but most of them suggest action not economically feasible by manual methods.

The process of claiming issues of periodicals not received is an exercise in management by exception. Serials librarians have done this form time immemorial but the missing factor has been timeliness of action to assure reasonable receipt of the claimed issue due to laborious hand methods. If computer-based serials control is applied, a computer report may notify the serials librarian of all issues of foreign journals not received in a predetermined interval and produce the claim forms for these issues. As another example, the director may be troubled about a seeming overload in the acquisitions system.

Trying to pinpoint the reason for an increasing backlog of book orders, he does not ask for a record of all requests searched but just for those representing books already in the collection. Thus he and the acquisitions librarian by applying the principle of management by exception find that one third of the searched are for books already in hand or on order, indicating a significant reason for the overload in acquisitions. Again, the director of the library does not need to know the current balances of all book accounts each month but be does need to know in time for taking action that a given account has fallen to a predetermined minimum; or he may wish to see monthly reports on the balances of all book accounts beginning the seventh month of the fiscal year in order to decide whether the same rate of expenditures can be continued for the remainder of the year.

The concluding examples of the exercise of management by exception indicate computer rather than manual handling. The acquisitions librarian does not need a weekly report of all books ordered but rather a continuous report of items on order for a predetermined period and not yet received at the time expected. For keeping a measure of the extent of the cataloguing backlog and for taking action on books for which Library of Congress catalogue cards have not been received within a predetermined period, the catalogue librarian needs a report of the number of books in process and a list of the titles to be originally catalogued in the absence of Library of Congress cards rather than a non-selective listing of all books in process.

Report of Findings and Recommendations

Finally, the study staff should submit to management a written report precisely stating its findings, conclusions, and recommendations. The study staff should provide enough detail to enable management to make the correct decision in relation to overall organizational goals. Depending on these recommendations and the decisions of management the study staff may or may not proceed to the culminating step of a systems study—that of design.

It is customary to think of reports as formal documents with such attending characteristics as formal language, exceedingly impersonal tone, great care in the making of claims and conclusions, inappropriate jargon, and inflated writing using redundancy and repetition. These characteristics can be obviated by using simple, direct language to state what needs to be stated, and not more.

Ideally the analyst in the actual writing of the report should have already in a sense, written most of it because he has collected and organized all of the data needed to prepare the report of findings. He can follow his own investigation, can put together those parts of the report that contain information best known to him, and can finish the report by filling in any gaps from the information he has already recorded. The analyst should be able to state in specific terms in writing what the objectives of the study were and what was accomplished by the study. The accomplishments of any study should be stable in specific terms within the compass of a short paragraph of two or three sentences. This paragraph will become, then the topic paragraph of the conclusion section of the report and as such is the most important statement in the entire report.

The task of filling in the gaps of secondary information will take a good deal of the time required for writing the draft of the report. This part of report writing can be difficult if the analyst does not have sufficient orientation to the organization of the report.

Organizing the Report of Findings

Some authorities seem to think it is detrimental to list the generalized outline of a report but if the writer will realize that the outline is generalized and that it should be used judiciously and changed when he believes it is necessary to change, a good outline is very useful. The outline follows:

Front matter ;

- Cover with title and identification
- Title page
- Tables of contents and figures
- Foreword, preface, and acknowledgments.

Body ;

- Introductory summary
- Statement of problem
- Objectives of study
- Scope of study
- Possible outcome.

Methods (s) of study ;

- Planning and schedules
- Personal
- Equipment and materials
- Procedures.

Results;

- Collected data
- Interpretation of data (reduction)
- Methods (s) of data analysis.

Conclusion;

- Conclusions
- Recommendations
- Implications.

Back matter;

- Appendixes
- Detailed data sheets
- Computations
- Large figures and drawings
- Appended documents and correspondence
- Bibliographic matter
- Index (only if report is voluminous)
- Back cover.

Sequence of Writing

One of the hazards resulting from an outline such as the one above is the inference many people draw that the actual writing of the report should be done in the order indicated. A more appropriate order is suggested here.

The first piece to be written could be that labelled "Statement of Problem," and in particular the subsection "Objectives." The next section should then be Conclusions, followed by Recommendations. Then the Results section can be sketched out fairly fully and Method (s) come next.

From here on the order of the writing does not make as much difference as in the earlier parts, with two exceptions. The Introductory summary should be very nearly the last section to be actually written. This section, frequently called "Abstract" or simply "Summary," is the most-read part of the report and should therefore be the best. The last thing, usually, is putting together the table of contents and other similar tables. The table of contents should be started with an outline such as the one here, with appropriate changes made to that outline as the report is developed, and with the notion that the outline will indeed become the table of contents by the addition of page numbers.

Point of View

The report writer needs to know what point of view he should use in the writing. It is most likely that he will need a dualistic point of view: first, he is the expert communicating to peers; second, his writing should be organized from general to particular; it should have the inverted pyramid style of the news reporter. The writer of the report has done the investigation that he is reporting; he should know more about it than anyone else. On this basis alone he is the expert. The general-to-particular organization of the writing itself is called for because it is true that more than one person will make real use of the report and that these uses themselves will very and that any one reader will not have to or want to read all the various sections of the report. If every section and subsection is no organized, all readers will be able to grasp the total import of the report without having to struggle through every paragraph.

The best device to indicate the orientation of the report to the reader is the liberal use of headings. The organization and selection of these begin with the early outlining of the report. Just as the outline for the report becomes the table of contents, it also serves as the basis of the list of headings. The writer should take advantage of this in checking several times during the actual writing to see that he is using the outline to indicate headings and to check and change his outline as he includes additional headings. An excellent discussion of the formatting of headings is included in Ulman and Gould.

Functions of Parts of the Report

Following are brief statements of functions of the individual parts. The order here is that of the outline listed earlier.

***Cover* :** Two functions are performed by the cover. It physically holds the report together and provides sufficient identification for the locating and handling of the report as a document; the cover should provide for easy access into the report itself through convenient binding in terms of the thickness of the report.

***Title Page* :** The title page contains the informative title and complete identification as to author's name, position, organization; date and place of publication; place of the report in any series, including serial enumeration, if any. It is usually desirable that all the information on the title page be included on the cover.

***Table of Contents, Illustrations, Fig* :** Informative, complete, and highly utilitarian guides to the reader as to location, parts, size, and interrelationships are supplied by the front material tables. Such tables should be made as legible as possible and should occupy as much space as is needed to assure completeness and legibility. They should not be crowded.

***Foreword, Preface, Acknowledgements* :** These sections are considered optional; they should be used to indicate something about the justification for the writing of the report, any special circumstances that tend to make the report different from what the reader might expect, and any unusual help given the writer/analyst. If these sections are used they should be kept brief.

***Introductory Summary* :** Most readers appreciate a summary that is not a linear abstract. The summary should give short versions of the important parts of the report, particularly the objectives of the study, the method of study (this should be very brief), the specific results, the conclusions, and the recommendations. If the writer has followed carefully the general-to-specific order of writing, the beginning sentence or two from each of these sections will serve as the essence of the summary. Many writers indicate that the summary can best be written by simply repeating such sentences verbatim and providing adequate transitions. The introductory summary should be considered by the writer as a document that may have to stand in stead of the entire report; it is therefore a very important part of the report and should be worked on with great care and a good deal of energy and thought.

***Statement of Problem* :** This section defines the study (it should not define the report except as an incidental matter). It is probably the second most important part of the report.

***Method(s) of Study* :** In many reports this is an invaluable section but if the method is routine and well known, the section may be quite brief and even nonexistent.

Results **:** Although many report writers consider this section as very important, often it is not and frequently it is not even read thoroughly, if at all. One of the problems here is that "Results" is confused with "Conclusions." The only prac-tical function of this section is to state in abbreviated form the actual data collected, so that the reader, if and as he wants, may verify the conclusions from the actual observations.

Conclusions **:** The conclusion functions as the answer to the question, "Precisely what was accomplished by this study?" If this question is not well answered, the reader is likely to gain the impression that not much, if anything, was accomplished by the study.

Back Matter **:** Customarily the back of the report serves as the repository for all the other material that did not seem to fit into the body of the report. This is too often the case. Instead, the back of the report should contain items of information that may be of good use to some readers. The analyst should attempt to make a reasonable judgment as to the potential utility of the material and if in doubt should not include it.

Use of Illustrations and Graphics

If the information to be presented concerns primarily a description of a space, such as a reading room or a set of offices, and if the information is primarily dimensional, a dimensioned drawing such as a floor plan is more communicative than words. The argument can be carried on to other characteristics besides dimensions the conclusion being that other forms of illustrations (sketches, perspective drawings, flow charts,) and so forth may prove superior in their communicability to words. When this is the case, the "non-verbal" may be used first and supported by verbal interpretations.

A table containing specific numerical values is easier to use than a graph from which certain values must be derived. If the specific numerical values are not the major concern but trends and comparisons are, bar charts, column charts, and even pie charts are much more communicative than tabular material.

Most illustrations and graphics should be introduced with text material and it is probably best that the writer follow the nonverbal with a verbal interpretation. This means that the nonverbal material will be worked into the text of the report linearly—this is, so that the reader is almost forced to study the nonverbal as he reads the verbal material. Illustrations and graphics should not be located in other parts of the report, even if only page away. A discontinuity occurs when this happens and when the reader gets to the page where the non-verbal material is, he tends to look immediately at it rather than at the continuation of the verbal material he is reading. Finally, non-verbal material should be presented in good style. The art work should be neat and professional. Legends should be plentiful, accurate, and informative. In regard to the use of mathematical expressions over English, Kapp states "... every writer, before embarking on mathematical forms of presentation, should ask himself the question: is your mathematics really necessary? Keeping in mind who the readers of the report may be, the use of mathematical formulas may not be the best means of communication. Rather their use may complicate decision making by management to implement the report's recommendations.

Douglass, Schmid Sigband, Tichy, Ulaman and Wyld are considered excellent treatments of report writing and contain good bibliographic material.

Principles of Systems Design

In designing a new system the same data used in preparing the report of evaluation of the existing system are used in the design phase that culminates the systems study. The evaluation report obviously serves as the starting point or basis for the design of a new system, containing as it does suggestions for substantive changes by the analyst who at this point in the study should be conversant with the strengths, weaknesses, and unsolved problems in the present system and should be fairly well convinced about the corrective actions to be taken.

Review of Goals

The goals and objectives of the library's management should be reviewed in relation to the requirements currently being placed on the library as well as in relation to the library's long-range plans of development and those of its governing administration. These goals, after being reaffirmed, amended, or changed, can be accepted as definite and the requirements of the existing system may be re-evaluated against them. Are extant requirements still pertinent? Can specific requirements be changed if this is needed? Answers to such questions cannot be arrived at arbitrarily but should be developed in the light of pro and con views of the responsible staff members who are to make the new system operable. Any desired changes in requirements controlled by outside sources would be subject to consultation with such sources.

Economic Feasibility

In addition to confirmation of the goals of the library the analyst should secure affirmation of the economic parameters that must be taken into account in designing the new system. If in his preliminary decisions about what corrective measures should be taken the analyst sees the feasibility of computer applications, will the library and its governing administration approve the additional cost of electronic data processing including the cost of peripheral equipment needed for library computer-based operations? If additional personnel is suggested for increased productivity and elimination of chronic backlogs of work, is the administration prepared to meet the increased operating costs? These and similar factors of increased costs should be delineated before attempting the design of the system if it is to result in one fitted to stated cost limitations rather than one providing an apparently ideal solution.

In evaluating a proposed new system management's decision to accept it is strongly influenced by cost of installation and operation; that is, staffing, equipment, space, new forms, and other expense items. Consequently the proposal to management must include a comparison of the total and, more important, the unit operating costs of the current system with the projected costs of the proposed new system; it must also include the conversion expense and any capital expenses entailed in remodelling and expanding working space.

The cost of changing over from a current system to a new or modified one are always significant and often are not sufficiently analysed and evaluated for valid managerial decision. Estimated time (costs) and the cost of units of new equipment to be blended with existing equipment required for conversion are necessary in any case but entirely imperative in the case of converting to computer-based operations. Underestimation of the time needed for records' conversion and the auxiliary equipment and staff required may lead to considerable embarrassment and even to failure in implementing the proposed system.

As an illustration of the seriousness and impact of the time-cost factor, let us assume that the analyst recommends and management concurs in the adoption of a computer-based cataloguing system for the library. Such a decision can be ill founded unless supported by an estimate of the comparative cost of continuing the cataloguing by traditional methods and the cataloguing by computer-assisted methods; and it should be further supported not only be an estimate of the cost of converting the present catalogue records for a beginning base book catalogue but also by a projected estimate of the annual costs to be incurred in keeping the machine readable record up to date and the book catalogues in print and cumulated.

In recommending any computer-based system it should be realized that the conversion of man-readable records to machine-readable records may be the most expensive aspect of the programme. The next most expensive factor generally is the printing and publishing of the machine output. It is, incidentally, these two factors that call for application of the principle that machine records should contain only data clearly essential to meeting the library system's requirements.

To continue with the illustration the analyst can readily make a close estimate of the annual cost of personnel, supplies, and other expense items incurred in the existing cataloguing operations. The proposed computer-based system contains the same cost elements but with the addition of programming; personnel, who may be staff members available because of discontinued manual functions, for preparing the computer input; purchase or rental of in-house input machinery; subscription to the Library of Congress MARC magnetic tapes; computer processing time; and the printing and binding of the cumulating catalogue records during the year. Programming costs are usually very difficult to estimate, mainly due to two factors: (i) the individual programmer's ability and knowledge of library requirements; and (ii) the complexity of catalogue filing and catalogue data. Computer processing costs will very with the programmes execution time in producing a required listing. To a considerable degree the computer time costs will be affected by the preciseness of the programmes logic and the size of the data base. In estimating the printing and binding costs dependence may be placed on a printing house representative.

It can be anticipated that annual cataloguing personnel charges will remain approximately the same. Supplies and expense items including new equipment rental or amortization, except for on-line input devices, will tend to be less than in a manual system. The estimated additional annual operating costs are offset by savings such as lesser cataloguing costs up to the computer-connected operations; elimination of the need to purchase additional catalogue cases as the collection grows; the freeing of centrally valuable floor space taken up by the catalogue cases; elimination of the preparation of duplicate sets of catalogue cards for departmental and subject-area catalogues; the possible sale of printouts from the MARC tapes to regional institutions as aids in cataloguing, current book selection, and collection evaluation; the processing of books more speedily to the shelves; the saving of the time of library users and the staff with the printed book catalogues being available at various points within and outside the library; and the possible sale of the printed book catalogues to other libraries.

Referring again to estimation of the extraordinary annual expense of computer processing and press printing of book catalogues during the year, the yearly pattern of printout and publication consistent with adequate service to readers must be determined—monthly, quarterly, four-month, or semiannual cumulations. The monthly cumulation pattern obviously is the most costly although it does provide near-maximum user utility outside of on-line accessibility to the catalogue data in the computer data base. The cost of the monthly pattern will be found to be in the order of twice as great as that for any other of the alternates. It further will be found that the variation in cost among the quarterly, four-month, and semiannual cumulations is not significant. Although less convenient to the user than the monthly cumulation, the quarterly pattern including two noncumulated monthly catalogues in each quarter results in the reader having to consult from two to a maximum, of five printed catalogue listings until the annual cumulation is supplied.

The costs of converting and printing the existing catalogue records as the basic book catalogue in the "start-up" of the computer-based system represent an extraordinary one-time expense with no offset savings over manual cataloguing methods because the card catalogue must be maintained until the base catalogue is printed and published. The costs to be estimated here include the cost of preparing and "loading" the catalogue data into the computer, the cost of computer processing, and the cost of press printing the base catalogue in the edition size found to give the most effective service to users. Preparation costs of catalogue records for the computer include estimation of the hourly rates of there cords' input keying operation, proofreading, and correcting, as well as an estimate of the time required for inputting the records into the computer.

To complete the analysis of the cost involved in his recommendation to install the computer-based cataloguing system, the analyst using the cost data gathered to this point should prepare a five or six-year calendar of computer and publishing costs including the one-time base catalogue cost in the first year of the operation of the computer-based system. A pattern of catalogue cumulation must be proposed: single-year cumulations to the fifth year when a five-year cumulation would be produced; annual cumulations on a year-to-year basis; or other patterns judged appropriate to the economic capabilities of the library and that will give adequate service to users. Given an anticipated annual average acquisitions rate and using currently prevailing personnel and machine costs, the analyst can extend this analyst over a period of years showing that the annual costs of records' conversion, computer processing, and press print will remain more or less constant. It, however, can be anticipated in a computer-based cataloguing system, that net annual costs will be greater by approximately 25 per cent than those incurred in following conventional manual procedures, excluding any of the possible offsets mentioned earlier.

An analysis such as that described above should be undertaken for all proposed computer-based systems if the governing administration is to reach a valid decision on whether or not to adopt computer-based methods for the library. Computer-based or noncomputer-based systems design should be validated by analysis of the time-cost factors involved.

A major factor in management's decision to accept a newly designed system will be the improved ability to satisfy the system's requirements. This improvement may be beneficial to a related system within the library, to a coordination of systems, to library users, and to management decision making. Although these benefits are usually too intangible to be measured in dollars and cents, they should be submitted in justification of costs. For example, improved service to library users, improved quality, timeliness and form of information and reports required for decision and action, and improved coordination of operations among systems may be cited to justify a computer-based circulation system.

Unit Costs

The cost of the processing of each unit of material in each system is necessary in a comparison of the total operating cost of the former systems with that of a newly designed one. Comparative total costs do not supply management with a basis for making a decision to accept the proposed system. Determination of the cost of processing one book order, of cataloguing one title, of discharging one book, or of processing a similar work unit of a system, correlated with the standard processing a similar work unit of a system, correlated with the standard rate of processing each unit, should yield meaningful total costs' comparison in relation to the rated capacity of the old system and the required capacity of the new. Therefore, management can decide to accept increased total operating costs, aware that a stated requirement for increased productivity legitimately causes the differential in operating costs.

This discussion on unit cost of processing is confined to the major cost factor of directly chargeable personnel within a given system. While this, in general, is sufficient for establishing unit costs, it may be refined and in certain cases should be : for example, the shared use of workers between systems with each chargeable at a prorated cost and the shared use of equipment whose rental and operating costs also are proportionately chargeable.

Elements of Design Phase

The design phase of the systems study includes nearly all the elements of the analysis phase, varying only in objective and approach. It will be recalled that in the analysis phase a beginning was made by determining the procedures and methods currently employed by the system, followed by analyses of the requirements, outputs, and inputs found in the system. In the design phase the beginning process is validation or determination of the requirements to meet management's goals, validation or revision of the system's outputs, and validation or change of controllable inputs. Based on the results of these decisions new operating procedures are promulgated to fit the needs of the system in meeting its requirements. Thus the order to approach in system design is verification of requirements and then specification of the system's inputs/outputs. Greenwood supplies a thorough outline of the analyst's tasks in designing systems. There is also a strong element of parallelism between the design and the evaluation phases. In evaluating current operating procedures and methods the analyst is observing and seeking evidence of the efficacy as well as the inadequacy of applied procedures and methods. In the process and as a logical by-product he is gradually formulating and substantiating his ideas for needed change, revision, or scrapping of specified procedures, anticipating the design of a new system. Directed to design a new system the analyst retraces his steps through the system in the evaluation phase. He checks his findings and prepares specific recommendations for recasting procedures for organisational structure and job descriptions, for redesigning forms and reports, and for improving working-space conditions.

Objectives of New Design

Among the several objectives in designing a system perhaps the major one is planning for all functions of a system to logically fall within the purview of the system. Other important objectives are that there be correlation and interdependence of all functions, subsystem to subsystem and worker to worker; that similar correlation exist in the preparation and maintenance of records and files and that necessary duplication of records and files be eliminated; and that the systems' activities be performed in a logically sequential mode, organised physically for the smooth flow of work through the system.

Another significant objective in systems design is definition of the authority needed by the head of the system as well as by the supervisors under him in order that all staff members may make the decisions and take the actions indigenous to the operating effectiveness of the system. Corollary to this objectives the analyst should designate the one supervisor to whom certain workers in a system are to report. The establishment of this relationship is necessary to prevent worker disorientation and the consequent hampering of the orderly flow of work designed into the system.

Having a knowledge of the primary requirements of the system the analyst-designer should specify what ancillary requirements, if any, are to be met and the outputs necessary to satisfy all the requirements placed on the system. For each new or modified requirement and output a new or corrected worksheet for each requirement and output should be filled out as fully as possible. Although the some worksheet forms are used, the difference lies in the analyst's approach. Here he is specifying the requirements to be met and the outputs to be prepared in meeting those requirements instead of simply recording the status quo of requirements and outputs called for in the initial analysis of current methods and procedures. If the new design is restricted to available capabilities in the present staff, procedures should be designed to fit these capacities and levels of ability. It is particularly important that procedures be as routine as possible in order to limit the disruptive effect of any exceptions in the preparation of data and records standard to the system's operations. The same is true if the new design is to make use only of available equipment. If restricted to the use of typewriters by budgetary exigencies, for example, there is no point in designing a system to exploit the characteristics of a paper-tape typewriter or key punch.

Manuals of Procedures and Operations

A cardinal principle in designing a system is that all procedures developed should be put in writing. As procedures for each operation are developed they should be described in sequential detail in writing, tested and supported by flow charts graphically illustrating the procedural steps, in each operation. These detailed descriptions of the procedural to be followed in the various operations are, of course, the basis of integrated manuals of procedure covering the system's major activities and fixing the logical flow of work through the system. Appendix I to his chapter contains an illustration of written procedures or operations and a flow chart covering the preorder search subsystem in the acquisitions system. Appendix II contains an illustration of an integrated manual of operations that is designed for the total library system. It is constructed to reflect the administrative structure of the organization, the procedures within operations, and the forms used with a record retention policy statement for each form. The programme, policy, and procedure for processing the library's photocopying office charge accounts are outlined in detail.

Manual Procedures

The design of appropriate manual procedures is a principal prerequisite in the design of any type of system whether it involves electronic data processing or not. In any case and even in the most competent of computer-based systems there is substantial use of manual procedures in gathering information, in preparing this information as input to the computer system, and, as necessary, in processing the outputs to satisfy the requirements to be met by the system. In designing the system, however, it is essential to know whether methods and procedures will be based on the use of common business machine aids or on the use of the computer and peripheral machine aids.

The analyst should be thoroughly familiar with the various types of business machine that can be used in support of sound manual procedures in a system employing punched card, paper-tape, accounting, or copying equipment. At the same time he should be conversant with the techniques of computer-based systems as well as the supporting manual equipment compatible with computer input/output operations. Manual procedures systematically and logically developed for achieving maximum efficiency in an on computer-based system should supply satisfactory basis for building a computer-based system should this become feasible in the future. At that time programmers will need to reanalyze in minute detail procedures considered adaptable to computer manipulation for instructing the computer in the step-by-step accomplishment of tasks in substitution for manual processes.

Criteria of Procedures

Good procedures possess certain characteristics that should be kept in mind in the course of designing a system. As the analyst develops procedures for implementing a system he should raise the following questions about each:

1. Does it furnish the outputs needed in satisfaction of stated requirements of the system?
2. Does each step in the procedure have a definite purpose in the generation of the output? Is it clearly necessary?
3. Does each function in the procedure move the item being processed one step nearer its completion as an output of the system?
4. Are operations staffed to achieve balance among procedural steps resulting in a smooth work flow and prevention of bottlenecks?
5. Are non-routine processing steps reduced to a minimum with a path minimizing disruption and delay provided for any exceptions?
6. Are available mechanical aids used to the extent possible in satisfying the objectives of the procedure?
7. Are the forms used in the procedure so designed as to supply data in a logical format common to related functions and systems, saving time of execution and obviating annotation in their flow through the system?

Satisfaction of the criteria implied in these questions is fundamental to the successful flow charting of the procedures.

Design of Printed Forms

The analyst in the course of the inputs/outputs survey has gathered samples of all the forms used and by the time he begins the design of the new system he will have decided on the forms or copies of forms to be eliminated, changed in format, and created. Because forms are the means of transmitting information and storing and avoiding repetitive transcription of information, the importance of the proper design in data processing is obvious. It is equally important that the form be designed for convenience and time saving in its preparation and use. The impact of the time lost in working with ill-designed forms is also obvious. The design and redesign of forms is influenced and guided by several requirements and decisions.

1. Does the form provide for the recording of information in an itemized order consistent with the logical ordering of the elements of information recorded, permitting the most convenient preparation and use of the information at the least cost?
2. Does the form best serve the reciprocal and correlative characteristics of recorded data? In illustration of both Items 1 and 2 the book request form should be designed for recording bibliographic data during the preorder search in itemized progression standard to bibliographic entry; it should serve both for the purposes of ordering a book and for being a record for the originator of the request—thus indicating a two-part form. The book ordering form should provide for itemized arrangement of data in the exact format of the book request and should be in multi parts to serve as an order slip, vendor's packing slip, in-process slip, request slip for Library of Congress cards, the on-order record in the public catalogue, and the notice slip to the originator of the request notifying him that the order has been received.
3. How will the form be prepared? If it is to be hand-written, item spacing must be sufficiently generous to avoid unintelligible abbreviations and crowding of characters. If it is to be machine prepared, machine spacing and consistency of item starting points permitting maximum use of the tabular setting should be designed into the form. If both handwriting and machine preparation are involved, the form's design should be flexible enough for both methods. A principle here is the minimizing of handwritten data, confining it to the checking of boxes next to specified information printed on the form. The use of check boxes wherever possible not only speeds preparation and use of the form but may also improve the accuracy of the record due to the simplicity of checking a specific box.
4. Will the form be the basis for a temporary or permanent data file? Standardized size should be adopted fitting the filing equipment usually available in a library. If a sheet form is required, it should be designed with adequate binding margins, punched if for ring binders, and specified in standard size for economy in printing and photocopying.
5. How many copies of the form are really needed to transmit information? For example, a requirement to be satisfied by the cataloguing system is notifying the request or of a book that it has

been received and is ready for his use. The copy of the book ordering form used for ordering Library of Congress cards is returned and is used to notify the request or reducing the multi part form by one.

6. Should commercially available stock forms be adopted? The adoption of such a form more frequently than not necessitates compromises when applying the from to local informational needs. Apparent savings in the purchase of stock forms can result in increased costs of processing. Forms designed to meet the data needs for specific inputs/outputs of a given system are more economical, useful, and efficient than standardized forms designed for routine and purportedly common applications. Forms should not be regarded as inviolable but should be constantly re-evaluated with respect to their usefulness and ease of preparation. Whenever justified, they should be redesigned and replaced for more economical processing that will more than offset the cost of new ones and the discard of the inventory of the old.
7. What are the criteria in designing the multipart form? The first factors to be considered are the reciprocal and correlative characteristics of the data to be carried be the form—that is, the number of copies to be transmitted to other points. If such a multipart form is indicated, it should be printed in a continuous perforated strip for economy in processing achieved by elimination of repeated machine insertions and alignments. The advantages and disadvantages of carbon inserts and self-carbon papers should be studies, as well as the stubbing of the continuous form by adhesive, stapling, and other means for holding the alignment of copies. For example, in machine operations stapling can prove injurious to the equipment as well as cause misalignment of copies of the form. The arrangement of the multipart form should allow sequential extraction of copies in the order of the uses to be made of them. Further, the arrangement of copies should provide for the distribution of the original and the clearest carbon copies to the points where the data are used most. If instructions relating to certain parts of the form are needed, these spaces should be referenced to the instructions by number or other coding. The use of different coloured copies of the multipart form should be investigated for identifying the origin of the form. If a copy of a form is to be mailed, it should be designed for insertion in a window envelope.
8. Is the form clearly understandable? The form in all its copies should be identified by headings clearly indicating the particular purpose and use of each copy. The exact data to be entered in the

form should be self-explanatory. For purposes of routine distribution the various copies should be identified by numbers, bold-printed titles, or different colours of paper stock. As required the form should carry on its face or verso printed instructions for its preparation or use.

To summarize the foregoing considerations and decisions in the design or redesign of forms, the following elements should be sought: clarity of layout requiring a minimum of printed instruction; handwriting held to a minimum with checking of printed captions maximized to reduce errors and save time in entering information; arrangement of items in a sequence parallel with the functions to be performed; appropriate spacing for convenient entry of the required informational; and a size for easy handling and for economy in printing, preparing, photocopying, filing, and mailing.

The design or redesign of forms is an inescapable task in the design of a new system. The function of the analyst is to apply the principle that the same data or information should be recorded one time only and used by means of multiple parts at various points in the system. Although the captioning of forms and the sequential arrangement of their itemization and arrangement of copies for distribution are functions of the analyst, he usually can depend on the sales representative of a reputable business forms and systems house to furnish a large measure of assistance.

The representing acts as a catalyst by again thinking through the purpose and arrangement of the form with the analyst, often suggesting improvements and refining phrases and captions. The representative also accepts responsibility for such mechanical features as the substance and quality of the paper stock in relation to whether the form will receive a large volume of use, be filed, or be discarded; the best copy duplicating method in relation to the machine used in executing the form; the use of single or continuous forms in relation to frequency and method of preparation; and most important the sales representative will see to the drafting of the form and its proper design for efficient preparation and use by the methods and machines employed by the library.

Aspects of Design the Computer-based System

The principles of design discussed in this chapter apply in the design of a computer-based system, varying only in the precision, logic, clarity, standardization, and specificity of information to be acted on and the anticipated decisions to be implemented by the computer. The following outline indicated the areas with which the analyst should be concerned in designing a computer-based system.

1. *Characteristics of Available Computer System* : Most libraries cannot justify the cost of maintaining a computer system for their exclusive

use. Therefore it can be anticipated that most libraries will be faced with designing their operating systems to fit the capabilities of available outside equipment. The characteristics and availability of such equipment should be know:

(*a*) Means of input (punched cards, paper tape, telecommunication).

(*b*) Means of storage (magnetic tape, disk, drum, core memory).

(*c*) Storage capacity.

(*d*) Means of output (printout, punched cards, magnetic tape, cathoderay tube).

(*e*) Relative speed of machine components.

(*f*) Computer time available for library operations.

(*g*) Available "off-line" equipment (sorter, tabulator, interpreter).

2. *Generalized Systems Chart* : A diagram showing the following should be made:

(*a*) The primary input and output.

(*b*) The major activities of the system.

(*c*) The interdependence among the various systems.

3. *System Requirements Analysis* :

(*a*) Analyse requirements in terms of a computer-oriented system, keeping in mind that through programming the computer system can be assigned many of the routine decisions found at all levels of management.

(*b*) Analyse for all possible applications of the principle of management by exception, determining and designing reporting systems best serving management's needs.

4. *Inputs/Outputs*

(*a*) Determine the input/output information required to satisfy the system, taking advantage of the speed of the computer.

(*b*) Evaluate inputs/outputs of the present system and determine what additional inputs/outputs are required and/or what inputs/outputs are not required; determine the minimum essential information.

5. *Input Media*

(*a*) Evaluate existing forms or design new ones as required to capture needed data.

(*b*) Determine within the characteristics of available computer equipment the machine-readable media best adapted to the system's requirements (punched cards, paper tape).

(*c*) Evaluate and select equipment to be used in the library to generate machine-readable input records (key punch, tape typewriter).

6. *Computer Storage and Output Media*

(*a*) Determine media best suited for computer reports—for example, punched card, magnetic tape, printout, microfilm, within the limitations of available equipment.

(*b*) Determine for each record the type of computer storage media required for efficient processing (sequential or random) within the capabilities of available equipment, such as magnetic tape, data cell, disk, or drum storage.

(*c*) Evaluate and select any equipment to be used in the library to store and process computer output to yield records and reports, such as an electronic accounting machine for punched cards.

7. *Functions*

(*a*) Identify each function required for successfully meeting the system's requirements.

(*b*) Determine those functions to be performed under programmed control and those under manual control.

(*c*) Detail the procedures to be followed in the performance of each function.

8. *Decisions*

(*a*) Identify each decision required for successfully meeting the system's requirements.

(*b*) Identify those decisions that may be delegated to the computer mention, identify the responsible person.

(*c*) Identify the source records and reports from which the information is obtained for making each decision.

9. *Resulting Actions*

(*a*) Identify the actions to be taken as the result of each decision.

(*b*) Identify the functions or further decisions resulting from each action.

The study staff should prepare the flow chart of the new system in sufficient detail: (i) to furnish guidance for the programming of the computer-based parts of the system, and (ii) to permit preparation of detailed instructions for the manual procedures of the system. The study staff should continually modify the computer-based system until the system's objectives are realized. An acquisitions system to illustrate major aspects of computer-based systems design principles.

The final steps in the design of a computer-based or non-computer-based system are to:

1. Estimate the cost of installing the new system and its operating cost.
2. Compare the cost of the old system with that of the new.
3. Determine the staffing requirements of the new system.
4. Prepare a summary report for the library's management outlining the features of the new system in relation to the old.
5. Prepare a detailed procedural manual and time schedule for conversion to and installation of the new system.

Systems Installation

The responsibility of the analyst should not end with the completion of the design phase of the systems study. The installation of the newly designed system should also be done by the systems analyst in cooperation with the line supervisor. It is logical that the installation should be the responsibility of the analyst since he designed the system, is aware of the nuances of his design, and has a definite interest in seeing that the system starts up successfully. The analyst should coordinate and correlate the various factors entering into the implementing of new system—such as staff training, new forms, new equipment, and new facilities—so the installation can proceed according to a realistic time schedule. For example, the installation of a computer-based circulation system could involve coordinating the preparation and procurement of machine-readable identification cards, punched cards for books, data collection devices, computer programmes, and new computer-produced forms such as overdue and recall notices.

There are three possible ways in which a system may be installed: (i) all at once on a crash programme basis with title, if any, break in service during the transition; (ii) *simultaneously* as a parallel programme with both the old and the new system being concurrent for a predetermined time; and (iii) *step by step* on a piecemeal basis where portions of the new system are implemented within the old system. The size and nature of the new system will have considerable bearing on what installation approach the analyst may take. For example, it may be possible to implement a punched-card circulation system step by step. The preparation and insertion of the punched cards in the books may be accomplished on a piecemeal basis; that is, as books circulate punched cards could be made up and then be inserted when the books are returned. When a sizable portion of the active collection has been covered, the switch over to the punched card system could then be made. The simultaneous type of installation, although expensive, may be feasible where assurance that a new system will perform as accurately as the old is desired. This would be particularly true in accounting operations where the new system's tallies should correspond with those produced under the old system. The all-at-once approach may be used if a new operation is not considered complex, such as the use of photocopying machines to reproduce catalogue cards. The programme could be operational almost immediately after the card stock is available, the copier installed, and the staff trained.

Systems Follow-up

After installing the system the analyst should plan to check back on its progress. This is essential if he is to obtain on-site feedback about the system so that he in cooperation with the line supervisor can make any necessary revisions and adjustments in operations, forms, and staffing. The analyst's follow-up report may also serve to justify and increase managements confidence in the new system.

The appropriate time to make the follow-up survey will vary with the situation. In any event it may be well to audit the system a month after it has been declared operational. After this initial observation, it also may be well to have a review of the system annually. The follow-up report should not be done at a distance but by visiting the system and speaking with the staff and checking whatever controls may have been built into the system. For example, the statistics being kept in the new system may have been designed to reflect the effectiveness of the new system over the old. Reports on costs, unit production, and usefulness of equipment may be of value in the follow-up evaluation. Another method of testing quality control would be for the analyst to discreetly observe the progress of units through the system.

The changes and recommendations resulting from a systematic follow-up study assure the continued success of the new system.

11

New Technology for Library and Information Science

In the present chapter we intend to discuss the developments in new technology that could be of benefit to people doing research in the humanities field. As a framework for this it proposes to describe some of the projects currently being supported by the Research and Development Department of an international Library, and use these to illustrate some of the tends discernible, and to identify some of the problems that may be raised as the new technology becomes increasingly and more widely available and used. First, we support two projects in this area.

One, organised at a reputed regional polytechnic, is concerned with the investigation of access to material stored at a remote site. His present device consists of a microfiche storage and retrieval device which is accessed by the user sitting at a remote terminal entering keywords.

The appropriate fiche is then scanned electronically, held in a buffer store, and displayed on the screen of the terminal. The user can move round the image on the screen by using a joy stick control. When fully developed, this device will permit users keyword access to centrally held microfiche stores of text, graphics, pictures or any combination thereof. This should be compared with current systems such as BLAISE, SDC and Lockheed Dialog that permit access to stores to text only, and in the examples given, bibliographic text. The executive's current storage medium is microfiche, but he is about to go to the USA on a study visit to investigate other storage media available, in particular videodiscs. Videodiscs will permit the encoding of large quantities of text and graphics and voice or sound.

> *"It is literally true that no man has ever used more than a small fragment of his brain power...."*

A second project in this area, organised by senior academics of the Department of Computing at the University College of a metropolis involves the investigation of facsimile transmission over packed-switched networks (PSS, ARPANET, EURONET). So far the project has developed techniques for the storage and retrieval of data in machine independent form; for sending messages with the text; and for archiving. Facsimile itself is not new, it has been in existence for a hundred years or so — the newness of Professor Kirstein's activities centres about the use of digital, rather than analogue machines. His future activities include further developments of his earlier results, plus the investigation of how word processing and facsimile transmission can be combined in the interests of economy.

Word processors are suitable for the manipulation of text, but not suitable for the transmission of graphics or exact images. Facsimile can, obviously, cope with both graphics and text, but only by treating the text as another form of graphic and hence developers would not be able to take advantage of the efficiency inherent in the enconding of characters.

It was also planned, at a suitable stage of development, that the heads of involved departments would investigate the inter-working of the two systems, to permit facsimile images to be obtained from microfiche or videodisc stores. The exact storage device used in these projects would vary according to what is the current best bet from the technological view point.

However, we have a glimpse at devices that will permit users to access stores of graphics and full text and will extend on-line access from mere bibliographic information to the information itself, and will permit the setting up of new types of data bases, hitherto technically unfeasible.

One of the outstanding issues still to be resolved in this area is one of resolution; the quality of the image. Both these systems digitize the data by scanning either the document or the fiche. How good of picture is presented to the user depends essentially upon how many "lines to the inch" are scanned. Too thin a density will result in a coarse image. However, the greater the density of scanning, the more digitilised information is generated all of which needs to be transferred down the telephone line or stored.

Although there are techniques used to compress the digitalised data so it can be sent down the telephone line more quickly, or stored more efficiently, probably for each application, a compromise will have to be struck between the level of resolution required or which may be acceptable, and the associated costs of transmission or storage.

Interest in man-machine interactions is not new. There has been research going on into this at a fundamental level for some time funded by other bodies. However, interest has been awakened in this area probably by the introduction of Prestel, a system designed for the mass market that really is simple to use. This should be compared with the other information retrieval system available commercially today — e.g. BLAISE, Lockheed Dialog and SDC, some of which are going to be demonstrated by Mrs. Vickery later on this afternoon. The command languages and underlying concepts are rooted in 1960's developments and so do take rather a long time to learn how to use and have not really to be recommended for use by the casual user. This has lead to library professionals developing skills in the use of these systems so that they can do the search required on behalf of the user. The simple retrieval software with Prestel, based upon the presentation of a menu of alternative courses of action to the user, for him his choice by the depression of a key on a keypad, has stimulated an awareness in manufacturers and information providers of the benefits of simple-to-use systems.

One cannot deny the large economic force encouraging this stimulation. The attraction of sales to a mass market are obvious, and has fostered an awareness that systems must be easy to use and reliable for them to be taken up by the man in the street. This new feeling was very much in evidence at the recent Viewdata 80 conference. Big business has woken up to the advantages of so called user-friendly systems. Our excursions into this area are modest but will provide a useful service and bridging between the information systems we are familiar with today, and those of the future.

Dr. P.W. Williams of UMIST has received institutional support to undertake some work on the use of microcomputers to act as friendly interfaces between the user and the computerised information retrieval systems. Dr. Williams hopes to devise a programme for the microcomputer that will interprete the users' requirements to the computer and make the computers response more readily intelligible to the user. In addition he will be looking at how the microcomputer could cope with the translation of commands from one command language to another. As you will see from Mrs. Vickery's demonstration, different systems have their own way of doing things, and it would greatly simplify matters for the casual user, if he only had to learn one set of commands, the micro translating them into the form most appropriate for the system currently being accessed. In this Dr. Williams will be following closely the initiatives of Alan Negus who has been doing a lot of work recently for the EEC on common command sets.

Electronic Journal and Word Processing Projects

As we have mentioned earlier one of the leading researchers' interest in word processors, and how they may be used in association with facsimile transmission. We have recently awarded a grant to the National

Reprographics Centre for Documentation (NRCD) to investigate the usages of word processors in a special library environment, as well as being used to produce reports and duplicate letters, etc., and the normal business uses of the machine. As well, they will be investigating how a word processor can be used to produce more than one version of a journal — one in a format suitable for normal printing, and another version in a format suitable for producing microfiche. Staff at NRCD will be investigating the information retrieval capabilities of the machines — their uses and limitations, and also how the devices can be interfaced with COM equipment and other forms of output. Another project under negotiation at the moment is concerned with the research into the electronic journal concept. We hope that this project will start this year and at present delicate negotiations are proceeding on a number of fronts. On the one hand, negotiations are underway to lease some software appropriate for the job, and on the other hand, the final details of the methodology for setting up and using such a journal are also being finalised. A whole family of different aspects will be looked at, including different forms of input, changes to refereeing patterns, changes to the journal format and in the behaviour of people making use of the facility. We do not want to dwell too long on this since the situation is still fluid.

However this project and the word processing project at NRCD are examples of projects for which the essential novelty is not particularly the technology, but the application of the technology to an environment for which it was not originally designed. These two projects also underline ways in which people may find that traditional ways of doing things are being, let us hope improved, by the introduction of technology.

The New Technology Group

Remarkably, parallel with the establishment of some of these projects, especially the remote access and document storage ones which have been running for quite some time, since 1975, the Research and Development Department felt the need to set up a special committee to investigate new technology and how it could be applied to library and information problems.

The department had become aware that developments were taking place in somewhat esoteric research environments, and perhaps in other application areas, the results of which could directly benefit the library and information world, if they could be caught and trapped.

A forum was therefore established of scientists and information professionals to bridge the gap. It looks at existing and emerging technology to see whether the technologies are developing in such a way that the needs of library and information are catered for — and suggests projects where this can be encouraged. It looks at developing existing new technology to see how it can be used to benefit existing or new services and it is also concerning itself with the idea that existing professional staff need some educating so that they can make use of the emergent new technology when it becomes available, and are discouraged from the more unfruitful areas. Two areas that the Group particularly singled out of the new technologies that should have an impact in the library and information communities in the near future are novel input technologies and novel forms of storage.

The latter I have touched on earlier in the form of Dr. Barrett's interest in mass stores (microfiche and now videodiscs). We had a brief flirtation with holography last year, but it's future is unclear at present due to internal rearrangements at Plessey (who are doing the research in the UK) and the possibility that for some applications holography has been overtaken by events — the introduction of videodiscs.

However, mass storage, the technical developments and the reduction in costs over time will have an impact on library and information work in the provision of media to permit the economic storage of full text and graphics. Novel input technology has two themes. On the one hand, some devices like the hand print input device, and voice input when available are attempts to overcome the lack of user-friendliness of keyboards which are fine for those who can type, but no little deterrent for those that cannot.

Advances here include a pair of devices, that allow users to print on paper overlaying a sensitive pad. The movements of the pen are used to recognise the characters being printed — and the code for the character can then be passed to the computer or wherever. To the computer the device behaves like an ordinary keyboard. There are other devices also, like the Microwriter, with five keys. Combinations of keys are depressed to form the desired characters. The combinations of keys have been selected so as to mimic the shape of the characters to provide a simple aid to memory.

Devices of this nature continue the theme of a trend towards more user-friendly systems. The other feature that new forms of input bring is of course the possibility of inputting material other than text. Tablets have been developed that permit the input of graphics drawn on the them which have found applications already in the computerisation of maps, etc. The British Library has been supporting, since the autumn of last year, a research project based at Cambridge University Library under Mr. A. Tucker to look at the integration of Chinese and Roman script in automated library catalogues. Roman scripts have traditionally been input into library catalogue systems using keyboards, and Chinese and non-Roman scripts coped with by the usage of romanisations and transliterations. The development of the Ideographic Encoder at the Faculty of Oriental Studies and Cable and Wireless (a commercial company) has enabled the input of Chinese in its ideographic form. The device consists of a drum over which is laid a matrix of Chinese characters. To input a character, it is located by rotating the drum and positioning the curser over the character—being identified by its row and column co-ordinates. These can then be manipulated in the way analogous to the way a code could be for a Roman character. Developments in COM have resulted in devices that are capable of the right definition and resolution to display these characters at the size required.

These two developments paved the way for the Cambridge project which includes the further development of the Encoder to cope with a full character set; the selection and arrangement of the characters at the drum to suit non-native Chinese speakers the development of all the necessary interfacing required to handle the character sets with input facilities for Chinese Telegraphic code and all the official romanisations; the solution of problems of sorting and filing the Chinese characters; and the integration of this project with developments in the standards areas and the construction of a library catalogue containing part of the record in Chinese and part in, say English. Another interest the New Technology Group had was to negotiate with the appropriate bodies some test bed facilities, to have available for usage with suitable projects. The negotiation of specialised computing facilities always takes time, and the proposer of a project requiring computing or other complex facilities may not easily have access to them.

So far these include batch, parallel processing and novel input testing facilities. Predictions of the impact of new technology on the user are always difficult since there is generally a time lag between the technical feasibility of an operation and it being adopted on a large scale, due to financial assessment and organisational changes that are required for their further implementation. Some tentative effects can be predicted, as having some impact in the near future.

The user will observe a trend towards multi-purpose and integrated technology. Multi-purpose editing terminals, that will permit access to computers, to Prestel, and to other remote stores, that will have facilities for receiving traditional print-out and facsimiles. Perhaps with voice and other sound capabilities. This approach would favour the naive user, the person without the time or the inclination to ascertain which piece of technology to obtain to access specific information sources; the larger markets that would ensure would also favour the user allowing potential reduction in cost. The necessary equipment and telecommunication sub-structures are gradually being developed and will emerge in the light of needs and market forces. The trend towards cheaper storage will allow users to computerise and automate new or larger data bases. The changing economic will be such that in the future, the storage of full text will become an economic proposition should it be desired rather than merely the bibliographic surrogates common at present. These developments, together with improved input devices will enable people to consider the establishment of data bases of graphics and other non-textual material, hitherto decidedly uneconomic, except perhaps on microfiche.

Users' needs will increasingly come under consideration. The effect of market forces attempting to reach a wider audience outside the traditional market for computerised products, and economic forces causing users to consider very carefully the efficiency with which such devices are being used will result in an emphasis on fitting the device to the user rather than expecting the user to conform to the rigours of the machine. This change will greatly affect the ease with which users take up the new technology and greatly affect the new uses to which it can be put. These will favour the trend towards electronic dissemination of information and people feeling as happy to communicate via a terminal as perhaps they do by telephone today. The researchers in some organisations will find that his reports and papers are being prepared increasingly on word processor equipment. He will see the benefits in increased freedom to create, amend and change his work. The use of retrieval software, either in the word processor or in the computer to which copies of documents could be passed, can be used to enable the researcher to manage more efficiently reports created by him, or other colleagues. Increasingly, the user may find himself disseminating his research results via electronic means, benefiting from the speed that electronic communication can generate. The form of the journal article favoured by this medium and the type of communication may well differ from the traditional form. As far as those concerned with the humanities are concerned; perhaps the most important thing is a ready understanding of the needs of the group is essential, so as to be able to influence the evolution of the new technology to take account of the undoubted special needs of the humanities researcher and his information needs. Education of future users should be a serious consideration so that they can see the benefits (or otherwise) of the changing technology, can adjust to the changing scene, and accept the changing role of the information centre as more and more information becomes available.

The economic situation is changing rapidly too, so it is as well to keep this factor under consideration also so as to be able to determine at what point it is best to introduce technological change.

In fact, the need for facsimile transmission from remote access storage facilities was discussed. Its importance was questioned, when fiche can easily be transmitted by post. A central storage facility was seen as having the advantage of facilitating up-dating. It was stressed that decisions did not to be made between new technology and existing technology. There is a need for a mix and to select the technology most appropriate to the needs of a given situation. For instance, some fiche might be required on hand while some might be placed in remote storage. In the context of the use of technology to facilitate up-dating, it was suggested that there might be a need to freeze up-dating in order to obtain a snapshot view. There was some discussion of the drawbacks of facsimile transmission, particularly the time taken for scanning. It was suggested that the implementation of facsimile transmission would depend on the economic climate, which affects the balance between central and local storage. Developments in word processing and its applications to libraries were discussed.

The National Reprographic Centre for Documentation at Hatfield Polytechnic is evaluating the use of a Word Processor, not simply for preparing reports, but also in terms of exploiting the accompanying software supplied by the manufacturers, with particular reference to the capacity to take over traditional library functions. Concern was expressed about the long-term conservation aspects of new technology.

It was admitted that while information is available concerning microfiche, less is known about videodiscs, which are currently mainly used for entertainment purposes in the United States. Questions of copyright and security were raised. Not all the copyright issues have been resolved. It was questioned whether humanists are less willing than natural scientists to share there current thinking. It was pointed out that there are means of providing electronic locks for personal files. One of the problems of technology was seen to be that it is moving so rapidly that ideas may not be exploited commercially because they might be overtaken.

Generally, Librarians have often demonstrated a pre-recorded online search. The search dealt with the history of violent crime in the eighteenth century. A number of different data bases were used, on two systems, Blaise and Lockheed Information Services. The recording was done using the Mediatron, a device which enables real searches to be stored, together with voice-over and cued slides. The search was presented on a V.D.U. and a monitor.

As an example, the bibliography of a classic book, “The making of the English Working Class” by E.P. Thompson, published in 1965, was cited. Thompson lists papers found in the Public Record Office, in London, in the Manuscript Room at the British Museum and in the Sheffield Reference Library. He also consulted the Radcliffe papers at a private country mansion, at Rudding Park, Harrogate. It was pointed out that students engaged in work for a PhD need to look in depth at a narrow field and so inevitably need primary materials. Very few primary materials are recorded in machine-readable form, and the demonstration was concerned with improving access to secondary sources, in order that time thus freed could be devoted to teaching and thought.

The prerequisites for conducting an automated search are:

— a terminal

— a. V.D.U.

— a printer

— an outside telephone line

— a modem

— an intermediary who knows the command language of the system and the data base or the end-user with this knowledge.

The demonstration showed how different numbers of references could be obtained from different data bases, using the same search strategy. The benefits were obvious in terms of speed, but some drawbacks were pointed out. An amusing example was the finding of a reference on the murder of newspapers (the machine is not able to cope with metaphor).

The first part of the discussion was concerned with the relevance of searching in the manner demonstrated. In response to a question about whether the searching of data bases made sense to the users, Mrs. Vickery said that the historians who had been approached for the pre-recorded search had certainly felt so and were themselves using the technique to update a particular publication in writings on British history. Some assessment of the value of searching data bases in the sciences had already been done and the possibility of assessment of its use in the humanities was being considered.

One issue discussed was whether the interest of humanists in searching data bases in machine-readable form would only develop when primary sources could be accessed in this way. Another matter for discussion was the place of the interview with users for whom a search was to be conducted.

The question was posed concerning whether the pattern of interviewing prior to search would continue and whether users would therefore continue not to do their own searching.

It was suggested that the major problem in users conducting their own searches was that of the knowledge of different command languages. The situation would improved if command languages were standardised.

Another advantage of conducting interviews with the potential user is that this helps the user to specify his/her requirements. This could be particularly relevant to the cost of searching. The cost of searching was discussed. Searching is getting cheaper, but obviously the cost depends on the search. One issue is that of the value placed by researchers on their own time normally spent on searching. Another question raised was that of the possibility that the more effective the search, the more expensive the follow-up, for instance in terms of inter-library loans.

Aspects of the usefulness of searching data bases were mentioned, particularly the use of the technique to the researcher for finding new material. Comments were also made on the potential use of the technique for teaching purposes.

The Need for Resources Guides

Basically, the need for radically improving the available guidance to library and other research resources in the UK has been repeatedly stressed in professional literature and meetings for at least a decade and a half, and with increasing frequency. In 1965 the Library Association's report *Access to information* envisaged one function of a national bibliographic centre as 'compiling and publishing detailed guides to sources of information.'

The present seminar's predecessor in 1975 felt that '... not enough was known about special collections of book and non-book materials in the humanities.... More research was wanted on the requirements of users of the various guides to literature and resources.'

In the same year a seminar of the SCONUL Information Services group '... especially noted the need for improved guides to good collections of specialised material.' The most extensive study to date of resource guides and library directories, conducted in '1976 by Aslib on behalf of the British Library, pointed out that no coordination existed for identifying demand for resource guides, updating existing publications or planning new ones. A recent article of my own has been devoted to the question of how best to characterise libraries and collections for the purposes of entries in resource guides.

This sector seeks to focus this widespread concern over inadequate resource guiding on the three practical questions which will bear directly on any future initiative:

(a) What would be the advantages, if any, of developing coordination and planning procedures to be applied to the preparation of resources guides?

(b) What should be the qualities of a good resource guide, and what principles should underlie its preparation?

(c) What contribution can resource guides be expected to make towards facilitating study and research, especially in the humanities and social sciences?

What is the distinctive usefulness of a guide to library, archival or other research resources? If the enquirer is not using the guide to find an address or telephone number (which is the primary purpose of a library directory in the narrower sense), and if he is not using it to try to locate a specific publication (which is the primary function of a union catalogue) — then the resource guide's sole remaining distinctive feature is the description it gives of each collection. In other words, *subject access* is the only service which a resource guide can offer if it aims to be more than an address list. The enquirer *may* also use it as an aid in guessing where particular works are to be found, if he has no access to union or other catalogues, just as he *may* use it to find a name or telephone number but he is likely to expect, in the first instance, reliable information about the character of the collections included which will enable him to judge those most likely to aid his work.

A guide which can provide this kind of information will also possess the basis for other contributions to research: it can facilitate the planning of research so that it takes full account of all existing resources in the field; it can permit the identification of inadequate or non-existent resources in particular subjects or locations; it can provide the foundation for better cooperation between libraries; and it can give libraries better standards of comparison between themselves. If resource guides are to provide adequate subject access for the user, their compilers will need to differentiate between users and between subjects.

The distinction sometimes made between `general' and 'specialised' resource guides is not, in my view, a useful one. It suggests that the 'general' enquirer may find it easier to use a guide which describes collections only briefly, and which probably covers holdings in many subjects in a large number of libraries. The 'generalist' who will benefit more from such guides in a mythical being. If an enquirer turns to resource guides at all, he will — on the assumptions made earlier — be looking for libraries likely to hold material in the subject or topic which interests him, however limited his knowledge or qualifications in that subject may be. Lack of detail in a resource guide, combined with a multitude of entries, will yield either far too many 'possible' locations, or will be too unspecific for the user to identify any 'possibles' at all. This is not to say that two or more resource guides might not be designed to cover the same subject, or indeed the same libraries, if they were orientated towards people with different kinds of interest in them.

It might, for example, be appropriate to have one guide to resources in history for the undergraduate student, another for the amateur local history enthusiast, and a whole series for postgraduate and other advanced researchers. My point is that none of these is a 'generalist'" they all have specific and differing needs which should determine (a) which collections will concern them, (b) what range of material in those collections will need to be included in the guide, and (c) how the holdings should be described. If, then, a resource guide is to be compiled primarily to facilitate access to collections by subject for defined classes of users, its preparation and presentation will need to observe several important principles. Firstly, the coverage of the guide will need to be carefully defined, whether it is of a traditional discipline, an 'area study,' or a developing interdisciplinary subject. The class of users will also need to be defined, contacted, and consulted at the planning stage of the guide.

The compilers will need to be familiar with the structure and terminology of the subjects to be covered, so that the collections can be described consistently in the terms, and to the degree of detail, which are most appropriate. Consistency and thoroughness in description are something which the user has a right to expect from a resource guide: that is, that all significant collections, throughout the range of topics which the guide purports to cover, should at least be mentioned in the entries for the libraries concerned, and should at least be indexed too. As noted above, the compilers will have to decide on the depth to which the collections will be described, and this will vary with the guide's subject and readership. For instance, should we note only the presence of holdings in 'Russian history,' or should we distinguish between collections on the economic, political, military and local history of Russia?

A decision on this will require the compilers to fix the terminology and the hierarchy of subject division to be used both in characterising the collections and in preparing the index. It needs to be remembered that the description of each collection will not be read in isolation: it will be compared with other entries in the guide. Not only must all relevant holdings be mentioned, but all the 'mentions' must use a carefully-controlled vocabulary and variation of length, to ensure that — for example — a 200-title special collection in a small library is not described with a much greater verbal fanfare than a 2000-title holding on the same topic in the Bodleian. An important practical consequence of this requirement concerns the process of gathering information for the entries in the guide. Whatever combination of questionnaires, personal inspection and literature searching is used to elicit the necessary data, it is essential that all the collections should be reported on in the terms set by the compilers. Faced with an unspecific enquiry about their holdings, no two libraries will (left to themselves) respond with exactly comparable accounts.

Enquiries will need to be persistent enough to verify exactly what every library has in the subject of interest, rather than simply hoping that all of them will possess staff with enough time, knowledge, records and inclination to supply the details required. A question which will have to be resolved separately for each guide is whether, and if so to what extent, the descriptions of collections should mention individual works or items. We suggested above that resource guides can offer a contribution to research which is distinct from that offered by catalogues of books or lists of periodicals. A resource guide can (or should be able to) provide information on the subject profile of collections which catalogues and title lists cannot give because of their itemised nature and, usually, their author/title arrangement. There is the further consideration that resource guides which note the presence of some individual titles will run the risk of misleading either by the omission of some locations or by the undue prominence given by haphazard occasional mentions.

There may be some merit in recording fully the location of a limited number of 'key' titles, or (in a subject where the volume of data is not impracticably large) in incorporating, say, a union list of serials into the guide itself.

In fact, there is no lack of 'resource guides,' 'library directories' and 'guides to sources of information.' Nevertheless, the opinions quoted in the introduction to this paper emphasise that there are still many subjects and specialities which are not served at all by such publications. Just as importantly, if the contentions of this paper are accepted, many of the compilations now in existence are far from being the thorough and consistent guides to available material which the enquirer has a right to expect. If, then, uncoordinated action by organisations and individuals has failed to provide adequate guiding to British research resources in many subjects, there may be a case for establishing some fresh organisational form which could identify subjects or areas for which resource guides (or better resource guides) were desirable, and could promote and advise on their preparation and publication. The concept of a point of responsibility, at national level, for facilitating access to library resources, has already been accepted in Canada and USA.

The National Library of Canada's Resources Survey Section, formerly the Office of Library Resources, has for some years been issuing the series *Research collections in Canadian libraries,* while the National Referral Center, attached to the Library of Congress, is producing the series *Directory of information resources in the United States.*

The functions of a similar agency in this country, as they related to resource guiding, a might be on the following lines:

1. Seeking specialist organisations and/or individuals capable of preparing suitable guides, and encouraging initiatives from such specialists.
2. Undertaking the necessary consultations and research in order to identify subjects or topics for which guides to research resources were desirable.

3. Responding to applications for limited grants to assist in the compilation of resource guides.
4. Giving or obtaining expert advice on any aspect of a guide's planning, compilation, design or publication.
5. Coordinating, though without any mandatory powers, plans for the preparation of guides in adjacent or overlapping subjects.
6. Using the findings of resource guide compilers to assist it in providing the appropriate authorities, as well as researchers and librarians at large, with assessments of the quality and distribution of the country's research resources in specific fields; to formulate recommendations for improved coverage; and to indicate the scope for better cooperation and more efficient use of resources.
7. Assisting in the publication of resource guides of a high standard, either by establishing a resource guide series published by the office itself or its parent body, or through agreements with publishers elsewhere.

Obviously, it is important that any central office of this kind should not attempt to bring the actual compilation process of resource guides under the administration of its own staff; nor, in encouraging high quality, should it impose rigid conventions upon the guides approach and the presentation.

The real services which a 'resources survey office' could perform in this respect would seem to lie principally in making better use of specialists' expertise and in promoting cooperation between specialists in order to provide resource guiding of a higher standard and in more fields. Building on this work, it could greatly improve the present state of our knowledge about provision for research in any country.

Generally, we want to look away from fully fledged historians, and PhD students back to the undergraduate level—at which researchers pick up their attitudes to librarians and information services and their approach to seeking information, and in particular to look at the work of the Travelling Workshops Experiment concerning user education for history students. We should also explain at the outset that the Travelling Workshops Experiment has now become part of a commercial undertaking known as Newcastle-upon-Tyne Polytechnic Products Limited—and that I was with the team for the last phase of the research project alone.

We propose to introduce the Travelling Workshops Experiment history package to you now, discuss some of the thinking behind it, and then have a look at one of the components of the package—an introductory tape-slide programme which lasts for about 20 minutes. To cite an example, three subject specialists were appointed to the research team at Newcastle to work in the areas of biology, social welfare and mechanical engineering — and hereforth we shall defer—and refer any enquiries on the early development of the Travelling Workshops Experiment to Colin Harris, who as many of you know, was one of the founding members of the team.

For those who are interested a list of publications about the project is available and so is the British Library Research and Development report. Suffice it to say that the project went through several evolutionary stages, and with the team's experience in conducting formal workshops for undergraduates they moved to the adoption of a self-instructional approach in the preparation of learning materials.

For those who are not familiar with the Travelling Workshops Experiment, or with the idea of information learning packages we shall briefly outline ways in which the first three packages, developed by the Travelling Workshops Experiment, have been used:

1. The package has been used in workshops of some kind — typically conducted on two or three afternoons in successive weeks. Workshops generally incorporated an extensive display of sources.
2. The materials have been made available in the library itself over a period of time, from a week to a term — a method which avoids the artificial atmosphere of a workshop.
3. Entirely independent use of the materials by students has occurred, but, as you might expect, this was most successful where combined with formally time-tabled seminars.

To return to the history package — by the beginning of 1979 the Travelling Workshops Experiment had already received a second grant for the purpose of investigating whether the common framework of the first three packages was appropriate in other areas — particularly in the humanities, and history was the subject chosen.

We might remind you here of our predecessors who met at Gregynog where "warm agreement was expressed all round of the idea that young scholars and students, in general, needed a better training in information services than the average supervisor could give."

The plan, then, was to see how far the existing package framework was appropriate for the subject of history—and relevant to the needs of students of history.

In order to achieve this relevance and also to give the materials produced the full weight of academic authority, a new method of preparation was tried. There earlier packages had been developed solely by subject specialists who were also librarians, but this was a joint work. We sought to marry the bibliographical skills of myself as a trained librarian, and also a history graduate, with the critical authority of an academic consultant— Professor Norman McCord of Newcastle University. The Professor maintained a fairly heavy teaching commitment, and memories of my own student days were not altogether dim — so between us I feel we kept the question of relevance high on our priorities.

We were concerned to equip users of the package with the ability to evaluate the sources they meet. Naturally we endeavoured to give some critical comment on the major sources cited in the package but our hope is that as a result of using this package students will be in a far better position to assess the authority, currency and relevance of material which they encounter in future.

Notably, because treatment of this area is an integral and compulsory part of most undergraduate courses. Secondly, we felt this to be an area in which undergraduate have reasonable access to primary sources, and is therefore an area in which many students choose to pursue research for dissertations and projects, so common now in the requirements of a first degree. That the coverage spanned three centuries was to our advantage too in that it prevented us from becoming too narrow in selection of material and examples. Now to the components of the package. The main vehicle of instruction is the student handbook. Implicit in its structure, chapter by chapter, is a systematic search strategy.

It moves from the consultation of reference works, and books and bibliographies, looking at the use of theses, conference papers and so forth. Exercises, for which students are required to use particular sources, are included at the end of each section in order to suggest the range of material available. The final step, for some students, is the identification, location and use of primary source material. At each stage our intention was to outline the nature of the type of source (that is — what *is* a bibliography, and what *is* an abstract) and then to direct attention to major and standard items, and lastly to indicate the variety of material available through the inclusion of particular examples. We need not embark on a tedious recital of the content of the handbook but suggest that you might examine it carefully yourselves if you wish. Here we just want to bring to your attention one or two points.

Firstly, in selecting material to be included, we tried to describe only standard and essential tools and other sources were named purely as examples of the type of source under discussion. Much of the liveliest exchange between the Professor and me derived from this question of selection, and it is worth indicating that we occasionally felt obliged to include publications which we knew to be limited in usefulness. For instance we indicated that the *Annual bibliography of British and Irish history* is the most up to date of current serial bibliographies but that it is not annotated.

This example leads us to a second point-the importance we attached to introducing students to the wide range of 'one-off' subject bibliographies available to historians. We discussed the points students should consider about the compilation and content of a bibliography which they are using.

Further, a key problem was how much information should be included on primary sources. We examined these in groups: Documentary records, Archaeological evidence, Audio-visual materials and we had a nice *convenient* section on Miscellaneous sources, including oral history and place names. I hasten to add that the categorisation of sources used was definately pragmatic! Some introductory points on the problems of using primary sources precede a discussion of the different types of record. There is no attempt to give comprehensive coverage but rather to indicate useful sources of information.

A belief section of access to records rounds off the chapter, by indicating repositories such as the P.R.O. However, I must emphasise that although we identified major repositories, and indicated the wide range of smaller collections, we were anxious to extend a restraining hand to avoid over-enthusiastic sorties of valuable resources. The posters displayed given a general indication of the range of reference books available, and the other two were designed as more specific instructional aids, which can be used as a method of point-of-use instruction in a library as well as being used for workshops and so forth.

For example, the poster explaining the use of the *Art and Humanities Citation Index* followed a format successfully used by the team with other citation indexes. A more detailed explanation of how to use this index is provided by the audio-cassette programme, which lasts for some 15 minutes, and can of course be used by an individual or with groups. The listener handles the different parts of the index while listening to the tape—not only learning *how* to use it, but also gaining some familiarity and confidence in handling the tool.

A teacher's manual is provided for the assistance of academics or librarians, or preferably both, who are planning to run a user education course based on the package. This manual grew out of the experience of the team in giving workshops, and so is very much a practical guide. Before we go on to show the tape-slide programme I'd like to look again at our main objective—which was to test the applicability of the established framework of the first three packages to this subject.

In fact we found that the established pattern was appropriate. Certainly it was essential to first consider the bibliographic structure of the subject—and then we made changes in emphasis finding that we did not need to make changes in the framework. In this package you find more extensive treatment of bibliographies, introduction to a wider range of abstracts and indexes, and of course an examination of primary source material. Greater emphasis is laid on the need to evaluate and assess material, and on how to go about this. The only real change in the presentation of material is the use of the enlarged typescript in this package—subsequent to criticism of the earlier packages.

Well—the package went on sale at the end of last year—and the Travelling Workshops Experiment has become part of a commercial undertaking know as Newcastle-upon-Tyne Polytechnic Products Limited. Naturally it is for time, and use, and package purchasers to say how successful this product is. A preliminary survey of those who have bought the package to date indicates a generally favourable reaction, particularly to the handbook. On the whole the more specific comments on content fit in with what one would expect—one person felt *Historical Abstracts* should be omitted, (since it is now on-line) another felt *Arts and Humanities Citation Index* was irrelevant. One felt the treatment of research methodology and primary sources to the pleasing, another that this is irrelevant to the need of undergraduates. A fair number were concerned that not all the sources cited are available in their library, and one or two points were raised about the tape-slide programme.

We want to draw together first some points about the preparation of these packages which might profit from further investigation.

1. There is certainly scope for research on the effectiveness of the use of different combinations of media, and the exploration of other forms, such as video.
2. The possibility of providing guidelines and aids to facilitate the inclusion of more 'local' aspects of library instruction by particular institutions should be considered. This need has certainly been articulated by package users and could have the advantage of both tying in the package with local library provision, and relating it to work currently being undertaken by students.

Miscellaneous Issues

Serials Crisis

The term serials crisis has become a common shorthand to describe the chronic subscription cost increases of many scholarly journals. The prices of these institutional or library subscriptions have been rising much faster than the Consumer Price Index for several decades, while the funds available to the libraries have remained static or have declined in real terms. As a result, academic and research libraries have regularly canceled serial subscriptions to accommodate price increases of the remaining current subscriptions.

The subscription prices of scholarly journals have been increasing at a rate faster than the inflation rate for several decades. This chronic inflation is caused by several factors. Each journal title publishes unique research findings and as a result is a unique commodity that cannot be replaced in an academic library collection by another journal title, such as less expensive journal on the same subject as one could with commodities. The publisher thus has the ability to act as a monopolist. Scholarly journals vary greatly in quality as do the individual articles that they publish. The highest quality journals are often expected and demanded by scholars to be included in their institution's library collections, often with little regard or knowledge about the subscription costs. Traditional metrics for quality in scholarly journals include Impact Factor and Citation count as recorded by Journal Citation Reports. This leads to a price inelasticity for these higher quality journals.

Another possible set of factors in this situation includes the increasing domination of scholarly communication by a small number of commercial publishers, whose journals are more costly than those of academic societies. However, it must be noted that the institutional subscription prices for journals published by many academic society publishers exihibit similar inflationary patterns as seen among commercial publishers.

An additional problem is a dramatic increase in the volume of research literature and increasing specialization of that research, academic subfields. This includes a growth in the number of scholars and increases potential demand for these journals. At the same time funds available for purchase journals are often decreasing in real terms. Libraries have seen collection budgets decline in real terms compared to the United States Periodical Price index, and there are other library expenditures such as computers and networking equipment.

Currency exchange rates can serve to increase the volatility of subscription prices throughout the world. For example, many of the publishers of scientific journals are in Europe and do not set prices in United States dollars, so the prices of such scholarly journals in the United States vary in relation to exchange rate fluctuations.

As with most issues described as a crisis, there is much discussion among those who are confronted with the crisis, in this case librarians and scholars, about the crisis and how to address its consequences. Academic and research libraries are resorting to several tactics to contain costs, while maintaining access to the latest scholarly research for their users. These tactics include increasingly borrowing journals from one another or purchasing single articles from commercial document suppliers instead of subscribing to whole journals. Additionally, academica and research libraries cancel subscriptions to the least used or least cost-effective journals.

Another tactic has been converting from printed to electronic copies of journals, however, publishers sometimes charge more for the online edition of a journal, and price increases for online journals have followed the same inflationary pattern as have journals in paper format. Many individual libraries have joined co-operative consortia that negotiate license terms for journal subscriptions on behalf of their member institutions. Another tactic has been to encourage various methods of obtaining free access to journals.

Developed in part as a response to the serials crisis, Open access (publishing) models have included new models of financing scholarly journals that may serve to reduce the monopoly power of scholarly journal publishers which is considered a contributing factor to the creation of the serials crisis. These include: open access journals where the reader of a journal or the library at their institution does not need to pay a subscription or a pay per-view charge to read the articles published in that journal. This free access is achieved through a number of basic models. First is the publication fee model in which a funding agency, a university, or the author(s) of an article pays a publication fee per article to ensure that it will be available to readers free of charge. Sometimes these journals will waive the publication fee if the author cannot pay. Secondly, some open access journals receive institutional subsidies or are grant funded, which makes it unnecessary for the journal to charge publication or subscription fees.

This reliance on money from interested parties could conceivably lead to journals being forced to follow the agenda of the funding agency or government and thus may compromise editorial independence; however it should be noted that much of the research conducted and submitted to scholarly journals throughout the world is funded by the aforementioned interested parties. A third model is for publications to be funded by advertisements if readership of the journal is sufficient to recoup costs.

Delayed open access journals are traditional subscription-based journals that provide open access after an embargo period from the initial publication date. A subscription or an article purchase would be required to read the materials before the end of this embargo period. These journals may additionally deposit their publications in open repositories. Many scholarly society journals have adopted this model. While this model increases access to scholarly research literature for many, academic and research libraries that continue subscriptions end up paying for access to a rolling file of the most recent material of the embargo period only.

Hybrid open access journals are traditional subscription-based journals that permit authors to pay a fee to make their article available free of charge to the reader. This gives the author the advantages of open access to their published research but subscribers continue to pay subscription fees for such journals to gain access to the restricted content. This model has been adopted by many of the commercial publishers and large scholarly societies. It has the potential to increase revenues for the publisher, while at the same time subjecting libraries to continuing price inflation. This model doesn't serve to end the serials crisis — unless the subscription price for a hybrid journal should decline in some fashion related to the proportion of the journal that has become open access. Oxford University Press announced on July 25th, 2007 price reductions for 2008 calendar year online-only subscriptions for its "Oxford Open Journals", however, in many cases these subscription prices are still higher than 2007 calendar year subscriptions. The price reductions are only a reduction compared with the price Oxford University Press would have charged in the absence of Open Access content. Springer Verlag has outlined its intention to develop pricing based on changes in the proportion of Open Choice (TM) articles as compared to the subscription model articles, Hypothetically, this model could serve as an intermediary step in a switch to the widescale adoption of the open access journal model.

Information Architecture

The term information architecture describes a specialized skill set which relates to the interpretation of information and expression of distinctions between signs and systems of signs. It has some degree of origin in the library sciences. Many schools with library and information science departments teach information architecture. Information architecture (IA) is the art of expressing a model or concept of information used in activities that require explicit details of complex systems. Among these activities are library systems, Content Management Systems, web development, user interactions, database development, programming, technical writing, enterprise architecture, and critical system software design. Information architecture has somewhat different meanings in these different branches of IS or IT architecture. Most definitions have common qualities: a structural design of shared environments, methods of organizing and labelling websites, intranets, and online communities, and ways of bringing the principles of design and architecture to the digital landscape. Historically the term "information architect" is attributed to Richard Saul Wurman. Wurman sees architecture as "used in the words architect of foreign policy. I mean architect as in the creating of systemic, structural, and orderly principles to make something work—the thoughtful making of either artifact, or idea, or policy that informs because it is clear."

In the context of information systems design information architecture refers to the analysis and design of the data stored by information systems, concentrating on entities, their attributes, and their interrelationships. It refers to the modelling of data for an individual database and to the corporate data models an enterprise uses to coordinate the definition of data in several (perhaps scores or hundreds) of distinct databases. The "canonical data model" is applied to integration technologies as a definition for specific data passed between the systems of an enterprise. At a higher level of abstraction it may also refer to the definition of data stores.

Information architecture is defined by the R.I.P.O.S.E. technique, developed in 1989 as:

1. The conceptual structure and logical organization of the intelligence of a person or group of people (organizations). Note: In this case the term *intelligence* is used to the effect of "knowledge used to inform".

Information architecture is defined by the Information Architecture Institute as:

1. The structural design of shared information environments.
2. The art and science of organizing and labelling web sites, intranets, online communities, and software to support findability and usability.
3. An emerging community of practice focused on bringing principles of design and architecture to the digital landscape.

It is worth mentioning that the term Information Architecture has been criticized, as the term "architecture" is primarily used for habitable physical structures and imply that information systems are static like habitable physical structures or buildings. Information systems are "living systems", which frequently get updated, altered, and morphed, both by author and users. In some cases, information systems dynamically adapt to specific actions and context of users. Since the discipline of architecture ("habitable physical structures") increasingly uses materials and solutions that are less static, this criticism may be unjustified.

User-Centred Information Designers analyse cognitive, behavioral, and emotional processes of users and define User-Centred Information Systems and taxonomies. Furthermore, some activities involved in the creation of information systems can be similar to activities involved in the creation of taxonomies. Some have suggested that the term information architecture is analogous with taxonomy. Others contend that the activities involved in the creation of a taxonomy are a subset of the activities involved in developing an information architecture, since this typically also involves articulating the objectives of the information, and understanding the intended audience. Some practicing information architects specialize in developing taxonomies, as part of their IA "toolkit," along with deliverables like site maps, flow diagrams, and screen-level design prototypes to represent the structure of a Web site or interactive application.

Further, because information architecture practices and techniques became popularized with the advent of the World Wide Web, some information architects may lack experience designing systems that are not web-based where browsing is less relevant. Users of enterprise systems and business systems typically have different goals from users of web-based systems. Business systems within the enterprise, for example, provide users with tools to expedite required business tasks. In contrast, commerce sites, social sites, and news sites invite users to explore and browse information in many cases to support their business model. It is important for Information Architects to understand the specific business and user requirements rather than apply the same techniques to shape every system's information. Finally, with the ever increasing integration of applications within the enterprise, neither websites nor corporate data models and master data systems can any longer be considered in isolation. Information Architecture will be challenged to evolve to include the entire spectrum of both structured and unstructured data, ranging from transactional systems to ad hoc usage.

Publishing has a crucial place in the librarian's ethos. To the outsider the book trade has never been easy to understand. As the structure is now being modified it is even less comprehensible and not noticeably more rational. One of the difficulties has been that traditionally the trade, or at least the publishing part of it, has been conscious of a cultural role and responsibilities, and has insisted that the publisher is not like other businessmen or manufacturers, but is concerned with other values as well as profit. This claim is not without some justification, but it has produced an ambivalence which has always affected the relationships of publishers with authors, or even librarians. Quite apart from the publishers' ideals or pretensions, it is true that there are unique features of the book trade which made analysis difficult. Books are 'different', not only because of their essential cultural role, but because a book is not a commodity in the usual economic sense, and each title is unique. One book costing £I is unlikely to be comparable in any other way as a product to another book costing the same amount. If one compares book publishing with the other communications industries, the special characteristics of the former are apparent. Unlike broadcasting or newspaper publishing, expensive plant is not required, so that small firms can enter the business. Advertising resources for each book (product) are limited by the short production runs—short in comparison to a mass circulation periodical or newspaper. Books are not necessarily mass media and quite small editions can be produced economically. The contents of books are not influenced by a dual role of advertising media, as are periodicals and newspapers.

Lastly, because of their usually compact physical form and the absence of auxiliary equipment for their use, books have several practical advantages over other media. (Their relative disadvantages, especially the loss of immediacy, are obvious, and have been touched upon in earlier chapters.) These characteristics make it possible for publishers to respond to demands for a wide variety of different material; book publishing is, therefore, a fairly flexible industry which includes many different types of activity in the act of presenting communication.

Paperback Publishing

At first sight it is very odd that a vital distinction in modern book production should be whether a book has a hard or a soft cover—particularly when one considers that in continental Europe books have traditionally been published in paper covers. The difference is that the paperback represents the impact of mass production and mass selling on an industry otherwise geared to the supply of a smaller market. It shows another aspect of the clash between *nouveau* mass culture and that of a conventional minority. It has been estimated that paperback sales in Britain now account for about sixty per cent of all book sales.

Even if we regard some paperback publishing as a medium of mass communication, a considerable part of the paperback trade now sells books which are neither cheap nor necessarily popular. Prices have increased in proportion more than they have for hardback publications, because a variety of 'quality' paperbacks are being published in relatively small editions. Publishers' own cheap reprints in the old sense have almost ceased to exist; they have been replaced by paperback editions and, in general, fewer copies of them are printed than in the paperback editions of new books. The 'egghead' paperback trade, which first developed in America and has grown in importance with the expansion of higher education, is not directed at a mass market. It takes advantages not of a mass market, but of a *known* market (students) which can be more surely attracted to buy cheap editions. Apart from the publications intended for students, particularly at the tertiary level, it should be emphasised that Penguin Books proved long ago that quality publishing in cheap paperback form can be a commercial proposition, through sales figures which in the thirties would have seemed impossible. This was the key to Penguin's success in the first instance.

The reference to Penguin, which first began publishing more than thirty years ago, serves to remind us that paperback publications are not new in Britain, but the overworked term 'paperback revolution' has been widely adopted because of the extent to which this sector of the trade has come decisively to influence the rest. In fact, many would agree with John Calder ('Some aspects of book publishing', *Library Association Record,*

1967) that paperback publishing has 'taken over' the trade. He points out that many hardback publishers can survive only by selling paperback publishing rights in their books as quickly as possible after the contract has been signed with an author.

According to Calder, in most cases the only reason for publication in hardback form is to *obtain press reviews* which cannot be had for a paperback, and when paperbacks start to be reviewed in the same way, as presumably will happen, the trade will be 'turned upside down'. For the moment, first publication in soft covers under a paperback firm's imprint is still largely regarded as 'unserious'. There is the further significant point that most of the large British paperback companies are now American owned or controlled and they are becoming, not necessarily through 'parental' influence, very much more profit-conscious, with the resulting qualification which this imposes on the material they select to publish. There is, therefore, what might be called a crisis in publishing, and the advent of the paperback is partly responsible. Many publishers have prophesied doom for the conventional hardback trade, though from the point of view of the consumer it may seem largely irrelevant what kind of covers books have, provided that they are produced and distributed in sufficient numbers. The paperbacks does present special problems for librarians and these are discussed below.

Partly because of the paperback phenomenon, and partly for economic reasons which are not confined to the book trade, publishers have had to adopt the attitudes of 'modern' businessmen or perish. They now refer to 'marketing' and 'selling'; they are using automation in warehousing and distribution; they pay attention to exports; and, most important, they have continued to amalgamate their firms, so that eventually there may be only a few large publishing groups left in control of most of the trade. At present, six of the largest British publishing groups account for about thirty per cent of the sales. These are International Publishing Corporation, Collins, Penguin Books, Associated Book Publishers, Hutchinsons, Routledge and Kegan Paul. This trend has caused some concern. It has been suggested, notably by Raymond Williams ('Books in peril', *Library Association Record,* January 1963), that this amalgamation process will affect the *quality* of publishing, and may make it more difficult for works of merit but no obvious commercial value to find a publisher. He stresses that the current emphasis is on *speed of sale,* and this will mean that there will be pressure *on authors* to help serve the interests of rapid selling.

It is true that book production and distribution is now being diversified, and is, to some extent, passing into the hands of people who do not value books in the way the old fashioned publishers did. Paperbacks of suitable market appeal are being distributed in supermarkets and by slot machines, as in the United States. (In this context it is of interest to note Penguin's claim that American reliance on supermarkets is not really economic, since, although there are vast sales, there is also a higher proportion of the stockholding returned unsold to the publisher—possibly as much as fifty per cent.) There has also been an increase in the use of direct selling, instead of through bookshops, as is noted below. There can be no doubt that commercialisation and amalgamation have their dangers—publishing's new technocrats are a significant portent, but whether they are a menace to civilisation remains to be seen. So far there is probably insufficient evidence to show that all Raymond Williams' fears are justified. He has on numerous occasions proposed the setting up of a 'Book Council' in order to keep publishing and bookselling in the hands of those who value books. One of its functions would be to establish (with the aid of a state capital grant) a distributive system for the selling of books. It is certainly true that many of the large companies which are moving into book publishing are not book publishers in the traditional sense at all.

Some of them, like the Thomson Organisation, are newspaper publishers. Whether a state agency—like a Book Council—is a better alternative is a matter of opinion. It should be added that although mergers take place with some frequency, there is still in existence a large number of small independent publishing units (some of the big groups allow their subsidiary imprints some measure of independence), and this is of relevance to the alleged *overproduction* in British publishing. Clive Bingley (in *Library Association Record,*) suggests that the growth is partly caused by publications being put into lists to maintain financial turnover levels while the volume of sale for individual hardback titles continues to fall. Bingley goes on to point out that the long term trend of hardcover sales to individuals is downwards, and argues that there is a causal relationship between this fact and the rising levels of book prices. He analyses the other reasons for price increases in some detail, as does a statement by the Publishers Association in the same issue of the LAR. This statement admits that price increases are continual, but concludes 'What is maintained is that across the board these increases are not unreasonable and that British books are not highly priced and remain the cheaper unsubsidised books in the world outside the Soviet bloc.'

Many public librarians, bothered by local government committees, fail to appreciate either the justice of the increases or the reasons for them. It may be that publishers should have increased their prices dramatically long ago in preference to the recent steady creep, which has been estimated to be at the rate of roughly ten per cent a year during the 1960's. The trade has long been afflicted by social attitudes to books which cause people to expect them to remain cheap even when other commodities continue to rise in price. It is possible, and a point of much debate, that the knowledge that books can be borrowed free, whereas other items cannot, causes even the reading public to feel that the purchase of a new book is a greater extravagance than buying a bottle of whisky for the same amount of money.

Growth of Exports

It is to be noted that one postwar development has seen books become an important export industry. The Publishers Association, encouraged by the government, responded to the trade's awareness of the importance to its future of expanding export markets, by setting up in 1966 the *Book Development Council* to promote book exports abroad. It appears that none of the available trade statistics can be accepted without qualification, but it may be safe to say that at least half the books sold annually by British publishers go abroad. Overseas markets have become vital, and Macmillan's for example, have made an interesting and controversial innovation by co-operating with several African governments in establishing and developing their state publishing enterprises.

The Bookshop Crisis

Remarkably, the outstanding trend in modern bookselling has been a decline in the number of good bookshops of the traditional kind—reflecting perhaps the decline in hardcover book sales already mentioned. Many towns do not now have a good bookshop at all, and even in London many of the best shops have closed down. It has been estimated that eighty per cent of the UK bookselling trade goes to ten per cent of the booksellers, and that the remaining twenty per cent (mostly single copies) goes to the rest. Of all books bought it is probable that only about one half are sold over the counter in bookshops. Chain stores like W.H. Smith and Son Ltd. do not offer a service comparable with that of the traditional bookshop. In the United States, bookshops of the old type are not often found, but numerous alternative outlets exist, and, as Calder notes (in the article already quoted), you can buy a book in about every fifth building in a large town. In Britain, however, the booksellers are declining in number, and the new outlets which might replace them do not yet exist in sufficient quantity; in addition, many people in the trade do not want these new outlets.

They are not, after all, part of the traditional book trade at all. Even so, diversification is likely to increase and, as far as booksellers proper are concerned, there is likely to be a move towards the consolidation of existing shops into larger groups to face the competition, and a greater reliance on mail order selling. Those who appreciate the cultural value of a good bookshop in the life of a community must regret their gradual disappearance. A reason for the decline of small bookshops, and a sound justification of consolidation among them, is that the large number of books now in print has meant that many of the small bookshops are incapable of holding a broad enough range of stock to retain general custom; this is one of the acknowledged functions of the bookshop (the other being the provision of bibliographical information, so that books can be ordered). It may be that it is the marketing difference between the bookshop and the new mass retail outlets that is now a more important factor in the organisation of the trade than the disintegrating distinction (for business purposes) between hardcover and paperback books. (For example, publications first issued in paperback are now often reissued in hard cover editions, instead of vice-versa; also, many publishers, especially the university presses, issue books simultaneously in soft and hardcover editions.)

Publishers and booksellers now depend on libraries' custom, particularly public libraries, far more than even before. There has been enormous increase in hardcover *reading* in recent years, even though book buying by private individuals has declined. The majority of this reading is through the agency of public libraries, which lend approximately 500 million books a year. One quarter of all books which are bought in the UK is bought by public libraries, representing a spending power of £15 million annually. Because of the increasing importance of the library market, the book trade has increased its contacts with libraries in a number of areas. There has been fruitful co-operation, and inevitably some friction, on particular issues. The following are some of the most noticeable developments.

Decline of Subscription Libraries

Ever since the eighteenth century, subscription libraries have played a significant role in British social life, and throughout the nineteenth century they provided literature for middle class people who did not use the public libraries. With the arrival of the railway age, Charles Edward Mudie established in 1842 what was to become a nation-wide network of subscription libraries, and later the firm of W.H. Smith followed suit. The early twentieth century saw the establishment of Boots' 'Booklovers Library', the Time Book Club in London, and libraries in a number of department stores such as Harrods. In addition to these commercial circulating libraries, there were in most of the large provincial towns what can best be called 'proprietary subscription libraries', which maintained a permanent stock: these also date from the eighteenth century. The London Library was founded in 1841—a library which for intellectual workers, particularly writers, has provided a service which cannot be equalled by public libraries. It is perhaps for this reason that, in spite of continuing financial difficulties, the London Library alone remains the best known of these ventures.

There were undoubtedly economic factors as well. As far as public libraries are concerned, readers who formerly used subscription libraries have increased the demand for certain types of 'middlebrow' literature, and placed a heavier burden on reservation or request systems. These are the kinds of people who arrive in the library on Monday mornings with a list of requests compiled from the review columns of the Sunday papers. This demand has been called 'best-seller pressure', and by some librarians condemned—a curious professional example of the puritanic attitude.

The point is worth stressing, because students of librarianship commonly suppose that the subscription libraries simply dispensed light literature, and presume that their demise has transferred the light fiction 'problem' to the public libraries; if this is really a problem, it is one which has always been there. It is true, but only partly relevant, that subscription libraries did provide light novels, and there are still small stationers who run a 'library' service wholly devoted to this kind of literature. What is relevant, perhaps, is that public librarians can no longer employ the argument that those who require light fiction should go to the subscription libraries. Otherwise, the main impact of this situation has been the need to increase the number of copies purchased of books which are currently news.

Book Clubs

In the United States, book clubs offering cut price editions of selected titles to a subscribing membership represent a large trade outlet. Because of quasi-legal agreements concerning the sale of new books in club editions, book clubs in the UK have hitherto been of lesser importance. In 1968, however, the discovery of a technical loophole, and subsequent hasty ratification of it by the trade, made it possible to publish new books simultaneously in trade and book club editions. An increase in this type of publishing seems likely.

Joint Working Party

After a conference initiated by the North-Western Polytechnic School of Librarianship in 1965, a Working Party for Library and Book Trade Relations was set up, with Peter Wright, then lecturer at the school, as chairman. The working party was concerned about the fact that, although librarians and members of the book trade have common aims, their attitudes and their methods are frequently in conflict. This was an *ad hoc* informal body which was interested in practical results, and its most important achievement so far has been the introduction in 1968 of PICS, the Publishers' Information Card Service.

This project is a commercial undertaking, with editorial services supplied by Whitaker's, the bibliographical publishing firm. Essentially the scheme provides a centralised information service about new books, with the information presented on standard cards designed eventually to replace much of the diverse publicity material which individual publishers circulate. The service is free to receiving libraries, and the publishers pay £10 for each title for which they wish to have a card printed. The cards are, as far as possible, advance notices of publication compiled from information supplied by the publishers. The information given includes not only the title but scope, contents, readership, a note on the author and the standard book number. The administrative and practical advantages of this service, both for librarians and publishers, are readily apparent; booksellers could also find uses for the cards. As G.R. Davies points out (*Library Association Record,* January 1969), the book trade had not sufficiently realised that, although forceful publicity may be an appropriate means of promoting sales to private individuals, it is not helpful to librarians. In addition, publicity material is issued at random times in all shapes and sizes, from hundreds of publishers, and it cannot rely on individual attention from librarians. It represents in many cases the production of expensive material destined straight for the wastepaper basket. Davies also notes that the production of PIC cards by publishers themselves is not a practical proposition; a centralised system is required, and in fact costs each participating publisher less than if it were to be done by himself.

Public Lending Right

The long standing discussion on the establishment of a public lending right for authors represents one area where the book trade and librarians have not agreed. Just as a composer or a dramatist receives payment under performing rights legislation whenever his work is performed in public, so authors have sought to establish their right to an analogous public lending right, by which they would receive a payment when books are borrowed by public library readers. There have been a variety of different proposals since 1951, when John Brophy first suggested that for every loan of a public library book its author should receive one penny. These have included the similar proposals incorporated in a Society of Authors' pamphlet *Critical times for authors* (1953), and a memorandum drawn up by A.P. Herbert under the auspices of a special committee of the Authors' and Publishers' Lending Rights Association. This memorandum, published in 1960, surveyed the practical difficulties of setting up a workable scheme, and noted the objections of librarians. It recommended that a Bill should be presented to parliament, to amend the Copyright Act of 1956 for the establishment of PLR under the aegis of the (then) Ministry of Education. In 1960, Woodrow Wyatt presented the first PLR Bill to the House of Commons. This was based on the penny per-issue principle, but the government would not support the proposals, and it was decided to abandon any attempt to relate PLR to copyright legislation. A second Bill was drafted, and presented by William Teeling, but the opposition remained too strong and it was duly 'talked out'—in November

1960, and again in March 1961. Meanwhile, the Library Association had expressed total opposition to the scheme, which this time proposed that the library authorities should be allowed an option to charge borrowers. Following this second failure, the campaign continued, and included a motion in the House of Commons (1961) and a booklet by A.P. Herbert called *Libraries: free for all?* This last suggested that public libraries should make a maximum annual charge to registered readers of *7s 6d* per head. There was also an attempt, which failed, to introduced an amendment to the Public Libraries Bill of 1964.

Further impetus was given to the campaign by the publication in 1965 of the government white paper, 'A policy for the arts', produced by Miss Jennie Lee, minister with the responsibility for the arts. She subsequently showed herself sympathetic to the idea of PLR, but rejected any proposals which invalidated the concept of the 'free' public library. In principle she found Scandinavian practice more acceptable, since these schemes do not involve payment by public-library users.

The next stage was the setting up in 1965 of a working party by the Arts Council of Great Britain, to consider all aspects of PLR. The initiative thus finally passed out of the hands of the Authors' and Publishers' Lending Right Association (APLA), which had sustained the campaign for six years. During the period it had become evident that proposals which involved payment by the public or by the local authorities could not gain acceptance. This working party sent their report to the Department of Education and Science in 1967, and the scheme which it proposes involves a grant from central government funds, on the basis of fifteen per cent of the annual sum spent on books by library authorities. The amount available would then be divided, with seventy five per cent going to authors and twenty five per cent to publishers (previous proposals have not always included the publishers). The use by libraries would be calculated, not on any figures for the number of times a book is borrowed, but on *stock held*. To obtain the required information, three representative library authorities would each year be sent a list of all books in copyright, and they would send in a return showing how many of these books were in stock. In the words of a Society of Authors leaflet, the PLR committee to be set up by the Department of Education and Science to run the scheme would then 'gross up these sample returns in the ratio they bore to the total stock of all library authorities in the country'. The leaflet claims that Danish experience suggests that this might yield approximately 10*d* a book, 'so that, on 2,000 copies of a single title held by public libraries throughout the country, an author would receive £85 a year'. It will be apparent that the scheme is strongly based on the Danish principle.

During 1969, several statements were made by government spokesmen indicating that there was official sympathy for the Arts Council schemes, but that, in the words of Baroness Phillips, 'the government tend to have an open mind but a closed purse'. Later, in reply to a parliamentary question, Miss Jennie Lee, the minister responsible, said that there were alternative proposals to be considered, and that a working party would be set up. It therefore appears that there will be yet another working party report before a solution is found, but the present evidence suggests that eventually some form of PLR will emerge. There is not need to summarise here the arguments for and against PLR, for during the controversy they have been constantly repeated. Certain comments, however, are called for. What must strike any impartial observer is that this campaign has taken eighteen years to come anywhere near the possibility of a successful conclusion, and one reason for this has been the total lack of co-operation between the Library Association on one hand, and the bodies representing the authors on the other. (Publishers have been sympathetic to the idea, and have, naturally, pressed their own claims.) Many of the earliest proposals, which were impractical both from an administrative and political point of view, might not have been pursued for so long if librarians had shown themselves at once to be more sympathetic or co-operative to the principle. At no time has the organised profession admitted that the authors have any kind of a case, and some of the statements by individual librarians published in the press have betrayed an almost paranoiac antipathy towards writers, for reasons which it would be uncharitable to pursue. The Library Association did at one time meet representatives of APLA (1962), but this has been the limit of professional concern. (The LA stated that it could not accept representation on the 1965 PLR working party because the local authority associations were not represented. In January 1968 the Association of Municipal Corporations announced their unqualified opposition to any PLR scheme, particularly if publishers were to be, in their words, 'subsidised'.)

The Net Book Agreement

The Net Book Agreement, which allows publishers to establish and maintain the prices at which their new books may be sold, has survived a fair amount of hostile criticism, as well as an investigation in 1962 by the Restrictive Practices Court, which gave judgment in its favour. Public libraries therefore continue to purchase books at the ten per cent discount provided for under the library Licence Agreement, which was revised by the Publishers Association in 1964. The Court concluded that, in general, public libraries would not benefit from the abrogation of the Net Book Agreement. Nevertheless, in view of the continued rise in book prices, many librarians have claimed hat the ten per cent discount off publishers' prices is insufficient.

12

Main Elements of Electronic Libraries

E-book

As a recent development, an e-book is the digital media equivalent of a conventional printed book. Such documents are usually read on personal computers, or on dedicated hardware devices known as *e-book readers* or *e-book devices*. Many mobile phones can also be used to read eBooks. Early e-books were generally written for specialty areas and a limited audience, meant to be read only by small and devoted interest groups. The scope of the subject matter of these e-books included technical manuals for hardware, manufacturing techniques, and other subjects. Numerous e-book formats emerged and proliferated, some supported by major software companies such as Adobe's PDF format, and others supported by independent and open-source programmers.

Multiple readers naturally followed multiple formats, most of them specializing in only one format, and thereby fragmenting the e-book market even more. Due to exclusiveness and limited readerships of e-books, the fractured market of independents and specialty authors lacked consensus regarding a standard for packaging and selling e-books. E-books continued to gain in their own underground markets. Many e-book publishers began distributing books that were in the public domain. At the same time, authors with books that were not accepted by publishers offered their works online so they could be seen by others. Unofficial (and occasionally unauthorized) catalogues of books became available over the web, and sites devoted to e-books began disseminating information about e-books to the public. As of 2008, new marketing models for e-books were being developed and dedicated reading hardware was produced. E-books (as opposed to ebook readers) have probably already achieved global distribution thanks to the Internet. Actual details are unquantified or unqualified-but of course anyone with a computer can read an ebook-you don't need an ebook reader.

Only two e-book readers dominate the market, Amazon's Kindle model or Sony's PRS-500. E-books have seen good growth in Japan throughout the 2000s and it currently has an e-book market worth ¥10 billion. However, not all authors have endorsed the concept of electronic publishing. J.K Rowling, author of the Harry Potter series, has stated that there will be no e-versions of the books. Experts from Plastic Logic, a display technology company based in Cambridge, UK, reported of a technique that allows printing polymer transistors onto a surface of flexible plastic. This technique makes it possible for the screens to bend and bounce, thus giving the e-books additional endurance.

Comparison of E-books with Printed Books

Advantages

(a) Text can be searched automatically and cross-referenced using hyperlinks.

(b) A single e-book reader containing several books is easier to carry around (less mass and volume) than the same books in printed form. Even hundreds or thousands of books may be stored on the same device.

(c) E-books can allow non-permanent highlighting and annotation.

(d) Although they require electricity to be read, the production of e-books does not consume the paper, ink, and other resources that are used to produce printed books.

(e) Font size and font face can be adjusted.

(f) E-books may allow animated images or multimedia clips to be embedded.

(g) E-books allow for greater fidelity in colour reproduction compared to CMYK colour printing (although some e-book readers have only monochrome displays).

(h) E-book devices allow reading in low light or even total darkness by means of a back light.

(i) An e-book can automatically open at the last read page.

(j) While an e-book reader costs more than one book, the electronic texts are generally cheaper.

(k) Also for the supplier e-books require little space, they can therefore be offered indefinitely, with no going out of print date, allowing authors to continue to earn royalties indefinitely.

(l) Text-to-speech software can be used to convert e-books to audio books automatically.

(m) Ease of distributing e-texts means that they can be used to stimulate higher sales of printed copies of books.

(n) It is easier for authors to self-publish e-books.

Problems

(a) E-book readers are more fragile than paper books and more susceptible to physical damage.

(b) A small book is easier to carry around (less mass and volume) than an e-book.

(c) If not viewed on computers, e-books require the purchase of an electronic device and/or peripheral software which can display them. If they are to be viewed on a personal computer, it may require additional software

(d) Most publishers don't produce the e-book equivalent of their printed books. In other cases, e-books are given a lower priority in terms of the publisher's resources, resulting in a disparity in product quality, release dates and the like. This problem is not endemic to every publisher, but has an effect on the quality of the overall pool of merchandise available.

(e) E-book readers are more likely to be stolen than paper books.

(f) Looking at a screen for a long time may cause eye strain and sometimes headaches.

(g) E-book readers can malfunction due to faults in hardware or software, such as hard disk drive failure.

(h) E-book readers require electrical power; in the case of mobile use, the battery can get exhausted.

(i) E-books can be easily hacked through the use of hardware or software modifications and widely disseminated on the Internet and/or other e-book readers, without approval from the author or publisher.

(j) If an e-book device is stolen, lost, or broken beyond repair, all e-books stored on the device may be lost. This can be avoided by backup either on another device or by the e-book provider.

(k) Screen resolution of reading devices may be lower than actual paper, making it difficult to read e-books.

(l) From the reader's perspective, conventional ownership, fair use, and access to the book's content is challenged and restricted by Digital Rights Management.

(m) There is a loss of tactility and aesthetics of book-bindings. Also lost is the ability to very quickly riffle through the pages to search for a particular section or to get a sense of the book merely by sight.

(n) While the written language is universal for books, e-books are deliberatly prevented from downloading certain formats, meaning the owner has to buy a different model for each format.

The greatest disadvantage in an e-book is piracy. Most proprietary software were termed secure but soon pirated copies flooded the underground market. The same could be said of the e-book as well. Books are much more difficult to duplicate in an amateur printing press.

Digital Rights Management

Anti-circumvention techniques may be used to restrict what the user may do with an e-book. For instance, it may not be possible to transfer ownership of an e-book to another person, though such a transaction is common with physical books. Some devices can phone home to track readers and reading habits, restrict printing, or arbitrarily modify reading material. This includes restricting the copying and distribution of works in the public domain through the use of "click-wrap" licensing, effectively limiting the rights of the public to distribute, sell or use texts in the public domain freely.

Most e-book publishers do not warn their customers about the possible implications of the digital rights management tied to their products. Generally they claim that digital rights management is meant to prevent copying of the e-book. However in many cases it is also possible that digital rights management will result in the complete denial of access by the purchaser to the e-book.

With some formats of DRM, the e-book is tied to a specific computer or device. In these cases the DRM will usually let the purchaser move the book a limited number of times after which he cannot use it on any additional devices. If the purchaser upgrades or replaces their devices eventually they may lose access to their purchase. Some forms of digital rights management depend on the existence of online services to authenticate the purchasers. When the company that provides the service goes out of business or decides to stop providing the service, the purchaser will no longer be able to access the e-book. With digital rights management, it is argued by some to be a more apt use of money for commodity to be a rental or lease rather than a purchase. The restricted book comes with a number of restrictions, and eventually access to the purchase can be removed by a number of different parties involved. These include the publisher of the book, the publisher of the DRM scheme, and the publisher of the reader software. These are all things that are significantly different from the realm of experiences anyone has had with a physical copy of the book.

Some e-books are produced simultaneously with the production of a printed format, as described in electronic publishing, though in many instances they may not be put on sale until later. Often, e-books are produced from pre-existing hard-copy books, generally by document scanning, sometimes with the use of robotic book scanners, having the technology to quickly scan books without damaging the original print edition. Scanning a book produces an image file, which must then be converted into text format by an OCR programme. Occasionally, as in some e-text projects, a book may be produced by re-entering the text from a keyboard. As a newer development, sometimes only the electronic version of a book is produced by the publisher. It is also possible to convert electronic book to a printed book by print on demand.

However this an exception as tradition dictates that a book be launched in the print format and later if the author wishes, an electronic version is also produced. Among the first Internet-only publishers of new e-books were Boson Books, Hard Shell Word Factory and Online Originals, all founded in the mid-1990s. Each pioneered different aspects of what has since become common practice amongst e-book publishers, e.g. the support of multiple formats including PDFs, the payment of much higher royalty rates than conventional publishers, and the online presentation of free samples. Hard Shell Word Factory set the first professional standards for commercial e-books and pioneered author-friendly contracts. Online Originals was the first e-book publisher to win mainstream book reviews (in The Times) and a nomination for a major literary prize (the Booker Prize). In 2004-2005, many newcomers to e-book publishing have included major print publishers. At the same time, e-publishers have started to offer print versions of many of their titles. Thus the line between the two is fast blurring.

There are some parts of the industry where there are particularly notable leading firms. In the general field of science-fiction and fantasy, Baen Books, an American publishing company established in 1983 by science fiction publishing industry long-timer Jim Baen (1943-2006) has a well-established position. It is a science fiction and fantasy publishing house that specializes in space opera/military science fiction and fantasy (though it does not restrict itself to these subgenres).

It is notable for releasing books without DRM in a variety of formats, before hard-copy publication, and pre-releasing ebooks in parts before the hard-copy release. Many older titles are available for free, especially the first book in a series. E-books have their own bestseller lists, including those compiled by IDPF, BooksOnBoard and Fictionwise. There are two yearly awards for excellence in e-books. The longest-standing and most inclusive of these is the EPPIE award, given by EPIC since 2000. The other is the Dream Realm Award, first awarded to speculative fiction e-books in 2002.

Readers

E-book readers may be specifically designed for that purpose, or intended for other purposes as well. The term is restricted to hardware devices, not software programmes. Specialized devices have the advantage of doing one thing well. Specifically, they tend to have the right screen size, battery lifespan, lighting and weight. A disadvantage of such devices is that they are often expensive when compared to generic devices such as laptops and PDAs. Some prominent examples include:

- Pixelar e-Reader by Pixelar (2008/9)
- Plastic Logic (2009 estimate)
- Kindle by Amazon (2007)
- Kindle 2 by Amazon (2009)
- Cybook Gen3 by Bookeen (2007)
- Hanlin eReader by Jinke (distributed as "Lbook" in Estonia, Kazakhstan, Russia and Ukraine as "BeBook" in Europe) (2007)
- Sony Reader by Sony (2006)
- Liad by iRex (2006)
- Librié by Sony (2004).

E-book Formats Comparison

The following is a comparison of e-book formats used to create and publish e-books. A writer or publisher has many options when it comes to choosing a format for production. While the average end-user might arguably simply want to read books, every format has its proponents and champions, and debates over "which format is best" can become intense. The myriad of e-book formats is sometimes referred to as the "Tower of eBabel". For the average end user to read a book, every format has its advantages and disadvantages. Formats available include, but are by no means limited to:

Open Electronic Book Package Format

OPF is an XML-based e-book format created by E-Book Systems.

Hypertext Markup Language

HTML is the markup language used for most web pages. E-books using HTML can be read using a Web browser. The specifications to the format are freely available from the W3C. As markup language, HTML adds especially marked meta elements to otherwise plain text encoded using character sets like ASCII or UTF-8. As such suitably formatted files can be, and sometimes are, generated *by hand* using a *plain text editor* or *programmer's editor*. Many *HTML generator* applications exist to ease this process and often require less intricate knowledge of the format details involved.

HTML is not a particularly efficient format to store information, requiring more storage space for a given work than many other formats, even if images are not used to illustrate it. The format does not describe pages and has no facility to store multiple things in a single file.

Plain Text Files

E-books in plain text exist and are very small in size. For example, the bible is about 4 MB.

Amazon Kindle (AZW) Format

With the launch of the Kindle eBook reader, Amazon.com created the AZW format. It is based on the Mobipocket standard, with a slightly different serial number scheme (it uses an asterisk instead of a Dollar sign) and its own DRM formatting. Because the eBooks bought on the Kindle are delivered wirelessly over EvDO (the system is called Whispernet by Amazon), the user does not see the AZW files during the download process.

TomeRaider

The TomeRaider e-book format is a proprietary format. There are versions of TomeRaider for Windows, Windows Mobile (aka Pocket PC), Palm, Symbian and more. Several Wikipedias are available as TomeRaider files with all articles unabridged, some even with nearly all images. Capabilities of the TomeRaider3 ebook reader vary considerably per platform: the Windows and Windows Mobile editions support full HTML and CSS. The Palm edition supports limited HTML (e.g. no tables, no fonts), and CSS support is missing. For Symbian there is only the older TomeRaider2 format, which does not render images or offer category search facilities. Despite these differences any TomeRaider ebook can be browsed on all platforms. Tomeraider is popular among readers because of its huge free document base. According to their records the Tomeraider Website has over 4000 free ebooks to read. The IMDB movie database is also as a regularly updated Tomeraider ebook. Tomeraider developers have recently developed full Wikipedia (English version up to 2007 December data) as an ebook, which is 3.3GB file. You can download the file here with payment for bandwidth, but free for 2006 October data which is 1GB file.

NISO Z39.86 Format

DAISY is an XML-based e-book format created by the DAISY international consortium of libraries for people with print disabilities.

DAISY implementations have focused on two main types: audio e-books and text e-books. A subset of the DAISY format has been adopted by law in the United States as the National Instructional Material Accessibility Standard, and K-12 textbooks and instructional materials are now required to be provided to students with disabilities.

Arghos Diffusion

The ARG format is an XML-based proprietary format developed by the French firm Arghos Diffusion.

ARG files use a proprietary DRM and encryption method and are readable only in the *Arghos Player*.

It supports various input formats for text, audio or video, such as PDF, WMA, MP3, WMV, and allows multiple interactive functions such as bookmarking, advanced plain-text searching, dynamic text highlighting, etc.

Flip Books

A "Flip Book" is a type of E-Book distinguished by virtual pages that actually "flip", much like turning pages of paper in a real book or magazine. The first dynamic Flip Book Reader was developed in 2003/2004 by Interaxive Media for Nishe Media (Canada) and was therefore called "Nishe Pages". The first version was produced in part by Cybaris (Canada) and was first publicly showcased in August 2004. Soon thereafter, many copycat "flip books" started appearing thanks to technological advances in Macromedia Flash, mostly hardcoded using Flash components. The original software remains unique in that it is powered by a complete server-based CMS system that allows the books to be created, published, and viewed remotely from a web server without requiring any custom software to be installed. Nishe Media went defunct in 2004, leaving the unfinished software to Interaxive Media who continued its development in Hong Kong. Though not widely used outside of Asia, it is now at version 3.0 and is arguably the most advanced server-based E-Book platform. It remains privately held by the original developer, Ryan Sutherland, owner and founder of Interaxive Media.

Fiction Book

FictionBook is a popular XML-based e-book format, supported by free readers such as Haali Reader and FBReader.

Text Encoding Initiative

TEI Lite is the most popular of the TEI-based (and thus XML-based or SGML-based) electronic text formats.

Plucker

Plucker is a free e-book reader application with its own associated file format and software to automatically generate plucker files from HTML files, web sites or RSS feeds. The format is a compressed HTML archive, somewhat like Microsoft's CHM.

CHM Format

CHM format is a proprietary format based on HTML. Multiple pages and embedded graphics are distributed along with proprietary metadata as a single compressed file. In contrast, in HTML, a site consists of multiple HTML files and associated image files in standardized formats.

Portable Document Format (PDF)

A file format created by Adobe Systems, initially to provide a standard form for storing and editing printed publishable documents. The format derives from PostScript by removing language features like loops and adding support for things like compression and passwords. Because PDF documents can easily be viewed and printed by users on a variety of computer platforms, they are very common on the World Wide Web. The specification of the format is freely available from Adobe.

PDF files typically contain brochures, product manuals, magazine articles, up to entire books, as they can embed fonts, images, and other documents. A PDF file contains one or more page images, each of which you can zoom in on or out from. Since the format is designed to reproduce page images, the text cannot be re-flowed to fit the screen width, PDF files designed for printing on standard paper sizes are less easily viewed on screens with limited size or resolution such as found on mobile phones and PDAs.

Adobe has addressed this by adding a re-flow facility to its Acrobat Reader software, but for this to work the document must be marked for re-flowing at creation, which means existing PDF documents will not benefit. The Windows Mobile (aka Pocket PC) version of Adobe Acrobat will automatically attempt to tag a PDF for reflow during the synchronization process. This tagging process will not work on most locked PDF documents. When using Windows Vista with a Windows Mobile device and Adobe Acrobat, this tagging process must occur before the device is synchronized. Multiple Adobe products support creating PDF files, such as Adobe Acrobat and Acrobat Capture, as do third-party products such as PDFCreator, OpenOffice.org, and FOP, and several programming libraries. Acrobat Reader (now simply called *Adobe Reader*) is Adobe's product used to view PDF files, with third party viewers such as xpdf also available.

Later versions of the specification add support for forms, comments, hypertext links, and even interactive elements such as buttons for forms entry and for triggering sound and video. Such features may not be supported by older or third-party viewers and some are not transferrable to print.

Microsoft LIT

DRM-protected LIT files are only readable in the proprietary Microsoft Reader programme, as the.LIT format, otherwise similar to Microsoft's CHM format, includes Digital Rights Management features. Other third party readers, such as Lexcycle Stanza, can read unprotected LIT files. There are also tools such as Convert Lit, which can convert.lit files to HTML files or OEBPS files.

The MS reader uses patented ClearType display technology. In Reader navigation works with a keyboard, mouse, stylus, or through electronic bookmarks.

The Catalogue Library records reader books in a personalized "home page", and books are displayed with ClearType to improve readability. A user can add annotations and notes to any page, create large-print e-books with a single command, or create free-form drawings on the reader pages. A built-in dictionary allows the user to look up words.

DjVu

DjVu is a format that specialises in and particularly excels at storing scanned images. It includes advanced compressors optimized for low-color images, such as text documents. Individual files may contain one or more pages.

The format has long remained in obscurity, but now that free tools to manipulate the format are available, that is starting to change. The contained page images are divided in separate layers (such as multi-colour, low-resolution, lossily-compressed background layer, and few-colors, high-resolution, tightly-compressed foreground layer), each compressed in the best available method.

The format is designed to decompress very quickly, even faster than vector-based formats. The advantage of DjVu is that it is possible to take a high-resolution scan (300-400 DPI), good enough for both on-screen reading and printing, and store it very efficiently. Several dozens of 300 DPI black-and-white scans can be stored in less than a megabyte.

Post Script

PostScript is a page description language used in the electronic and desktop publishing areas for describing the contents of a printed page in a higher level than the actual output bitmap. Many office printers directly support interpreting PostScript and printing the result. As a result of that, the format also sees wide use in the Unix world.

eReader

eReader is a freeware programme for viewing Palm Digital Media electronic books. Versions are available for PalmOS, iPhone, Symbian, Windows Mobile Pocket PC/Smartphone, desktop Windows, and Macintosh. The reader shows text one page at a time as paper books do. eReader supports embedded hyperlinks and images. Additionally the Stanza application for the iPhone and iPod Touch can read both encrypted and unencrypted eReader files.

The company's web site-ereader.com offers a wide selection of eReader-formatted ebooks available for purchase and download, and also a few for free. The paid-for books are encrypted, with the key being the purchaser's full name and credit card number. This information is not stored in the ebook though. A one-way hash is used, so there no risk of the user's information being extracted. The programme supports features like bookmarks and footnotes, enabling the user to mark any page with a bookmark, and any part of the text with a footnote-like commentary. Footnotes can later be exported as a Memo document.

The company also offers two Windows/MacOS programmes for producing ebooks: the free Dropbook, and the paid-for eBook Studio. Dropbook is simply a file-oriented PML-to-PDB converter, and eBook Studio incorporates a WYSIWYG editor. PML (Palm Markup Language) is basically text with embedded formatting tags, so feeding a pure text file into eBook Studio or Dropbook also works.

There is also support for an integrated reference dictionary (with many options up to and including a 476,000-word Merrian-Webster Dictionary, including pronunciation keys) so that any word in the text can be highlighted and looked up on the dictionary instantly. Commercial fonts can also be individually purchased and downloaded at the company's web site, ereader.com.

Desktop Author

Desktop Author is an electronic publishing suite that allows creation of digital web books with virtual turning pages. Digital web books of any publication type can be written in this format, including brochures, e-books, digital photo albums, e-cards, digital diaries, online resumes, quizzes, exams, tests, forms and surveys. DesktopAuthor packages the e-book into a ".dnl" or ".exe" book. Each can be a single, plain stand-alone executable file which does not require any other programmes to view it. DNL files can be viewed inside a web browser or stand-alone via the DNL Reader.

DNL Reader

DNL format is an e-Book format, one which replicates the real life alternative, namely page turning Books. The DNL e-Book is developed by [DNAML Pty Limited] an Australian company established in 1999. THE DNL e-Book can be produced using DeskTop Author or DeskTop Communicator.

Newton eBook

Commonly known as an Apple Newton book; a single Newton package file can contain multiple books (for example, the three books of a trilogy might be packaged together). All systems running the Newton operating system (the most common include the Newton MessagePads, eMates, Siemens Secretary Stations, Motorola Marcos, Digital Ocean Seahorses and Tarpons) have built-in support for viewing Newton books. The Newton package format was released to the public by Newton, Inc. prior to that company's absorption into Apple Computer. The format is thus arguably open and various people have written readers for it (writing a Newton book converter has even been assigned as a university-level class project).

Newton books have no support for DRM or encryption. They do support internal links, potentially multiple tables of contents and indexes, embedded grayscale images, and even some scripting capability (for example, it's possible to make a book in which the reader can influence the outcome). Newton books utilize Unicode and are thus available in numerous languages. An individual Newton book may actually contain multiple views representing the same content in different ways (such as for different screen resolutions).

APABI

APABI is a format deviced by Founder Electronics. It is a popular format for Chinese e-books. It can be read using the Apabi Reader software, and produced using Apabi Publisher. Both.xeb and.ceb files are encoded binary files. The Iliad e-book device includes an Apabi 'viewer'.

iPod Notes

Notes is a feature of iPod that allows short text notes to be displayed on the iPod screen. As the size limit for one note is 4096 bytes, there are some tools that create the notes from the longer plain text file. Basic HTML is allowed, but otherwise the format is plain text only.

Libris

Libris is a Java based eBook reader for mobile devices such as cell phones. Libris will run on most Java enabled devices that support MIDP. The reader formats books to fit the device screen, and shows one page at a time using high quality anti-aliased fonts. Books may employ encryption or be unrestricted. Libris content may be produced using the MakeLibris tool. The Libris reader also supports the PalmDoc format.

Mobipocket

The Mobipocket e-book format based on the Open eBook standard using XHTML can include JavaScript and frames. It also supports native SQL queries to be used with embedded databases. There is a corresponding e-book reader. A free e-book of the German Wikipedia has been published in Mobipocket format.

The Mobipocket Reader has a home page library. Readers can add blank pages in any part of a book and add free-hand drawings. Annotations—highlights, bookmarks, corrections, notes, and drawings — can be applied, organized, and recalled from a single location. Mobipocket Reader has electronic bookmarks, and a built-in dictionary.

The reader has a full screen mode for reading and support for many PDAs, Communicators, and Smartphones. Mobipocket products support most Windows, Symbian, BlackBerry and Palm operating systems, but not Linux or Macintosh.

IDPF/EPUB

The.epub or OEBPS format is an open standard for eBooks created by the International Digital Publishing Forum (IDPF). It combines three IDPF open standards:

- Open Publication Structure (OPS) 2.0, which describes the content markup (either XHTML or Daisy DTBook)
- Open Packaging Format (OPF) 2.0, which describes the structure of an.epub in XML
- OEBPS Container Format (OCF) 1.0, which bundles files together (as a renamed ZIP file).

Currently, the format can be read by Adobe Digital Editions, Lexcycle Stanza, BookGlutton and the Mozilla Firefox plugin OpenBerg Lector. Several other reader software programmes are currently implementing support for the format, such as dotReader, FBReader, Mobipocket and

Okular. Another software.epub reader, Lucidor, is in beta. As of 7/23/2008, an update to the Sony Reader will allow the device to read.epub documents. In 2008 BookGlutton released a free HTML-to-EPUB converter.

SSReader

The digital book format used by a popular digital library company in China. It is a proprietary raster image compression and binding format, with reading time OCR plugin modules. The company scanned a huge number of Chinese books in the China National Library and this becomes the major stock of their service. The detailed format is not published. There are also some other commercial ebook formats used in Chinese digital libraries.

Multimedia Books (Eveda)

A Multimedia EBook is media and book content that utilizes a combination of different book content forms. The term can be used as a noun (a medium with multiple content forms) or as an adjective describing a medium as having multiple content forms. The term is used in contrast to media which only utilize traditional forms of printed or text book.

Multimedia EBook includes a combination of text, audio, still images, animation, video, and interactivity content forms. Multimedia EBook used for creation on the basis of a literary fiction book, addition of the audio-visual and interactive contents, the new form of creativity. The user (the former reader) has an opportunity to participate in events occuring to characters, to feel influence of a musical part of a narration and graphic part. The perception of several media forms of contents considerably expands depth of transfer power of art and creativity.

E-Book Reader Matrix

Much of the renewed enthusiasm for e-books comes from a new generation of e-book reader devices because they use the E Ink technology which has been eagerly awaited, and the feature sets are much richer than devices could offer in the past. This new display technology has the distinct advantage of using power for page turns only, not to maintain a page display. But most importantly, it provides a crisp, clear image on a larger display screen that rivals print seen in paper books.

If you were really looking for a more generalized solution check Mobile devices.

Devices

The main manufactures of eBook dedicated device hardware are: Sony, Jinke, Netronix, Amazon and IRex. However, some devices are branded with different names. These devices may be exactly the same as the 5 mentioned above or may have different firmware and therefore some significantly different specifications in that area.

Sony Portable Reader is the generic name for several Sony devices. Jinke Electronics creates the Hanlin eBook V3 and several other models. These products are branded under several different names including IBook, BeBook and Astak EZ Reader. The Amazon Kindle is only sold by Amazon. The Netronix brand is generally not seen in an end user product. Instead you will see devices such as the STAReBOOK and the Bookeen Cybook Gen3 that have the same basic hardware, the Netronix EB-600, but different firmware. Other Netronix devices include the NUUT, Soribook, and ESlick.

The "high-end" devices are currently supported by the iRex Digital Reader and iRex iLiad. Both Jinke Electronics and Netronix have pre-announced several new models including the eBook V9 with 9.7" display and EB-900.

There are also some new players: The Polymer Vision Readius is WinCE-based, and it is cell phone sized with a rollup QVGA screen. The Plastic Logic devices will give iRex some competition.

Electronic Journal

Basically, Electronic journals are scholarly journals or magazines that can be accessed via electronic transmission. They are a specialized form of electronic document: they have the purpose of providing material for academic research and study, they are formatted approximately like printed journal articles, the metadata is entered into specialized databases, such as DOAJ or OACI as well as the databases for the discipline, and they are predominantly available through academic libraries and special libraries. Some electronic journals are online-only journals; some are online versions of printed journals, and some consist of the online equivalent of a printed journal, but with additional online-only material.

Remarkably, commercial sites are subscription-based, or allow pay-per-view access. Many universities subscribe to electronic journals to provide access to their students and faculty, and it is generally also possible for individuals to subscribe. An increasing number of journals are now available as open access journals, requiring no subscription. Most working paper archives and articles on personal homepages are free, as are collections in institutional repositories and subject repositories.

Most electronic journals are published both in HTML and PDF formats, but some are available in only one of the two. Some early electronic journals were first published in ASCII text, and some informally published ones continue in that format.

Computer-Based Acquisitions System and Relevant Issues

As we all know computers have revolutionised all aspects of library and information science. We shall now discuss a case study of an operational computer-based acquisitions system that applied the major principles and aspects of designing. Here we intended to illustrate the characteristics of the computer system used as well as the input/output media involved in satisfying the system's requirements.

Important Features of the Computer System

The capabilities and limitations of computer system available to the library must be known prior to deigning the computer-based library system. In the case of the described acquisitions system the equipment available to the library was in International Business Machine System 360/50 computer installation consisting of the following devices listed with their IBM type number and related capabilities.

1. There were two 1403 line printers for printed output. Each printer is rated at 600 lines per minute with 132 characters per line using a printing chain with the Standard Character Set of 48 graphics (26 upper case alpha, 10 numeric, and 12 assorted special characters). Using the Full Character Set (Text Printing) chain, which includes upper and lower case letters, numerals, and many more special characters than the Standard Set, printing speed is reduced by more than 50 per cent to about 250 lines per minute.
2. There was a 2050 central processing unit (CPU) with type 1052 typewriter and console that could handle compilation and execution of programmes together. CPU core storage is 131,172 bytes (characters)., Two 16-digit decimals may be multiplied together in 37.25 microsecond. This speed of data handling is illustrated by the fact that 18 three-line bibliographic records (call number, author, and title) plus a page heading may be formatted for printing in less than 1 second including an edit (Verification) of the call number and allowance for spaces between entries.
3. A 2540 card reader punch was available for reading punched-card input and punching output data. This machine reads 1000 cards per minute and punches 300 cards per minute.
4. There were four 2311 disk drives that house "compilers" and the various monitor systems." Compilers are programmes that translate instructions in specific programmes into the language that the machine can use. Monitor systems coordinate and direct the computer system's capabilities for maximum effectiveness in processing user programmes. There are 7.25 million characters of random (direct) access storage available from each disk drive and

it may be read at 56,000 characters per second. Direct access is essential to such operations as sorting or putting a file in some desired order. For example, 3000 variable-length records can be alphabetized in less than 3 minutes including the time it takes for the input and output magnetic tapes to be rewound.

5. Five 2400 model 1 magnetic tape drives for general input/output (I/O) operations were avai-lable. There are 23 million characters of sequential storage available per tape drive deliverable at 30,000 characters per second. The tapes are useful or files that will be used but not rearranged in processing.
6. A 2671 paper-tape reader was provided. With the feed and take-up spools, paper tape is read at 1000 characters (about three book orders) per second. The spooling accessory allows tapes to be read in proper data sequence without respect to how the paper tape is wound.
7. A 2361 bulk core storage provided over one million bytes of core storage supplementing the storage capacity available in the central processing unit.
8. Peripheral utility type equipment was also available including the 129 keypunch, the burster for breaking apart paper printout, the decollator for pulling out carbon paper and separating multiple copies of a printout, the punched-card duplicating machine, and the punched-card sorter.
9. A 2841 control unit for the disk 2311 drives and a 2821 control unit for the 1403 printers and the 2540 reader were available to synchronize the I/O devices with the CPU so that the programme processing would continue during the I/O operations. Being mechanical, these operations are considerably slower than the electronic operations of the CPU.

As a prerequisite, when the decision to purchase a book was made, the analyst could see the effect this would have on the acquisition system as well as others. He applied the principle of economy of recording information only once and began the design that could satisfy this principle. He also kept in mind five major internal requirements that the new acquisitions system had to satisfy: a current on-order file, a claiming procedure, a notification to requestor, various fiscal reports, and operating statistics. In order to satisfy the system need for records in two forms, eye legible and machine readable, an input device was needed to create the records in these formats.

The key punch, although it produces punched cards that are eye legible and machine readable, was unacceptable because it could not prepare the needed multiple-copy order sets. On the other hand the paper type that serves as input to the computer. The advantage of the tape typewriter over the key punch in this ordering application appear to be : (i) the production of a conventional, typed record that facilitates the revision and making of corrections, and (ii) the familiarity of the typewriter as a tool to all library clerical personnel.

The tape typewriter used in this application is controlled by a master tape that performs the following functions:

1. Positions the order form and controls the horizontal and vertical positioning of data.
2. Maintains control over format of data to be entered. For example, if in a certain area it is required that four characters of information be inserted into the record and if the operator only centers three characters of information, the machine will stop and not continue until the field has been filled.
3. The control tape automatically inserts into the input tape the necessary control characters to identify the beginning and end of each variable-length field.

In fact, satisfaction of the requirements resulted first in a multipart book order form that was designed to fulfil the existing requirements as well as to provide the necessary input for computer processing. The function of typing the book-order set and the disposition of the output in terms of external and internal requirements.

Parts one, two, and three of the multipart form may be considered as satisfying external requirements; copy 1 to be used for the vendor's records; copy 2 to go to the vendor for return with the book or for use as a report on the book's availability; and copy 3 to be used for ordering Library of Congress catalogue cards and on return, as notification to the individual requestor of the book's availability. The paper tape provides the input for various other requirements satisfied by computer-produced reports.

Current On-order File: Under manual procedures continuous control and updating of such a file is nearly impossible. However, it is possible to update the file keep it current with the computer-based system. Further, the computer-produced on-order file reduces the manual filing operation to the maintenance of a weekly interim in-process file. The computer-produced in-process list provides a biweekly cumulated list of orders including any changes made after the original typing of the order.

***Claiming Procedure (order follow-up)* :** Because the conditions under which a claim was initiated had to be specified in detail, this requirement cold be well satisfied by a computer-based record.

Operating Statistics: As the volume of book orders increased the task of keeping statistics obviously became more complex. The requirement of maintaining a variety of routine statistical reports and producing special reports as needed was suited to a computer control.

Fiscal Reports: In order to keep an accurate and current account of the encumbrances and expenditures of the acquisitions, system, a variety of fiscal reports were required. As the record-keeping function increased in volume and complexity the more amenable it became to computer-based manipulation. One of the fiscal reports includes statements of funds added, withdrawn, expenditures year to date, encumbered funds, and previous and current balances for each account.

Computer Processing Storage and Output Media

Basically, it was established that the initial computer input was to be the punched-paper tape produced by the tape typewriter and that the records were then to be stored on magnetic tape for processing by the computer. The design of the machine-readable record and the system for processing it had to be developed within the framework of these two parameters, paper tape for input and magnetic tape for processing and storage. In designing the machine record and specifying the processing the first step was translation of the record from the punched-paper tape into the magnetic-tape code, which is a character-by-character translation. Here advantage was taken of the computer's abilities to structure in a predetermined format, a magnetic-tape record that makes provision for all essential data elements whether or not they are present in the record being translated.

It the translated magnetic-tape record was to be readily updated throughout, if each new record could contain any or all of the allowable data elements, and if records could be entered in random order, additional parameters had to be considered to further develop the system. As a result, two major programmes were developed: the translation programme, including formatting and editing of the record, and a general processing programme. The two programmes had to be separated by another programme because of two other seemingly incompatible requirements: that records be readily updated and that they bee accepted in random order.

To update a record it first had to be found in the file. Finding it required that it be uniquely identifiable and implied, with sequential access storage (magnetic tape), that the records were in specified order. Thus each record had to have a code (handle) by which it could be located in the computer file. After a record was found, the specific part of it that was to be updated had to be identifiable and accessible within the record itself. Computer records come in two basic formats: fixed length and variable length. Using the former of satisfy the updating requirement was the logical choice since most of the records would contain predictable elements of data; for example, author, title and publisher. A size limit was set that was large enough to accommodate the longest expected variable of each element. Each element then had its own field (fixed) in the same place in every record regardless of whether the field contained valid data for merely blanks supplied during translation. From a programming standpoint, in this application, fixed-length fields and records were considered much more convenient to work with than variable-length fields and records. At this stage in the design of the machine record and the processing system the following points were decided upon:

1. Each record to have a unique number and was to contain fixed-length data fields.
2. A computer translation programme that would accept paper-tape input developed to:
   (i) translate the punched code into computer code,
   (ii) edit the translated data for validity, and (iii) format the data onto a magnetic tape for further processing.
3. A sort programme to arrange the records by their unique numbers.
4. Additional programmes to produce from the update master file output needed to satisfy the overall requirements of the system; for example, a printed in-process list and a current accession list.
5. A processing programme to update the records.

It is pertinent to note that to explain more fully the computer translation programme (item 2), editing the data elements was possible with the parameters established for valid data in any given field. If a price field, for example was defined as one containing only digits or the letters GIFT, then a gift book coded as FREE in that field would be considered an error by the edit feature of the programme. Such invalid data were to be printed out in an error listing for correcting the input.

The formatting of the records was done by the programmer after the data elements had been established for the acquisitions system. It was here that the programmer played an important role. Balancing the needs of the system against the capabilities of the computer, he developed a tape format that would take maximum advantage of the machine's size, speed, and logic features to meet the requirements of the system. All but three of the fields in the supplied directly by the paper-tape input. Content in the three fields named CONNO (control number), CLAIMS, and STATUS, each indicated by arrows, is supplied entirely under computer programme control as a product of data processing but there is a difference between the data in CLAIMS and that in either CONNO or STATUS. The data in CLAIMS is *informative;* that is, if the record were printed out, the characters in the field would supply information directly to the reader without need of translation. It should be remembered that one of the original demands made of the record was that it contain all the codes or *indicators* enabling it to be processed. CONNO and STATUS are examples of indicator fields. One feature of the system/360 computer that makes it a powerful data processing tool is its ability to access, test, and manipulate individual *bits* within a *byte*. A byte is composed of eight bits and represents one alphabetic or special character, two decimal digits or right binary bits of information. A byte for the letter A, for example, has the bits arranged thus: 1100000. By assigning each bit position a 1 or a 0 (on, off), eight separate conditions or any combination thereof may be carried in one byte.

The two fields STATUS and CONNO are each two-byte-long "message centers" with a combined potential for identifying 32 separate conditions. The data in STATUS and CONNO, then, are indicative rather than informative. If a particular record were printed out, its bit patterns, in STATUS and CONNO might or might not have a graphic representation on the printout and even if they did, the graphic would mean nothing in itself until it could be reduced to its own bit pattern and then interpreted. The combined four bytes of CONNO and STATUS may be used to indicate internally a record's condition and stage of processing throughout the time it is under programme control. Most conditions are best shown by the use of the CONNO and STATUS bit pattern "flags" rather than by relying on the presence or absence of information within the record. The presence of price data, for example, does not show that an item has been paid for, but a bit that can be set only when the invoice is cleared and paid shows the item as paid. Some of the conditions that the bits in CONNO and STATUS are sued to indicate are furnished below:

Bit Flags in CONNO and STATUS

	Bit	***Condition***
CONNO	0	On order
	1	Claimed
	2	Received—in process
	3	Invoice cleared and paid
	4	Catalogued
	5-15	Unassigned
STATUS	0	Departmental copy
	1	Reserve request
	2	General library copy
	3	Gift
	4	Gift plate
	5-15	Unassigned.

The process of sorting is accomplished by utility programmes. These programmes usually are supplied by the computer manufacturer. They are very general and flexible with broad computer applications such as sorting a file, merging files, and punching, cards. There are usually few limitations on the use of such programmes and normally all the user needs to do is to describe the characteristics of his file and individual record to a particular utility programme. In using a utility programme for a sorting operation the input and output devices are designated first, the size of the file is given, then the individual record is specified as to its length, the position and length of the fields to be sorted (given in the order in which they are to be printed out—such as by order number, author, and title); and the sequence of the sort whether in ascending or descending order. Related to the utility programmes are the macro instructions. A definition of macro, "of or involving large quantities," implies its use. In computer terminology a macro is an instruction having the capability of generating more than one machine-language instruction and is incorporated under a coded name into the monitor system of the particular machine.

Thereafter when the macro's code name command is given, the monitor system expands it into the predefined set of instructions. Some commonly used macros are open, close, read, write, get, put, print, and punch. Generally in an actual instruction these macros would be followed by one or more file names showing what device or file the specified command is to act on. The macro facility in general provides convenient shortcuts for the programmer and wherever necessary he can write his own macros. If, for example, under certain conditions. A were to be replaced by a many times in several different programmes, the programmer could elect to write a macro called "replace" which would contain all the instructions necessary to replace A with a.

For example, a utility sort programme specifying publisher and title fields within the acquisitions transactions tape could arrange the file by publisher and for each publisher the titles on order to generate a list of in-process orders. The sort procedure operates with a nondestructive readout. At the conclusion of a sort there is not just a single file in a different order from that with which the sort began but two files. The original file is not erased or in any way destroyed in the process of being sorted. In the acquisitions system s utility sort is used prior to the update programme to produce a file sorted first by order number and then within the order number by the transaction codes to bring each record and its associated updating information together in a predetermined order for processing by the update programme.

As previously stated the system was to accept updating information in random order but a sort was necessary between the translation and update programmes because the records on both the master and transactions files are in sequential order to expedite matching of update data with the proper master record.

Update and Update Programme

Basically, the term "update" is very general and may be roughly equated to the expression "file maintenance." In a strict interpretation this involves modifying a master file with current information according to a specified procedure that could include an exchange of characters for blanks or if the master record is being corrected, an exchange of valid characters for invalid ones. Using presorted input the steps of the file maintenance programme are to match each transaction to the proper master record, identify the type of transaction (price or date received) an enter new data or corrected data. The designation "update programme" was given the file maintenance procedure of updating combined with other procedures.

While the primary achievement of the update programme is a current on-order file, such features as bit testing and manipulation and speed of processing make it practical to satisfy other system requirements concurrently. Output is produced as a by-product of processing each record including such useful procedures as statists on books ordered and received, reports on the amounts encumbered and spent from various funds, list of errors in input data, and a file of items for which processing has been completed.

Changes in the Acquisitions System

From the design of the acquisitions system under discussion a core of programmed processing emerged that included facets of the operations in the acquisitions sub-systems. In a computer-based system the core of programme processing will often cut across the boundaries of subsystem as they existed before the new system was initiated. In this acquisitions system the various operations and functions of the manually maintained subsystems had to be realigned with the revised subsystems for the newly designed system to be effective. As a case in point we can consider the four acquisitions subsystem of preorder searching, ordering, accounting and reporting, and receiving and checking. The changes within the redesigned system are shown as follows:

Before	***After***
Preorder searching	Unchanged
Ordering	Ordering, I/O preparation and processing
Accounting and reporting	Data processing
Receiving and checking	Receiving, I/O preparation and processing

Notably, at east one major operation of ordering, the maintenance of an in-process file, has been taken over by the new subsystem data processing. Similarly the operation of maintaining account balances, previously maintained by accounting and reporting is now absorbed by data processing. The original requirements of the system are still being satisfied and further the new system has the potential of satisfying increases in these requirements.

In planning the design of the acquisition system that we have been discussing, the total-systems approach was used in considering the placing of the routine and data processing operations of the system under machine control.

As part of the design of the computer-based acquisitions system it was decided that punched cards for the circulation system should be produced from the magnetic-tape acquisitions record file after it has been updated with call numbers. The programme produced a master machine-readable circulation card for a currently processed book. This card, which lists the accession number, the author or title, and the call number, was inserted into the book.

This procedure was the first phase in implementing the computer-based circulation system while still operating under manual conditions. Because, new books are expected to circulate more than the old and because most new and circulating materials are equipped with punched cards, the automated circulation system should be fully operational at the time of installation.

Another output produced after the machine-readable acquisitions record has been updated with call numbers is the accessions list. It is arranged by call number and provides the author and title of each book. This bimonthly listing is distributed by the reference librarians as a current awareness service to users.

It is different from the in-process list in that the accessions list is shelf list of newly catalogued books. It is intended to a allow persons interested in a given subject to scan a pertinent block of call numbers and be aware of new library acquisitions that may related to his field of interest.

As a requirement of the machine-readable acquisitions file it was decided that the file should be a historical (retrospective) record primarily for the possible use of these records as the means to find and "lift" full machine-readable cataloguing data from MARC tapes or from some other library's cataloguing data bank.

This is seen as a way to save time and effort when the decision is made to convert existing cataloguing records to machine-readable form.

Computer-Based Serials System

Basically, designing a computer-based serials system follows the prescribed pattern: the establishment of requirements, the provision of forms and the determination of the manual and machine procedures that will satisfy the requirements.

In fact, the *primary* requirement of the serials system is to provide users with an accurate and current file of the library's serials holdings including all the necessary bibliographic information. In the instance we shall discuss, the file will be a union catalogue containing the data required on all serials in both the general library and the branch libraries.

The data in this file should be available not only in the general library but also in branches and to other possible users.

Second, the system should be able to provide the means whereby the user as well as the library staff may request and receive within a reasonable time special catalogues or reports of the serials holdings by such categories as call number, language, and subject; and it should also provide special listings by publishers, vendors, types of serials, status (such as active, inactive), and by all condition of receipt (gift, purchase, or exchange).

Third, the system should be able to guarantee that all issues not received by the library will be claimed promptly and on a set schedule and also that the renewal of all serial subscriptions will be controlled by the system.

Fourth, the system should be able to predict the time of receipt of a journal issue with accuracy thereby establishing a positive control over the timely receipt of all issues.

Fifth, the system must be able to maintain and control all the accounting records necessary for its own internal use and be able to report to the comptroller the information required for payment of invoices. *Sixth,* the system should be able to provide the binding department with necessary information and records for those journals that are to be bound. It also should be able to provide such information and records on a scheduled basis in order to maintain an even workload for the binding staff. *Seventh,* the serials system should have the ability to handle the many changes that occur in the various serials titles.

Compiling Serials Records

With the establishment of the requirements of the system the next task is to determine what information is necessary as input to the computer system if it is to satisfy the requirements as outlined. It should be determined where this information can be obtained if existing records are inadequate and what format and under what restrictions the input of information should be placed. The input worksheet should be designed to obtain the maximum amount of information with the least cost. The form finally adopted should contain all the information necessary for the functioning of the system.

The original step in compiling the serials record starts when the compiler removes from the existing central serials file the holdings record, or the current check-in record, or both. The holdings card indicates any title changes or title variations. If changes have occurred, the compiler removes from the central serials file those cross-referenced records pertaining to the title variations or changes in question; that is, all of the library's records covering the history of this particular title are removed. Referring to the serials control record worksheet, the first box in the upper left-hand corner carries the Dewey call number obtained from the library's record. In the case of the call number, where there have been title changes or there are multiple subscriptions and the same call number has been used for each new change or subscription, it is necessary for the compiler to add to the call number a hyphen and an additional digit (–1, –2, –3, and so forth) to identify each title within the computer record. The next step in compilation is to verify the official title, if possible, in the *National Union Catalogue* (NUC).

If it is found there, it is used as the main entry for input to the computer. The LC call number, if found in NUC, is recorded in the upper right-hand corner of the form. The compiler also indicates under the word "verified" the volume and year of NUC in which the title was verified. If the publication is not found in NUC, the next step is to search in the *Union List of Serials.* Here again, if the title is found, the entry is accepted as the main entry. If the entry is not found in the *Union List of Serials*, the search is continued in *New Serials Titles* and if necessary, in *Ulrich's International Periodicals Directory.*

The next item on the form is the short title which cannot exceed forty characters in length. The short title should conform to the title as it appears on the cover of the serial itself as an aid to checking in the issue. The abbreviations for periodical literature provided by the United States of American Standards Institute are used in establishing the short title.

Proceeding down the form the next blocks are Holdings-start and Holdings-end. This information is obtained from the library's holdings record. The information for the Publication-start and Publicationend blocks is obtained from NUC or the *Union List of Serials* and if not located, it is taken from other bibliographic sources. The items in the next two horizontal lines of data are coded. The following defines the data elements and supplies examples of some of the code structure.

Keyword	***Description of Data Element***
LIB (Library)	Refers to the particular library or collection that maintains the file of a journal (00 = general library, 41 = business and economics).
LOC (Location)	The location in the library. This is used primarily to indicate where the journal is to be shelved (2 = current display rack). It is also used to identify the location to which it is routed previous to shelving (A = table of contents photocopy service).
LANG (Language)	The language or languages in which the journal is published (01 = Chinese, 20 = multilingual with English).
TYPE	Refers to form of publication—that is, abstracts, periodicals, transactions (10 = index or abstract, 40 = proceedings).
STAT (Status)	Refers to variations such as active, ceased publication, discontinued subscription, title change (1 = ceased publication).
RET (Retention)	Refers to the period of time of retention and conditions under which a journal is kept, that is, one year and discard, two years in branch and forward to general library, and similar variations in handling (3 = discard after three years).
BIND (Bindery)	Refers to the commercial binder used.
Colour (Colour)	The four-digit code for the colour of binding cloth to be used.
ISSUE PHY VOL (Issues per physical volume)	Defines the number of issues that are bound in a physical volume.
INDEX	Refers to when and how the index is received and where it is found in the journal (0 = no index, 4 = separate, free on request).
INDEXED IN	Obtained from *Ulrich's International Periodicals Directory*. Here is indicated indexing services in which the journal is indexed or abstracted (175 = *Reader's Guide,* 095 = *Fuel Abstracts*).
FREQ (Frequency)	Defines the frequency of publication of each title-that is, monthly, weekly, quarterly, and so forth (01 = weekly, 16 = bimonthly).
NO. OF ISSUE VOL	The number of issues per bibliographic volume.
CC (Claim Control)	Indicates the waiting period at end of which an issue is claimed (21 = one month late).

JFMA.... (Jan, Feb, Mar, Apr)	Used for forecasting the time of receipt of issues so that the computer can produce the check-in punched card in advance of receipt.
REC (Receipt)	The condition of receipt— for example, gift, group purchase, membership, group purchase, exchange (4 = gift, 9 = group purchase.
GROUP NO.	If, for example, a journal is received as part of the package plan with the American Chemical Society, a unique two-digit number is assigned to American Chemical Society and each title received in the package plan is assigned that number so that all journals received under the plan can be identified as a group for accounting purposes.
DATE START	Refers to the date that the last subscription started and controls the renewal of the subscription.
LAST PAYMENT	Used to verify that a title was renewed previously and when.
SUB LGT (Subscription length)	Used in conjunction with DATE START to determine next renewal date of a title.
REQ DEPT (Requesting department)	Used in connection with the FUND NO for accounting and statistical purposes. The LIB codes are used in identifying departments that have requested subscriptions either for housing in the departments or in the general library.
FUND NO. (Fund number)	Refers to the account against which the subscription is charged.
SUBS PRICE (Subscription price)	Refers to the cost of a subscription or last renewal.
ISSUING AGENCY	Full name and address of the issuing agency (publisher).
SUPPLIER	The name and address of the supplier or vendor when different from the issuing agency.

Further, the balance of the serials control record worksheet is used for the additional bibliographic control data desired in this system. Entered in the last part of the form are the S-SUBJECT entries as found in NUC for each title. If the title is not found in NUC, the librarians revising the records must assign at least one compatible subject to each title. The A-ADDED entries used are those given in NUC excluding the added entry for editor. Indication of title changes follow the subject and added entries. If there is a title change with the new title continuing old volume numbering, such title change is designated F-FORMERLY ISSUED AS, or C-CONTINUED AS. On the other hand a title change with its own and new volume numbering is designated Z-SUPERSEDES or X-SUPER-SEDED BY. If two titles are merged to form a new title, both titles would be entered under the code M-MERGED.

Any necessary notes that will facilitate the user's approach to a serial title are entered under the code N-NOTES. After the information has been compiled on the serials control record worksheets, it must be verified and, if necessary, revised.

After the data on the worksheet have been revised and all corrections made, it is forwarded to the data processing operator who prepares the input tape using the paper-tape typewriter. Reading from the serials control record worksheet the data processing operator types this information on a serials control record form simultaneously producing paper tape containing all of the compiled information.

There are three ways of correcting information entered into the paper tape : (i) If a character is incorrectly typed, the operator immediately may insert a delete character to erase the error and continue with the typing. (ii) The operator at any time during the typing of a record may insert a special code which will indicate to the computer that this record is to be disregarded and that a substitute record will be entered. (iii) At the end of the record the operator has the opportunity to correct any field that may have been typed in error by inserting the field control number followed by the correct information; a computer programme will then insert the corrected information furnished by the operator, in the field indicated. Each serials control record form produced concurrently with the paper tape is proofread for typographical errors at the end of the day's production. Any errors that are found during proofreading may be corrected by the operator at any time.

The correction procedure is to punch five items into the paper tape; first, the code indicating to the programme that this is a correction record; second, a code indicating the type of correction (A for an addition to a record, C for a correction to some field within the record, or D to delete some item of information from the record); third, the Dewey call number of the title to be corrected; fourth, the field control number of the field in error; and fifth, the corrected information.

The correction record on paper tape will be used to make the necessary corrections, additions, or deletions to the machine-readable record identified by the Dewey call number.

Serial Record Load System

The next phase of the serials automation system consists of designing the programme required initially to load and format the serials records. Serial Record Load System, illustrates the generalized system. Requirements of the system are : (i) to produce a report for verification of each serials record loaded to date and arranged in Dewey call-number sequence; (ii) to produce a report for verification of each serials record loaded in the current run; and (iii) to produce a report of any record or records containing erroneous information (errors, duplicated records).

Inputs to the system are : (i) a paper tape containing new serials records; and (ii) A paper tape containing corrections, additions, and deletions to be made in existing computer records.

The first requirement of the programme is to produce a report listing each error found in the editing procedure. Based on the editing report the data processing operator will correct the errors (as described previously) and will re-enter the corrections into the computer in a later run of the translate and edit programme. The second requirement is to assemble the input data into proper format as developed for the master serials record. Master Serials Record, shows the layout of the computer record which consists of five sections. The first section of the record is fixed in length and contains the majority of the data characterizes as "basic identification and control data."

The second section is fixed in length and contains the accounting data including a five-year historical record of the payment of each serial subscription. (A five-year average of the increase in serials cost should permit forecasting of serials budgets with a high degree of reliability.) The third section of the master serials record, variable in length, contains bibliographical information on each title.

This includes the official entry, all subject entries, selected added entries, title changes, and all notes. Each of these items is variable in length and each field, except the official entry field, may contain more than one entry. For example, there might be two or three subject entries for a particular title.

The fourth section, variable in length, is the claiming and receipt section. This portion of the record is generated internally by the check-in programme at the time it forecasts the receipt of each issue of a title. The fifth section, variable in length, contains the binding information, the greater portion of which is created by the check-in programme at the time the updated information is received by the computer.

Thus, the inputs to the programme are (i) paper tape of new serials records; and (ii) paper tape of correction records. Output of the programme are : (i) serials transactions file on magnetic tape containing the new titles that have been loaded during a given run plus corrections to previous titles that were loaded at an earlier date and (ii) the editing report indicating what errors the computer has found during the edit process. Functions of the programme are : (i) to read in the data from the paper-tape reader (since the codes that are produced by the paper-tape typewriter are not the same as the code structure used in the computer, the characters on this tape must be translated into the appropriate machine language); and (ii) to edit each field of the serials record to make sure that it conforms to the requirements of length and content of the field and that the information as presented is valid. For example, under the area LIB (library) it is possible that the operator type a code that is not a valid departmental code— or in typing the MAIN ENTRY an invalid character was used or for an active serial the FREQ (frequency) code was omitted. Thus each item on the form, where it is possible, will be edited for validity and completeness.

The requirement of the programme is to sort the new serial record file into Dewey call-number sequence. Input to the programme is the serials transactions file produced in the translate and edit programme and containing new and corrected serials records. Output of the programme is a sorted serials transactions file containing new and corrected serials records in Dewey call-number sequence. Function of the programme is to sort the records contained in the magnetic-tape files into a desired order or sequence.

Requirements of the programme are : (i) to generate a new master serials record file; (ii) to make corrections to existing records; and (iii) to eliminate duplicate records. Inputs to the programme are : (i) sorted serials transactions file of new and corrected serials record; and (ii) a sorted master file of existing serials records.

Outputs of the programme are:

(i) a magnetic tape file containing all records, existing and new,

(ii) a printed listing of new and corrected titles loaded in this run, and

(iii) a printed listing of erroneous records.

Functions of the programme are: (i) to merge old and new records on the two input tapes into one output master file; and (ii) to correct any record in the old tape file prior to generating the new tape file.

Catalogue Report Generator System

The catalogue report generator system allows flexibility to the library staff and to the user by obtaining information from the system in the sequence and in the format wanted. This system is a medium by which users can exploit the informational potentialities of the serials control system. Generalized Systems Chart of the Catalogue Report Generator System, outlines the programmes and their interrelationships required in the preparation of specified printed catalogues and reports.

Requirements of the system are : (i) to provide the user with an accurate and current catalogue of the serials holdings containing the necessary bibliographic information; Serials Catalogue) and (ii) to provide the means whereby the user as well as staff members may request and receive special catalogues or reports of the serials holdings within a reasonable time.

Serials Listing by Subject; Serials Listing by Call No; Serials Listing Departmental Libraries-Arch). Inputs to the system are: (i) the master magnetic tape file of serial records and (ii) the data control punched cards for selection of data and desired sequence and format of the report.

Outputs of the system are printed catalogues or reports. When printout of these catalogues or reports is required, it is only necessary for the serials librarian to indicate this by the appropriate code in a control card. The generator system based on this code will automatically select from the master record the data required for the printing of a given list.

The requirement of the programme is selection of desired information from the master file by means of the data control cards. Inputs of the programme are : (i) a the master file of serials records and (b) data control card for each item of information that is to appear in a given report. The output of the programme is a magnetic-tape file containing information for each of the requested reports, or catalogues, or both.

Functions of the programme are : (i) stripping from the master serials record file the data required for the printing of catalogues or special reports as specified by the data control cards; and (ii) formatting such information and transferring the resulting record to an output work tape.

The requirement of this programme is to sort each of the report work tapes into desired sequence specified by the sort control card. Inputs to the programme are : (i) the report work tapes created by the catalogue report generator programme; and (ii) the sort control cards that define the order in which records are to appear. The output of the programme is a file of the records to be printed as a report or catalogue.

The requirement of the programme is to print in desired format any standard catalogues or special reports. Inputs to the programme are : (i) the sorted report file; and (ii) the print control card that defines the format in which the information is to appear.

Operating Systems

So far we have described in some detail the systems for compiling the original input to the serials system for setting up the master record file and for correcting this file and for setting up the reporting system required to produce the necessary reports or catalogues. The primary purpose of the serials operating systems is to provide efficient and accurate control of all records and the transactions.

Systems charts of the monthly and weekly operating systems, outline the programmes and their interrelationships that are necessary to fulfil the following requirements:

1. Predict the time of receipt of the journal thereby establishing a positive control over the timely receipt of all issues.
2. Guarantee that all issues not received by the library will be claimed promptly and on a set schedule and that the renewal of all serials will be controlled by the system.
3. Maintain and control the accounting records necessary for the serials system internally as well as report to the comptroller the information required for payment of invoices.
4. Handle the many changes that occur in the various serials titles.
5. Provide the binding department with the necessary information and records for those titles that are to be bound.

In fact, Outputs of the operating systems are : (i) an updated master file of all serials records; (ii) punched control cards anticipating receipt of issues; (iii) reports for controlling, claiming, renewals, and binding; and (iv) statistical and accounting reports. The operated systems work within three time frames: monthly, weekly, and daily. We shall now review functions that are performed by both the computer and the clerical.

Operating Functions

This section describes the function of the staff of the serials system and the data processing operator in maintaining records.

Check-in: When an issue is received, the serials clerk removes from the punched-card file the corresponding check-in card for the particular volume and issue.

In the case of an irregular publication it is necessary to record on the check-in card (if not there already) the volume and issue number, adding the month and year of publication. The clerk marks the call number on the issue and checks for changes such as title and frequency in the journal. If variations are not found, the check-in card and is forwarded to the data processing operator.

If changes have occurred, they are recorded on the serials control record worksheet, indicating the call number and the changes in the appropriate fields. The check-in card and the worksheet are forwarded to the data processing operator who, using the auxiliary punched-card reader attached to the paper-tape typewriter, enters the check-in card data into the paper tape.

The call number, issue, month, and year are punched into the paper tape as input to the weekly run of the check-in programme. If corrections or changes to a given title are made, the data processing operator holds these until the end of the day or week when the correction tape for input to the translate and edit programme is produced.

Ordering of New Serial Titles **:** On receipt of the first issue of a new title the serials librarian prepares a serials control record worksheet that is forwarded to the data processing operator for entry of the new title into the system.

Renewal of Subscriptions **:** The renewal control cards and the renewal reports are received from the computer. The renewal punched card is filed. The renewal report is verified and two copies forwarded to the supplier or the publisher for the renewal of the indicated titles. When the invoice, the invoice is received, the renewal control card for each title on the invoice, the invoice number, and the amount of the renewal are posted to the renewal control card.

The renewal control report is checked for each title and the renewal control card is then forwarded to the data processing operator. The operator duplicates the prepunched information on the renewal control card and key punches the new information (invoice date and number and renewal cost) and simultaneously produces a punched paper tape with this information. This is accomplished by using a key punch that is cabled to the paper-tape typewriter.

Binding Control **:** On receipt of the binding control list and the control cards the binding department uses the control list as its worksheet for the coming month. The jour-nals are taken from the shelves and checked for completeness. Binding orders are then prepared for the completed volumes. It is the responsibility of the binding clerk to submit correction reports for any issues or indexes found missing.

Claiming of Serial Issues**:** The weekly run of the check-in programme prints out the claim notices. These notices are reviewed prior to mailing because notice may have been received from the supplier or publisher that item will be delayed. In such event the computer record is updated. If the claim is routine, the notice is forwarded to the supplier. On receipt of the claimed issue the check-in card for that issue is removed from the file and forwarded to the data processing operator.

The monthly run of the check-in programme is the key to the successful fulfilment of the operating system. It is the function of this programme to forecast the transactions that are to occur within the serials system for the coming month and to produce the reports and control cards that are needed to handle successfully these transactions. The monthly run of the check-in programme has specific functions that must be performed.

A forecasting must be made of the issues to be received for each of the active during the coming month. Utilizing the FREQ (frequency) data in conjunction with the months of publication data (JFM....field) the programme will determine whether an issue is to be received or claimed; the check-in programme will determine, when possible, the volume and issue numbers to received in the coming period. A control card will be punched for each issue to be received. Simultaneously the programme will post in the waiting receipt and claims section of the master record the control data for each particular issue. The check-in cards will be filed in the serials department awaiting receipt of the issue.

A listing must be produced of all titles whose subscriptions are to be renewed during the second month following the monthly run. (For example, during the June run the computer will forecast those titles to be renewed during August of that year.) This programme determines the renewal date by utilizing the date of last renewal found in the DATE SUBS START (date subscription start field and the period of the last subscription from the SUBS LGT (subscription length) field, both found in the accounting data section of the master record. The renewal report is produced by vendor or by publisher showing the titles that should be renewed in the period. The report contains the call number, the title, the last renewal date, the subscription length, and the estimated price of renewal. At this point, programme also produces a control card for each item being renewed. The control card contains the call number and short title. The programme also posts to the accounting data control section the renewal cost incurred.

A binding report is necessary for those titles with sufficient consecutive issues to warrant binding into a physical volume. A control card is produced for each volume to be bound and an indication is made in the binding control section of the master record that an order has been issued for binding.

Accounting reports are required for the financial control of the system. These reports are based on encumbrances incurred by each fund and department account. In order to obtain a net balance for each fund and department account at the end of each month the encumbrances are adjusted to actual cost on receipt of invoices.

The programme must generate monthly statistics of the number of new titles added and their cost, the number of renewals and the estimated cost of renewals, the number of issues received, the number of bound volumes added to the serials collection, and other statistical information.

For all titles frequency of receipt is irregular the check-in programme will, on the receipt of an issue, produce a check-in card for the next arrival. This card contains only the call number and the short title of the issue and, if possible, the volume and the issue number but not the month or year.

Remember, at end of each week all input paper tapes for the serials system are forwarded to the computer center for entry into the weekly run of the check-in programme. These tapes are processed through the translate and edit programme. The output of this translate and edit programme. The output of this sort programme, arranged by call number and type of transaction, is the input to the weekly run of the check-in programme.

The function of the check-in programme is to post all transactions that have occurred to the serials master record file. The primary output of the weekly check-in programme is the claim notices. During the weekly run the programme audits each record, comparing the date of a forecasted arrival in the WAITING RECEIPT sector of the record to the CLAIM CTL (claim control) date. If the issue is overdue, a claim is issued. If a subsequent published issue is received prior to the receipt of an earlier published issue, a claim is issued is received, the WAITING RECEIPT sector of the record is cleared and the issue is posted to the binding control section of the record. The output of the weekly run is the updated serials master control file that is always the source of all printed reports.

A critical operation within the serials system is the check-in and claiming of journal issues. There is an alternative to the punched card, paper-tape check-in and claiming operations in the computer-based serials system. The direct use of the punched from the check-in file as input to the weekly run of the check-in programme could be a more efficient way to update the master serials record file. If the punched cards produced by the computer for the check-in operation contained the required information for check-in, the intermediate step of paper tape might well be eliminated. If this were done, no translate programme would be necessary because punched cards do not require this. This phase of the weekly programme would only require a card-to-tape utility programme. Another alternative could be that instead of punched cards, a monthly printout listing of expected journal issues could be used. After a journal issue is received, it could be crossed off the printed list, marked, and sent to the shelves. At the end of the month the printout would be sent to the claiming subsystem for processing. Those titles not crossed off would require a claims notice. The initial notice, both to the vendor and the computer record, would be produced on the paper-tape typewriter.

Subsequent claim notices would be issued by the claims programme under computer control. Updating the computer record with information about the issues that have been received would be accomplished by the computer not being notified. If no notice were received, programming would provide for the computer record to be updated automatically on the assumption that the issue had been received.

Computer Based Circulation System

As suggested by the theme total systems concepts are viewed and evaluated to indicate their importance in designing a computer-based circulation system. Planning with total systems concepts in mind should disclose most of the ramifications that will occur after implementation of a new system.

The phrase "total system," as used here, concerns itself with more than the immediate library system or the overall parent administrative system. Rather it is meant to designate the symbiotic relationships within the library and the general relationships of the library with society; that is, it is meant to deal with the interrelationships or interdependence among systems that affect one another and in many instances justify and facilitate the existence and performance of systems. Interdependence is the key word describing the inner workings of systems within a total system.

A limited, two-dimensional representation showing one phase of interdependence of systems is illustrated in total system. This diagram illustrates some of the interrelationships that do exist. General society, all inclusive, is the source not only for the people who are to manage the library but also for the library users and the supply of outside supporting services and materials to the library. When viewed in closer perspective the interdependent systems of the library in become obvious. Stylized, relationships between the systems within the total library are shown encompassed by the administration and planning system. Circulation is depicted as logically interrelated with the reference system and the cataloguing system. From the latter newly processed library materials are received and controlled by the circulation system in order to provide the library's users with ready access. The location symbols assigned and indexes prepared and maintained by cataloguing are used by the circulation system and by the library users to locate and relocate desired items.

One of the relationships between acquisitions and cataloguing in which the one furnishes the material for the other to process so as to make it readily accessible to the library user and to other systems, further serves as an illustration of the total systems concept. Reciprocally the records that cataloguing maintains allow acquisitions to search each purchase request effectively before ordering to avoid unwanted duplication of material work.

Design

When the circulation system is accepted as a system that is directly interdependent with other systems within the library as well as with outside systems (that is, the user), a more lucid understanding of the place of the circulation system within the total library system may be realized. It should also become increasingly clear that the design of a new system with its stated demands and requirements and its inputs/outputs will have direct bearing in varying degree on all the other systems within the total system. Therefore it becomes very important in designing a new system to be fully aware of what immediate and long-term effects a new printed form, method or procedure will have on existing cosystems. In considering the design of a computer-based loan system it should at least be able to emulate the worthwhile elements of the existing systems. These elements, probably common to all circulation systems, include the ability to :

1. Indicate what book is out and who has it.
2. Indicate the date the book was taken out and the date it is to be returned.
3. Allow for a daily count of circulation activity by type of material and possibly by the status of the user.
4. Search for missing books, and if found or not, notify the requestor of the book's availability.
5. Charge out and discharge library material.
6. Allow for reserving charged-out library material.
7. Maintain records of overdue books and issue notices as required.
8. Allow for a daily updating of the master file of out-standing circulation by interfiling the daily transactions.
9. Provide on users' notices the call number, title, and due date of the requested material.
10. Facilitate recall of charged-out material prior to its due date.
11. Enable the library to know the user's identify prior to borrowing any material.

Accepting the necessity for maintaining the objectives of the existing circulation system, the computer-based system could be designed by the analyst to gain a variety of improvements in the maintenance and accessibility of circulation records and more meaningful statistical records. In addition to improving on present objectives the computer-based circulation system should be designed to be flexible enough to:

1. Ascertain the user's identity and be able to correlate by statistical analysis, his subject background with the type of material he charges out.
2. Answer a user's enquiry as to the status of a book (out, in, missing) by current printouts arranged variously by author or title, call number, and borrower, including in each listing the date the material was charged out and is to be returned.
3. Provide work-unit statistics to indicate hourly and daily workloads.
4. Maintain a historical file of loan transaction records for use in periodic statistical studies.
5. Be as mechanical as possible in its charge and discharge operations so as not to be dependent to any appreciate extent on manual keying or writing functions and thus make charge and discharge operations as rapid and free of error as possible.
6. Allow for *portable* terminal data collection devices for use in inventorying the book collection and perhaps to allow for user self-charging of material.
7. Take into account short circulation periods, anywhere from a few minutes to several hours, allowing for class reserve books to be controlled by the computer-based circulation system. (This may be best performed in an on-line system).
8. Provide for continuing analysis of the book collection by frequency of use by subject and subject background of user so as to evaluate collection growth and adequacy.
9. Indicate the retrospective and current number of uses of any book within the library's collection to facilitate the ordering of additional copies of materials or the weeding out of inactive material.
10. Permit expeditious inventorying of the collection with machine readable records.
11. Maintain statistical records of user requests for missing books.
12. Allow for conversion to an online circulation system.
13. Be able to generate on request lists of books charged to individual users.
14. Machine produce on request and as needed recall and overdue notices.
15. Analyse the use made of class reserve reading material.

Remarkably, not only should the systems analyst be aware of what objectives the circulation system should fulfil, he should also be able to evaluate the commercially available mechanical data collection (input) devices best suited to realize the total systems concepts in the computer-based circulation system. Along with the decision made regarding the type of input devices to be used to capture the transaction record, a master punched book card (the input) for each circulating item, probably an 80-column punched card, should be produced with enough information to identify the book. If the bibliographic data is already computer based, it is only a matter of stripping the necessary information from the existing computer record and producing the punched bok card, interpreting the Hollerith code to make the card man-readable, and inserting it into the book.

An example of planning for the future is provided in the case of the library system that has used no book cards, even under the manual system, but still provided a book card pocket in the back of each book in the planned event that punched cards would be used as master book cards in a computer-based circulation system. If the cataloguing system is at present converting its records to machine-readable form, the master book card could be an economical by-product of the conversation process. As the shelf list is converted selected information would be punched into the punched card to create a master book card could for the circulation system.

If no machine-readable bibliographic records exist, the conversion of records to machine-readable form to produce the master book cards is a costly and critical operation prior to the implementation of the computer-based circulation system.

Master Book Card

Here it must be remembered that provided that a machine-readable record can be produced, the analyst should define the data to be carried on each master book card. He has less than 80 columns with which to uniquely identify the book because some of the card space is allocated for the identification number of the user, which will appear on the transaction card combined with the data from the master book card.

Therefore the information contained in the master book card and that added to the transaction card, although minimal, should allow for:

1. Positive identification of the specific book by the master book card. The order or accession number or the full call number, or both, including volume, part, copy, and so forth, would appear to be necessary.
2. *The due date* the computer programme can take this into account and provide the due date on the printout.
3. Enough bibliographic information to enable the user and the library staff to identify the book by author or title, or both, in a printout list of loan transactions. It may not be necessary for this information

to be punched into the master book card because a machine-readable shelf list in computer storage can be used either in real-time (immediate access) or in an off-line situation for complete identification of the book if the call number or the order number is used as the key to the entire bibliographic record.

An advantage to creating a master book card that is bibliographically self-sufficient is that it allows for generation of computer printouts directly as requested. The printing out of the outstanding circulation file can be accomplished by sorting and revising only the information pertinent to circulation without referencing the entire store of cataloguing data.

The data to be carried by the machine-readable user identification card should be specified by the analyst. If properly designed, this card serves as an excellent example of application of the total systems design concept. For the purposes of the library the identification card would be Hollerith coded with some identifying number that would serve as the key to each user's name and address and other pertinent information in a separate machine-readable file. This key number, which would be punched into the user's card, should have certain characteristics:

1. It should be short enough for the identification card and for the remaining space on the master book card when combined in a transaction card.
2. It also should take into account the accessibility of already existing machine-readable borrower files or other machine-readable files carrying this type of information that could be used to provide addresses and other data for collection development studies. If no machine-readable files exist, it is a matter of converting manual borrower or user files.

Further, identification card to be carried by each user should be provided or an existing card modified to meet the demands of the new system. This card requires key punching and if this is not amenable to an already existing card, a new one will be needed. If a new identification card is required, it should be designed to carry : (i) positive identification of the user by a photograph, name, the Hollerith coded identification number, and possibly the person's signature and (ii) any additional information that is compatible with other uses of the card outside of the library. In support of the total systems concept the identification card should be designed to be useful, if possible, in other systems. By embossing the name and birthdate of the carrier on the card it can be used as a "charge plate"; and by providing a photograph and signature it can serve as a very compact general-use identification card.

In a university situation such a card would find application in library, bookstore, registration, and student activities transactions. The most important characteristic of identification number to be punched into the card is the adaptability it will or should have in existing machine-readable identification files in various systems. Therefore special consideration should be given to the machine-readable number to be used: is it to be a locally unique number or a nationally unique one like the Social Security number? In support of the nationally unique number the implications of the increasing interest and activity in shared library resources indicate the need for universal identification. For example, in a network of libraries if a number of the cooperating libraries implement computer-based circulation systems and users from any one of these borrow books from various libraries in the system, the identification number should be machine-compatible throughout the system. This obviously necessitates a machine-readable central address file accessible to the cooperating libraries.

The format and content of the master book card and user identification are important to the contributions of the circulation system to the total library systems goals. This is in terms of the circulation system's ability to contribute effectively to the administration of the library and to collection development for best service to users. If a library is to capitalize on the statistical information available from daily circulation transaction records, some planned means of making use of this data should be provided. The materials circulated are obviously an indication of user subject and intellectual interests and development.

A variety of statistical records can be supplied by a functionally designed computer-based circulation system. Continuing statistical analysis can serve to signal and predict fluctuations in demands being placed on the library. Therefore data collection as a by-product of the circulation control system should be designed to be sensitive to the subtle changes in user requirements and expectations. The result of such an approach will verify the aptness of the techniques already in use to attain the library's service goals or it may show the conventional techniques to be inadequate. In order to analyse properly information gathered the data collection function needs to be designed to: (i) incorporate flexibility and compatibility in the gathered data to generate needed reports; (ii) balance economic limitations against statistical reports clearly required in terms of the broadness of their application; and (iii) consider the needs and demands of the user, the types of users, and the ecology of the library. A library network's requirements may well differ from those of any one member library.

Device

The mechanical input device in a computer-based loan system should be able to generate the necessary data for computer input. Apart from expeditiously accepting and processing the inserted master book card and the user's card, the machine should be able to withstand extensive use in repeated charging and discharging functions. It would seem that the more simple the machine's construction and the more independent it is of auxiliary equipment, the less chance there is of it failing. It should have the feature of being able to go on line.

Regarding the routine operations in which the machine will be involved, the discharging of books may be a problem area under certain conditions. In a one-card system the master card is used to produce the charge and discharge record for the input to the computer and in doing so requires that the book always stay with the master card. As a solution to this problem a two-card system produced by the input device is suggested.

Two cards are produced from the master book card : (i) a charge-out card that contains the same data as the transaction card and is placed in the book pocket along with the master card; and (ii) a transaction record card that serves as computer input. By this method the charge card can be removed from the returned book and the book sent immediately to the selves. The charge-out card serves to clear the computer record by matching with the transaction record as it appears in the computer.

By defining the necessary data to be incorporated in each master book card and user card the analyst should be able to extract a number of valuable statistical use studies and measures from the loan record. For example, because there are no precise means of ascertaining stack or in house use of books, those charged out should have significance in measuring the use of the collection and in collection development. Because the computer can readily provide records of actual use and non-use of books, this has direct bearing on collection development by the reference system. If a subject represented by a group of books is no longer referred to, the purchase of new materials in that subject field may be questioned.

Effective collection development through awareness of use should also provide data for subject profiles of specialized users, augmented and confirmed by personal interviews. If circulation records reveal that a title is used extensively, additional copies may be automatically purchased. Within the cumulative circulation statistical record, book use can be measured and classified by call number and perhaps, preferably, by means of the subject "tracings" in the computerized shelf list correlated with the subject background of users. From observation of circulation trends suggested reading lists of currently appearing titles could be produced as an awareness service in the subject areas of readers' interests.

Through the use of statistics it would be possible to predict inductively by any subject's use or non-use the significant growth or decline of interest by library users. This could be a direct aid in the library's book-selection subsystem. In most, if not all libraries, the administration is in competition for increased budgets with other units and offices of the governing administration. The library administration should be able to demonstrate through quantitative and qualitative use records of the library's collection the need for an increased book budget. These use studies may also indicate need for a decrease in or shifting of acquisitions funds that may have been wanted in maintaining unused subject collections.

An additional operation that would be dependent on a computer-based circulation record and shelf list would be that of inventorying the collection entirely or on a sampling basis. Records of user queries foe missing books in a given area might indicate the need for an inventory of that area.

The weeding of library collections is often neglected. By comparing a computer listing of materials used in the last five years, for example, against a machine-readable shelf, a list of material not loaned in that period could be produced. This list could serve as the basis of a weeding operation. This appears to be a better method than basing reasons to discard materials or place them in inactive storage on general age-use mathematical models.

If as one of the primary steps in implementing a computer-based system all master book cards are prepared but not inserted into the books until they are charged out, the remaining file of master book cards not inserted after x number of years would indicate those books not circulated in the predesignated period of time. This remaining file could be processed to produce a list of books eligible for weeding operations either withdrawal or referral to inactive storage. As implied previously circulation transaction records are one of the best sources of information about collection-use patterns. Other means of ascertaining use, including on-site observation and the counting of unshelved books on tables, may be too limited and may not cover the overall aspects that an extensive collection of computerized circulation records could provide. The percentage of books ten years old or older found on study tables in a two-week period and used as the basis to extrapolate a general statement on the entire collection's use does not necessarily provide sufficient guidance for weeding of a collection.

Under the total-system concept and the management by exception principle all facets of collection use are considered or may be considered. This reveals not only the extent of use of older books but also an itemized listing of these books, their subjects background of their users. By exploiting the full capability of loan statistics to measure and project library use, service to groups of library users may be improved. The current loan transaction indicates what is happening and there by may allow the library's administration to respond to the demands of the library's users as deduced from the loan statistics. If a definitive pattern can be obtained about how effective the library is in meeting user requirements, far more precise parameters of library service may be established. A further illustration of the total systems concept is the loan transaction record accumulated over a period of time; this could be very meaningful in arriving at staff subject specialist requirements.

The nature of the user, derived from subject profile analyses by questionnaire and personal interviews as well as from actual use reports, would provide a guide to the subject background and experience needed for meeting the needs of the library's community. Although this would be only a partial measurement, it would still contribute to a broader understanding of job requirements.

Recent Development: Online Applications

The analyst in designing a system utilizing the total systems concept not only should be aware of what effect the design will have on other systems but also should be cognizant of and prepared for new technological developments. A computer-based circulation system should be designed to take into account on-line operating procedures. By an on-line operation is meant direct input to the computer, usually with immediate response from the computer. Printouts may still be used as guides to the outstanding circulation. An on-line procedure makes unnecessary the preparation of the computer input, the transaction card of the master book card's data combined with user's identification. This transaction data goes directly into the computer storage. In an on-line application with immediate access, loan information will not only go directly to the computer but also, as requested, will be printed out on a typewriter terminal or displayed on a cathode-ray tube.

Metadata

Meta is a classical Greek preposition and prefix conveying the following senses in English, depending upon the case of the associated noun: among; along with; with; by means of; in the midst of; after; behind. In epistemology, the word means "about (its own category)"; thus metadata is "data about the data". The term was introduced intuitively, without a formal definition. Because of that, today there are various definitions. The most common one is the literal translation: "Data about data are referred to as metadata."

Example: "12345" is data, and with no additional context is meaningless. When "12345" is given a meaningful name (metadata) of "ZIP code", one can understand, and further placing "ZIP code" within the context of a postal address) that "12345" refers to the General Electric plant in Schenectady, New York. As for most people the difference between data and information is merely a philosophical one of no relevance in practical use, other definitions are:

(a) Metadata is information about data.

(b) Metadata is information about information.

(c) Metadata contains information about that data or other data.

There are more sophisticated definitions, such as:

1. "Metadata is structured, encoded data that describe characteristics of information-bearing entities to aid in the identification, discovery, assessment, and management of the described entities."
2. "[Metadata is a set of] optional structured descriptions that are publicly available to explicitly assist in locating objects."

These are used more rarely because they tend to concentrate on one purpose of metadata — to find "objects", "entities" or "resources" — and ignore others, such as using metadata to optimize compression algorithms, or to perform additional computations using the data. The metadata concept has been extended into the world of systems to include any "data about data": the names of tables, columns, programs, and the like. Different views of this "system metadata" are detailed below, but beyond that is the recognition that metadata can describe all aspects of systems: data, activities, people and organizations involved, locations of data and processes, access methods, limitations, timing and events, as well as motivation and rules. Fundamentally, then, metadata is "the data that describe the structure and workings of an organization's use of information, and which describe the systems it uses to manage that information". To do a model of metadata is to do an "Enterprise model" of the information technology industry itself.

Objective

Metadata provides context for data. Metadata is used to facilitate the understanding, usage, and management of data, both by human and computers. Thus metadata can describe the data conceptually so that others can understand them; it can describe the data syntactically so others can use them; and the two types of descriptions together can facilitate decisions about how to manage the data. The metadata required to effectively work with data varies with the type of data, their context of use, and their purpose. Often data providers will provide users access to a variety of metadata fields, which can be used individually or in combinations, and applied by different users to achieve different goals. These users can be human 'end users', or other computing systems.

When structured into a hierarchical arrangement, metadata is more properly called an ontology or schema. Both terms describe "what exists" for some purpose or to enable some action. For instance, the arrangement of subject headings in a library catalogue serves not only as a guide to finding books on a particular subject in the stacks, but also as a guide to what subjects "exist" in the library's own ontology and how more specialized topics are related to or derived from the more general subject headings. Metadata is frequently stored in a central location and used to help organizations standardize their data. This information is typically stored in a metadata registry.

These examples list metadata that describe particular digital entities. For clarity and consistency with some definitions of metadata, these examples are expressed with respect to digitized form of each entity, not data that is represented solely in a physical object like a book. In most cases, the examples illustrate the use of metadata to describe the entity's content (conceptually), how the entity came to be (provenance), and information necessary for the system to use it. The last set of information about system-related details is typically hidden from the user, but includes the internal file name, location, and creation/access times for the digital entity. Because the concept of metadata is specific to each situation—"one person's data is another person's metadata"—examples should be considered illustrative rather than absolute.

Examples of metadata regarding a book would be the title, author(s), date of publication, subject, a unique identifier (such as International Standard Book Number (ISBN)), number of pages, and the language of the text. Metadata unique to the electronic format includes usage (last opened, current page, times read) and other user-provided data (ranking, tags, annotations). System use metadata might include purchase and digital rights information for the content.

Digital images include both digital photographs, and images that have been created or modified on a computer. Metadata for a digital photograph typically includes the date and time at which it was created and details of the camera settings (such as focal length, aperture, exposure). Many digital cameras record metadata in their digital images, in formats like exchangeable image file format (EXIF) or JPEG. Some cameras can automatically include extended metadata such as the location the picture was taken (e.g., from a GPS). Most image editing software includes at least some metadata in the digital image, and can include content about the image's provenance and licensing.

Audio recordings may also be labelled with metadata. When audio formats moved from analogue to digital, it became possible to embed this metadata within the digital content itself. (Without any metadata, the digital content is simply a file containing the audio waveform.) Metadata can be used to name, describe, catalogue and indicate ownership or copyright for a digital audio file, as well as allow user characterizations of the audio content (ratings, tags, and other auxiliary metadata). Its presence simplifies locating a specific audio file within a group, through use of a search engine that accesses the metadata. The typical audio player or audio application on a computer relies heavily on metadata to provide user features.

As different digital audio formats were developed, it was agreed that a standardized and specific location would be set aside within the digital files where this information could be stored. As a result, almost all digital audio formats, including mp3, broadcast wav and AIFF files, have similar standardized locations that can be populated with metadata. This "information about information" has become one of the great advantages of working with digital audio files, since the catalogue and descriptive information that makes up the metadata is built right into the audio file itself, ready for easy access and use.

The HTML format used to define web pages allows for the inclusion of a variety of types of metadata, from simple descriptive text, dates and keywords to highly-granular information such as the Dublin Core and e-GMS standards. Pages can be geotagged with coordinates. Metadata may be included in the page's header or in a separate file. Microformats allow metadata to be added to on-page data in a way that users don't see, but computers can readily access.

Levels

The hierarchy of metadata descriptions can go on forever, but usually context or semantic understanding makes extensively detailed explanations unnecessary. The role played by any particular datum depends on the context. For example, when considering the geography of London, "E8 3BJ" would be a datum and "Post Code" would be metadatum. But, when considering the data management of an automated system that manages geographical data, "Post Code" might be a datum and then "data item name" and "6 characters, starting with A–Z" would be metadata.

In any particular context, metadata characterizes the data it describes, not the entity described by that data. So, in relation to "E8 3BJ", the datum "is in London" is a further description of the place in the real world which has the post code "E8 3BJ", not of the code itself. Therefore, although it is providing information connected to "E8 3BJ" (telling us that this is the post code of a place in London), this would not normally be considered metadata, as it is describing "E8 3BJ" as a place in the real world and not as data.

Markup

In the context of the web and the work of the W3C in providing markup technologies of HTML, XML and SGML the concept of metadata has specific context that is perhaps clearer than in other information domains. With markup technologies there is metadata, markup and data content. The metadata describes characteristics about the data, while the markup identifies the specific type of data content and acts as a container for that document instance. This page in Wikipedia is itself an example of such usage, where the textual information is data, how it is packaged, linked, referenced, styled and displayed is markup and aspects and characteristics of that markup are metadata set globally across Wikipedia. In the context of markup the metadata is architected to allow optimization of document instances to contain only a minimum amount of metadata, while the metadata itself is likely referenced externally such as in a schema definition (XSD) instance. Also it should be noted that markup provides specialised mechanisms that handle referential data, again avoiding confusion over what is metadata or data, and allowing optimizations. The reference and ID mechanisms in markup allowing reference links between related data items, and links to data items that can then be repeated about a data item, such as an address or product details. These are then all themselves simply more data items and markup instances rather than metadata.

Similarly there are concepts such as classifications, ontologies and associations for which markup mechanisms are provided. A data item can then be linked to such categories via markup and hence provide a clean delineation between what is metadata, and actual data instances. Therefore the concepts and descriptions in a classification would be metadata, but the actual classification entry for a data item is simply another data instance.

Some examples can illustrate the points here. Items in bold are data content, in italic are metadata, normal text items are all markup.

The two examples show in-line use of metadata within markup relating to a data instance (XML) compared to simple markup (HTML).

A simple HTML instance example:

Example

And then an XML instance example with metadata:

<PersonMiddleName nillable=”true”>*John*</ *PersonMiddleName*>

Where the inline assertion that a person’s middle name may be an empty data item is metadata about the data item. Such definitions however are usually not placed inline in XML. Instead these definitions are moved away into the schema definition that contains the metadata for the entire document instance. This again illustrates another important aspect of metadata in the context of markup. The metadata is optimally defined only once for a collection of data instances. Hence repeated items of markup are rarely metadata, but rather more markup data instances themselves.

Difference between Data and Metadata

Usually it is not possible to distinguish between (plain) data and metadata because:

1. Something can be data and metadata at the same time. The headline of an article is both its title (metadata) and part of its text (data).
2. Data and metadata can change their roles. A poem, as such, would be regarded as data, but if there is a song that uses it as lyrics, the whole poem could be attached to an audio file of the song as metadata. Thus, the labelling depends on the point of view.

These considerations apply no matter which of the above definitions is considered, except where explicit markup is used to denote what is data and what is metadata.

Use

Metadata has many different applications; this section lists some of the most common. Metadata is used to speed up and enrich searching for resources. In general, search queries using metadata can save users from performing more complex filter operations manually. It is now common for web browsers (with the notable exception of Mozilla Firefox), P2P applications and media management software to automatically download and locally cache metadata, to improve the speed at which files can be accessed and searched. Metadata may also be associated to files manually. This is often the case with documents which are scanned into a document storage repository such as FileNet or Documentum. Once the documents have been converted into an electronic format a user brings the image up in a viewer application, manually reads the document and keys values into an online application to be stored in a metadata repository.

Metadata helps to bridge the semantic gap. By telling a computer how data items are related and how these relations can be evaluated automatically, it becomes possible to process even more complex filter and search operations. For example, if a search engine understands that "Van Gogh" was a "Dutch painter", it can answer a search query on "Dutch painters" with a link to a web page about Vincent Van Gogh, although the exact words "Dutch painters" never occur on that page. This approach, called knowledge representation, is of special interest to the semantic web and artificial intelligence. Certain metadata is designed to optimize lossy compression. For example, if a video has metadata that allows a computer to tell foreground from background, the latter can be compressed more aggressively to achieve a higher compression rate.

13

Information Technology and Library Documentation

Practically, information technology is defined as the practices and procedures whereby the information processing requirements of the firm's operations are most effectively integrated into the managerial functions. Now industry has learned that electronic data processing and systems management can be severely limited without sufficient information.

In fact, in spite of the computer's almost unbelievable operational speed (micro-seconds and nano-seconds) the limiting factors are the input and output requirements. This input/output restriction places even more importance on information technology. For now, operational information must be planned with the ultimate objective of computer processing in the most efficient and effective manner.

It is not uncommon to find situations where three shifts of key punch operations are scheduled just in order to provide the computer operations with sufficient data for one 8-hour shift. There is one theory in management decision making that contends that what an individual manager will do in an organisation and the quality of the decisions depends on the quality and quantity of information furnished that individual. Information technology is the essence of effective systems management. As is discussed later in the text, the information flow into and out of the various subsystems determines the overall effectiveness of the systems operation.

Consequently, information technology is a double-directional concept. Information is planned and gathered as input for a system; the operational processing of that system then furnishes information output as needed by the other subsystems in the organisation's total system complex.

It is altogether appropriate, therefore, that information technology is classed as a discipline, for there are concepts and principles and practices of informational analysis to warrant the restrictions imposed by the discipline connotation. One of the inherent problems associated with information technology is that of restricting information flow.

Literally, many managements are simply inundated with paperwork, reports, and information data of all types. One firm became concerned with the number of management reports being prepared and held an elaborate management conference to analyse and screen each report in an effort to reduce the number by elimination or combination. The net result was an increase in the total number, with a monthly report on the reports being prepared.

Consequently, the real, more basic problem becomes one of determining what information the various subsystems managers do need in order to make sound decisions (processing). Because of the computer's capacity for processing data, information technology—i.e., information selectivity—has become a must in systems management. The basic approach to information technology is, by necessity, built around the management processes of planning and controlling via coordination. *Systems planning* is determining basic objectives and the course(s) of action necessary to achieve these objectives. *Systems control* is assuring that the plans are achieved and that the necessary replanning is accomplished. *Systems coordination* is the integration of the planning and controlling operations into a unified systems approach that considers and relates to all others subsystems in the organisation. Decision theory, an offshoot of Taylor's scientific management, is one tool that enables the systems analyst and management to implement concepts of information technology. Decision theory enables information needs to be programmed into three levels associated with the complexity of the system processing design.

These levels are normally considered to be:

(1) highly programmed decisions usually occurring at the lower levels in the organisation where the system processor is more routine and repetitive;

(2) semi-programmed decisions occurring at mid-management levels where exceptions and unusual circumstances are rare but do occur; and

(3) non-programmed decisions occurring at top management levels where considerable unidentified alternatives and analyses are frequently necessary.

Even at the non-programmed level of decision making, there are certain basic information needs that can be and should be programmed and made available for top management when and if needed. Decision theory, together with the discipline of information technology is a primary consideration and a limiting factor in the design and shape of an organisation's systems operations. The manner in which information is collected, analysed, and processed through the various subsystems, together with the managerial practices of delegation and authority will greatly influence the ultimate success of the firm in reaching its goals and objectives.

Computer technology, systems application, and scientific management have combined to foster certain sophisticated developments in information technology. Systems analysis and scientific management are the needs and computer technology is the manner in which this concept is implemented. Information technology embodies four operational techniques: source data automation (SDA), information retrieval (IR), data transmission (DT), and integrated data processing (IDP).

Source Data Automation (SDA)

The objective of SDA is to plan the information requirements so that when the data is first collected in the system it will be captured on a "machine usable form." Machine usable forms should agree with the input language for the computer system, or it will be necessary to convert the original SDA language to a machine usable language in a separate operation.

One of the more typical examples is the capturing of data (SDA) via punched paper tape from such sources as typewriters or cash registers and then converting this punched paper tape language into magnetic tape for computer systems input. While punched paper tape is acceptable as computer input, magnetic tape is much faster, thereby permitting a more efficient utilisation of the computer system. SDA normally assumes eventual computer processing. This is not necessarily so. The concept of SDA or, more simply *data acquisition,* is equally applicable for manual processing operations. The main objective is to systematise the processing system so that whatever data is needed throughout the system is acquired in the most efficient and useful manner as soon as possible. New developments in SDA include punched paper tape, optical character recognition, and magnetic ink character recognition. Punched paper tape was mentioned above, and is a very popular and common method of source data automation. Almost any electrical office machine can be adapted to produce punched paper tape as a by-product of its normal operations.

Certain data can be selected for recording on the punched paper tape, such as totals, sub totals, taxes, or department billings. Punched paper tape is compatible with most data transmission systems, and is an ideal arrangement for collecting data at remote points and then transmittng it to a central computer system for processing.

Optical character recognition (OCR). OCR is a relatively new concept in information technology. Technology itself has been the main reason for delaying the widespread use of OCR. Only in the last few years has OCR becomes economically possible for the smaller more routine data processing activities.

There are various techniques employed in the OCR field, but a typical arrangement involves photosensors reading the character (usually a typewritten or printed character, but more recent developments have successfully read handwriting), comparing this photosenthysis to a standard, and then recording the character in some predetermined machine usable language.

The typical speed of an OCR system is the reading and recording of about 2400 character per second. Some systems, too, can be programmed to select only key words, or to capture data that is located in a particular section of the form. OCR systems are most typically used by oil companies, utilities, and large credit card systems, where the information can be quickly recorded in account number with the amount involved posted by a machine used at the point of sale. As the technology permits more economic OCR systems, and as the systems professionals research more used of information technology, OCR promises to be one of the largest developing areas of computer and systems application.

Magnetic ink character recognition (MICR). MICR is quite similar to OCR, but it is different on two essential points. One difference is that MICR, depends upon the character being written by a special machine. This prohibits the data to be captured at its source, unless rather expensive equipment is utilised, and the point of sale or other initial recording transaction is altered considerably. The other significant difference is that the MICR characters are not actually read but the amount of magnetic ink used to print each of the character is sensed, and the magnetic force used to determine the value of that character. One of the largest users of MICR language is the banking system. The Federal Reserve System now requires all checks to be printed with the bank's identification code in magnetic ink so that the clearing house operations may be performed on mechanical equipment. An MICR sorter-reader can process up to 57,000 checks per hour. Large banks have begun using magnetic ink recorders to post the amount of each check, or the check itself, so that all remaining operations of accounting and customer statement preparation can be performed by computer processing.

Information Retrieval is a science within itself, the science of semantics. A more correct approach to information retrieval would be information storage and retrieval because the retrieval of information depends largely upon how and in what manner the data was stored in the computer system. There are at least three limiting factors imposed on information storage and retrieval techniques.

These are: (1) the thinking and verbiage of the original author, (2) the indexer who decides what details will be used in the storage, and (3) the researcher who must understand the manner of thinking and understanding of the author and the indexer. Information storage and retrieval involves indexing and storing vast amounts of data within the computer system and providing the methods whereby all or any part of the data can be recovered quickly in its original form. A concurrent problem associated with computerised information storage and retrieval is that the system works too effectively. It is not uncommon for a researcher to query the computer on a particular subject, and be furnished a list of hundreds of possible sources. It is akin to using the *Reader's Guide* in a library, and then painstakingly following up on each source listed under the desired topic.

The solution to this problem is more effective and scientific indexing and training of the researchers on how to phrase their inquiries. Then, too, some IR systems can be programmed to selectively search for key words, or key phrases, and evaluate the selection by a matrix formula thereby minimising the problem of word choices and connotative meanings.

Data Transmission

In fact, DT perhaps is the most important of all concepts dealing with information technology. Recent developments in the sophisticated use of computer systems equipment would not have been possible without concurrent developments in the transmission of data; i.e., machines talking to machines. Data transmission became a necessity with the large multiplant firms, geographical decentralisation, and the applications of very large scale computing systems in a central location. Many data transmission systems utilise inexpensive voice grade telephone circuits.

In fact, the Bell System was one of the pioneers in data transmission with the "data phone" to transmit punched card data. Recent developments in the data phone include provisions for punched paper tape and magnetic tape. The aim has been to achieve faster speeds of data transmission—speeds that approach normal computer input speeds, thereby eliminating the extra process and extra equipment of transmitting the data from a transmitter in a remote point to a receiver associated with a computer installation, and then storing the data for later input into the computer system.

Some data transmission facilities permit direct input-output transmission between two or more computer systems at different locations. The distance does not seem to be the problem, for data transmission is required even though the two systems are separated by only one floor of the building.

Integrated Data Processing

Notably, IDP is the cumulative concept dealing with all phases of information technology. IDP is concerned that the source data automation, the data transmission, and the information storage and retrieval processes are most efficiently and effectively coordinated with the computer's operating systems.

IDP is not limited to, nor reserved for, application with computerised systems. IDP originated with basic information technology whereby once the data was captured in the firm, by whatever means, the same data could be used many times in subsequent processing operations. Examples of noncomputerised integrated data processing include the sales order, billing invoice, shipping form, and inventory control record—all stemming from the original sales ticket. Integrated data processing is absolutely necessary for the total systems concept, and is quite essential for effective and efficient computer operations. IDP permits greater speed of information handling, contributes to the total systems complex, is highly efficient in reducing costs associated with information technology, and permits great accuracy since the original data is used many times without the data for each operation having to be transferred by human effort.

In fact, information technology is a vital element in computer and systems management, and it is one of the few operations almost totally under local management control. That is, it is the training, development, and the sophistication of systems analysis professionals that determines just what benefits, efficiencies, and advantages will accrue to the organisation from information technology techniques.

Automatic Data Processing

It is remarkable to note that two Rand researchers prophesied in a magazine article that:

> *...By 1970, devices for the automatic and semiautomatic entry of data into information systems will be common. Currently, identical information is often repetitively handwritten, then typewritten, then key-punched, and then transferred to magnetic tape for entry into a computer system. Transcription errors as well as duplication of effort inevitably result. Automatic devices, in contrast, accept data directly from the event creating the data, as, for example, when a telephone call automatically (without human intervention) creates and records information as to the origin, destination, and charge for the call. Semiautomatic devices minimize manual involvement in recording data and include, for example, credit card templates.*

What is SDA?

In short simple terms, Source Data Automation means applying automation techniques at the very spot where information originates. Going a little further, John W. Haslett, Shell Oil Company, states that SDA:... includes the introduction of reliable transaction data at the transaction source and the automatic movement of that data quickly and accurately through all accounting and statistical sequences to develop timely and reliable decision-making information.

SDA has been around for some time. Although the Ford Motor Company used to interchange the term SDA with IDP quite frequently in referring to its paperwork processing, most other management people until a few years ago preferred the term Integrated Data Processing. With today's emphasis on feeding data into computer systems, IDP has become SDA. Both terms call for taking source data at its point of origin and feeding it into an integrated system and out again with a finished product. With SDA a computer is usually involved, which reduces human intervention to a minimum. In private industry, after electronic computers began to demonstrate that they were not "gadgets" but management tools here to stay, executives such as Alan O. Mann began to reexamine the problems associated with data preparation:

> *It is apparent then, that these characteristics of industrial data lead us to seek integration. These factors make us conclude that our data processing is not yet integrated. Our data is not sufficiently timely. It is periodic, even though out actual operations are not. We hunt for pennies while thereby expending dollars. Our data is arbitrarily compartmentalised—even though it needs to be unitised to fulfil our company's avowed single purpose of manufacturing and selling its products at a profit. Herein lie the needs for integrated data processing.*

Advantages

The decision for choosing Source Data Automation techniques to resolve paperwork management problems can be supported by these advantages:

1. Elimination of repetitive operations through automatic reproduction of data at all levels of reporting.
2. Speeding up the processing of data through the mechanisation of source data at its *point of origin.*
3. Purification of data through controlled input and automatic movement of data.

4. Utilisation of personnel more effectively by reducing routine work, which in turn:
   (a) Enhances morale and
   (b) Encourages employees to apply their skills in an analytical rather than a clerical capacity.
5. Information availability to management on a more complete and timely basis because the use of pre-verified input media together with increased processing capabilities makes it more practical to record additional useful data at point of origin.

No difficulty usually exists in spotting an area where SDA technique might be applied to improve a work situation. Whenver there is duplication of effort, a growing rate of errors, rarely met deadlines, operations in the system which act as bottlenecks, too huge a volume of work for any manual processing, and many dollars spent continuously on overtime, then there is a need for SDA.

A Model System

Customers send in orders to the company by telephone, purchase order, or personal contact. Next, the expediter batches the orders in the most economical manner, and then gives them to a machine operator.

The operator goes to the files to pull our customer and product data which may be in the form of a deck of EAM cards, edged cards, paper tape, or magnetic tape or cards. A typical customer card will contain customer's name, address, credit rating, salesman's code number, customer code number, and other data. The product card might contain quantity, size, item name, unit price, and extended price for the quantity involved.

A SDA stored programme using a small computer would then perform these operations:

1. Print out transaction documents.
2. Computer, punch, and store required totals.
3. Compare cash totals for accuracy.
4. Fulfil billing requirements in the first writing of invoices.
5. Select out, punch, and communicate transaction detail summary data for central large-scale computer processing of sales and statistical reports.
6. Print out sales, stock level and control reports.

In milliseconds, a small computer can print out a combination invoice and bill of lading, plus other by-products.

Although the small computers serving as part of an SDA system perform yeoman service, they should not be confused with their mammoth big brothers which possess high speeds and huge memory capacities. Remember that the small computer has its limitations in memory, size, speed, flexibility, and in its inability to easily expand to a larger memory capacity. Nevertheless, it has its rightful place in SDA.

Many applications of SDA techniques can be found both in public and private management today. Perhaps one of the most far-reaching applications of SDA in the Federal Government will be that of adapting the Standard Form 50, "Notification of Personnel Action," to mechanised processing. Millions of these basic input documents are processed in the Government each year to show personnel actions affecting employees ranging from recording promotions to showing transfer of duty stations.

Charles J. Sparks, chief, Management Systems Division, U.S. Civil Service Commission, worked out the tremendously difficult task of getting acceptance from the hundreds of Federal agencies for the use of this new form. Sparks, writing in the *Civil Service Journal,* says:

> *To facilitate the use of ADP equipment and to achieve a greater standardisation of personal inputs, the Commission has revised this form (SF 50) in collaboration with agencies....... The form was also designed for possible future use on optical character recognition machines—that is, machines that will be able to "see" and "read". This is the first time in history that a standard form for government-wide use has been designed for Source Data Automation.*

On the local government level, SDA is being applied, too. In the State of California, unemployment insurance operations are largely mechanised. Claimants are issued an edge-punched identification card. When they file a claim, they present their card to a clerk, who types in the amount of the check. A benefit check is produced and at the same time a record is made on paper tape. At the close of the day, the local office sends the paper tape to a computer center elsewhere in the state for processing.

The very nature of the business requires 24 hour service. When only manual methods were employed, employees had to work overtime just to get orders out for the next day. The SDA system enables the company to eliminate its overtime costs and meet its customer demands.

SDA is not restricted to state-side organisations. In England, Shell-Mex & B.P., Ltd. made a study in which it found out that 85 per cent of its customers' orders came in by telephone. This in turn generated annual workloads of three million sales tickets, five million punched cards, and a quarter-of-a-million invoices!

To expedite the processing of this paperwork monster, a special electro-mechanical device was designed. It consists of a very large console containing hundreds of buttons, each having on it the name and address of a customer. Near the console is a panel for product input data. A clerk wearing earphones sits in front o the console. He takes a call, presses a button for the name and address of the customer, and then, at the most, presses another four buttons on the panel to record quantity, brand, day of delivery, and packing code. This action is recorded on paper tape for later processing.

Interchange of SDA Information

One of the most interesting aspects of SDA is the growing trend toward interchange of information between private industry and government. For example, the State of California encourages employers to file their wage records on magnetic tape for input into the state large-scale computer system. These records are then used in conjunction with other SDA-generated records, such as those mentioned earlier, *Data Processing* describes this trend in a recent article: Almost 30 large companies are now shipping a single reel of magnetic tape in place of hundreds of paper sheets to the Social Security Administration record-keeping headquarters each quarter. These firms use electronic data processing equipment to prepare payrolls, and the tape is a by-product.

Five major components usually make up an SDA system: SDA machines themselves, communications, data processing, and information retrieval equipment, and display devices.

No single piece of equipment stands alone. Together they make up an effective SDA system. Several characteristics of SDA machines are:

1. They are low in cost relative to more elaborate computer systems.
2. Because what they do and how they do it is generally easy to understand, little operator training is needed.
3. Basically, much of SDA hardware is nothing more than adaptions and modifications of office machines which have been around for years, including electric typewriters, adding machines, calculators, and accounting machines. These basic machines now have the ability to accept and produce input/output media as paper tape, edge-punched cards, and magnetic cards.

However, although these older machines play a very important part in SDA, the trend today shows a move toward newer and more dynamic methods. MICR, or Magnetic Ink Character Recognition as an SDA tool has proved to be very successful in banks where MICR numbers imprinted on checks are used to sort out checks to pertinent accounts.

Perhaps the technique offering the most to SDA's further growth is OCR—Optical Character Recognition. Although the Bureau of the Census was highly successful in developing a specially designed machines, FOSDIC, to optically scan data for the 1960 national census, progress in other areas of government has been slow, as it has also been in private industry. But it's only a matter of time before optical scanning techniques will greatly improve.

Data Handling

It is noteworthy that time and space are rapidly disappearing as barriers to the flow of business information. With the tools now available the question-answer-decision-reaction cycle, requiring the flow of data within the through the strata of a business organisation, can be about as fast as management wants it to be, even though the organisation components may be scattered throughout the world. Two of the tools which make this possible are data transmission and electronic data processing. Although data transmission predates electronic data processing by more than a hundred years, the blending of the two technologies is a relatively new art; a demanding one with few practicing specialists. Each of the various aspects of an information gathering, processing and transmission system—hardware, software, communication channels, forms, etc.—has its share of specialists. But the man knowledgeable in all phases of the blended technologies is still a rare individual.

Because the knowledge about telecommunications is "decentralised," the putting together of an information system generally requires a meeting of many minds. Technical minds must determine if what should be done can be done. Management decision-makers must decide if what can be done will be sufficiently effective to warrant the cost and effort involved.

Further complicating the picture is the virtually limitless choice of input/output equipment (terminal devices) available to the user. Devices most commonly used are those which handle perforated tape, punched cards or magnetic tape. But, computers are "talking to each other" in increasing numbers—nearly all third generation machines have this capability. Display/keyboard terminals, in which data appears on a TV-like screen, are becoming more common. Facsimile transmission is winning acceptance, although devices for this purpose are not numerous. Xerox Stewart Warner and Alden Electronics are in the market now.

Of course, all these devices require channels and converters, the basic ingredients of a communications link-up. Transmission channels most often used are either wire, microwave, or coaxial cable. Channels and converters usually are supplied by "common carriers" such as AT&T and Western Union. Service also is provided by General Telephone and Electronics and other "independents." The variety of the equipment and "grades" of channels available make it possible for a user to design two or three systems which will "do the job." How to choose which is best? The Bell System attempts to provide help in this direction by conducting seminars on a continual basis for top management and technicians form diverse industries. The criteria which Bell suggests as the basis for decision involve seven main factors: *Function* (what is the system supposed to do?), *distribution* (is the information coming from and/or going to multiple locations?), *volume* (are the messages long, short or both?), *urgency* (is the data needed immediately, within an hour, within a day, beyond 24 hours?), *language* (is the data in written form, spoken, graphic, in punched tape, punched cards or on magnetic tape?), *accuracy* (how critical is it that the data be error free? Would it be possible for example, to "read" a message if one word were misspelled?), *cost* (dependent upon all the other criteria and to be weighed in terms of benefits).

While all the criteria are interrelated, and a change in one most likely would require a change in others, speed and volume probably are the two which will provide the initial clue to system configuration, at least to channel requirements.

Channels can be "shared," used exclusively, used in a dual mode (to transmit and receive consecutively or concurrently), used for both voice and data, or for voice, data and facsimile—there are numerous possibilities and the price varies. So, too, does the price of the input/output hardware.

Another cost factor is the labour required to operate the hardware involved in the system, particularly the hardware involved in collecting data and converting it to machine language. And, the cost of the exchange media—paper tape, magnetic tape, film, paper—should not be overlooked.

One system employing different types of terminals and channels is that used by the United California Bank, which has more than 190 branches throughout California.

A satellite data center in San Francisco is linked via two high speed IBM 7711 data communications units and a 24-circuit channel to the larger data center in Los Angeles. The satellite center is equipped with two IBM 1460 data processing systems and Model 1419 magnetic character readers for capturing data from MICR (Magnetic Ink Character Recognition) encoded checks. The data center in Los Angeles has a 7074 computer.

Document Storage and Retrieval

[The] duality of knowledge has grown increasingly emphatic. In two centuries the store of information recorded about this world, its inhabitants and history has time and again doubled and redoubled. Since man's capacity to retain information within his own mind has shown little concommitant growth, the importance of knowledge of the second kind—of sources of information—has increased disproportionately. Fortunately, people have been bale to devise methods to supplement the ability of the individual human being to learn and remember where information is stored. Libraries and information centers, through the publication of reference works and indexes to their collections, immensely extended this ability, enabling the fruits of the pursuits of knowledge to be widely shared. However, in the familiar irony of success, discovery pyramided upon published discovery, until the flood of new information threatened in many cases to engulf the very institutions that provided the means for storing and retrieving it.

As the means for referencing current documents fell behind, the burden on the individual for locating and retrieving his own sources of information grew heavier. It became increasingly apparent that the technology that produced the information explosion would have to produce the means to effectively utilise it. First to nominate the computer as a candidate of the central library job of storage and retrieval was Dr. Vannevar Bush, himself nor a librarian but a renowned scientist, one time dean of engineering at MIT, head of the wartime office of Scientific Research and Development and advisor to the President on the establishment of government policy for the public dissemination of scientific information.

"There is increased evidence that we are being bogged down today as specialisation extends," he wrote in the July 1945 issue of the *Atlantic Monthly*. "The investigator is staggered by the findings and conclusions of thousands of other workers—conclusions which he cannot find time to grasp, much less remember, as they appear. Yet specialisation becomes increasingly necessary for progress, and the effort to bridge between disciplines is correspondingly superficial." His judgment of contemporary documentation procedures was that "professionally, our methods of transmitting and reviewing the results of research are generations old and by now totally inadequate for their purposes."

The Idea-Tracing Machine

Small and unreliable as it was in 1945, the electronic computer, in combination with microfilm and display devices, was seen as an important key to a more effective means of sharing knowledge in the future. Projecting from known technology, Bush foretold the development of an idea-tracing machine—memex, he christened it—from which future generations could rapidly retrieve all the ideas, opinions and findings recorded by previous thinkers on any particular subject. By the early 1950s, scientists and engineers by the hundreds had set to work on projects to improve the new computer. They succeeded in making it reliable, expanding its memory and learning to programme it, and they made enthusiastic predictions about its shortly replacing human labour. And the new computers (named Mark I at Harvard, ENIAC at the University of Pennylvania, 604 at IBM UNIVAC I at Remington Rand, and Whirlwind I at MIT) lost little time in demonstrating to the world their remarkable speed at performing complex computations and data processing operations. In the field of information sciences, these early days are remembered as "the period of high enchantment." Disillusionment followed upon the discovery that practical systems for mechanical translation or fact retrieval were not to be achieved as easily as originally supposed. Once the troublesome hardware problems were solved, so that electronic malfunctions ceased to be a distraction, the enormous complexities of language and ideas stood exposed as never before.

Teach a computer to analyse natural language? Never had the need for linguistic research presented it demands so urgently as when the gap between potential and immediately realisable computer usage revealed the inadequacies in theory, comparative studies and experimentation with language. Researchers experimenting with the construction of artificial intelligence systems were awestruck at the enormity of their chosen task. Would-be builders of translating machines endured the agonies reserved previously for poets. And hopeful documentalist discovered that replacing the human librarian was to be no simple matter.

The computer as a library employee seemed at first capable of nothing more demanding than the simplest of clerical task: preparing lists of holdings, keeping circulation statistics, and the like. But even while computers were maturing mechanically, while researchers were learning to overcome the early programming limitations and linguistic and mathematicians were working on the theoretical aspects of communication, the information explosion showed no signs of expending itself.

Diverse as the fields of application may be, the principles of documentation system design are essentially identical, whether the orientation of the collection is toward physics or medicine, law or economics and whether the documents take the form of bound books, single pages, drawings or microfiche cards. Likelwise, the system functions are parallel in almost all respects.

Whatever the content or form of the documents, the organisation responsible for providing information about them must collect them, analyse and represent their content in condensed form, classify, index, catalogue and announce them, and make the documents available with due speed, economy and convenience to the people who need them.

Similarly parallel is the recognition in many fields of the investment of intellect, time and economic resources required to bring the promise of fully automated information retrieval to fruition. Nevertheless, while information scientists continue to research and develop more versatile computer hardware, more sophisticated programming languages and better methods of system design, an increasing number of organisations are putting the best of modern technology to work now. To explore the potentials for information transfer which the new technology is thrusting open requires a closer look at the workings, the problems and the technological interfaces of document retrieval systems. The subsequent discussion attempts to put these matters into finer focus.

Truth in Labelling

If one probes somewhat into the intellectual underpinnings of document retrieval he finds that almost all systems—from the simplest to the most complex—are based upon the concept of the condensed representation, or label, which describes in short form the essential contents of a document. The condensed representation is the primary device for relating an individual's interest to a set of one or more documents in a collection.

Conventional libraries, for example, employ such condensed representations as subject headings, Dewey Decimal or Library of Congress classification numbers, book titles and abstracts to represent essential content. By referring to these devices, library patrons are able to select items which pertain to their interests. Traditional representations have served the needs of libraries well in the past and continue to be adequate and economical for small diversified collections.

Fro large general libraries and special libraries with sizable holdings in specific areas, electronic data processing equipment introduces the possibility of devising new forms of representation more suitable to machine processing. The problem is to make them as useful as traditional forms.

- How *does* one describe what a document is about?
- How can the representations be made so concise that descriptions of the entire collection can fit in a computer and yet be sufficiently informative for the user to judge whether or not a particular item pertains to his interest?
- Can a computer be programmed to read and represent a document automatically?

Questions of this nature stimulated considerable thought among the first generation of information specialists, and they devised numerous experiments to test the new ideas.

Several lines of research emerged from this activity. Some attempted to simulate traditional representations, such as abstracts, by means of computers. Other projects investigated new kinds of representations, such as term diagrams and ideographs—devices for "mapping" word and concept relationships. Most fruitful of the developments to date, in the sense of producing immediately applicable results, have dealt with techniques for indexing.

The index to a collection of documents is designated by today's information scientists variously as the "rime and central component in any information retrieval system," the "very heart of document retrieval," the "essential key to the document collection." It is the element that provides a common ground for a meeting of the minds of author, indexer and searcher—a meeting that necessarily precedes information transfer. Automation of the indexing process consequently merits consideration in some detail.

The indexing problem, from the point of view of indexer, searcher and designer of the indexing scheme, is essentially a problem of logic. How does the indexer describe the contents of a document; how does the searcher specify what he is looking for; how does the designer of the indexing language decide in advance how future users will state their information needs? Certainly such questions are not without precedent. As an activity associated with collecting documents, indexing is at least as old as the Great Library of Alexandria. Nor has the aim of indexing—to make a large body of facts as accessible to people as are their own memories—changed significantly in many centuries, although techniques have undergone a continuous, if gradual, evolution.

The influence of the computer has resulted primarily in the search for new ideas in indexing and the formulation of new techniques which take advantage of the computer's speed and accuracy. The problem that technology is asked to solve can be illustrated by reference to common experience. Most people have tried their hand at constructing and using an indexing language. Anyone who saves records of any kind—letters, receipts photographs, recipes—has had to devise a scheme for filing them if he hopes to be able to retrieve them conveniently at a later time.

Any document has an almost unlimited number of attributes by which it might be described. Deciding which are the most relevant to future needs requires first of all some prior knowledge about the circumstances under which the document is likely to be used, and then the construction of a logical bridge between the act of indexing and the act of searching.

The Language of the Index

The vocabulary of index provides the bridge building elements. Libraries and information centers today employ three types of indexing languages: classification, subject headings and key term vocabularies controlled by special thesauri.

Idea Classification

The problem of dividing all the territory of knowledge into interrelated fields or categories of knowledge is one with which philosophers have wrestled for over two millennia. Indeed, classification schemes propounded by Aristotle in the 4th century B.C. have outlasted all the other schemes that ever were and are ever likely to be. The influence of his "categories" can still be seen in major classification schemes adopted today.

The classification of ideas provided an early framework not only for philosophical thought, but also for organising collections of documents—stone tablets, scrolls, books, etc.—by category subject matter. Through recent centuries, as human endeavour kept adding to the store of documents and to the depth and detail of information it became necessary to describe ever-finer subdivisions of the categories. Sometimes it made better sense to begin again with a whole new order, and two systems that did—the Dewey Decimal and the Library of Congress classifications—greatly improved the organisation and indexing practices of the nation's public libraries.

A detailed and comprehensive classification scheme, in itself a beautiful monument of logic, could be embroidered upon and refined indefinitely. However, as the orders of indentation increase, the system as a language for the retrieval of ideas beings to "break down" or lose its usefulness. The problem with using classification exclusively to index by is, of course, that few documents fit whole and intact into very narrow categories.

This creates a dilemma first for the indexer, who must decide to which classification category the document belongs. He can only hope that the potential user of the document will think to look for it in the "right" category. And the user, trying to outguess the indexer, confronts an even greater problem.

Subject Headings

Subject headings differ from classification schemes in being mutually exclusive. Whereas classification terms are related in a hierarchial scheme, subject headings are — or are usually intended to be — uniform in depth. All conventional libraries index their books by subject headings, a fact that attests to the viability of this concept. Nevertheless, subject headings exhibit the same major disadvantage as classification schemes—namely, the ambiguity inherent in the assignment of items to unique categories.

To compensate for this shortcoming and to make it easier for patrons to locate the information they desire, libraries have developed elaborate cross-reference systems. Ideas that are commonly associated are brought together by multiple catalogue cards or "see also" references. The latter provide the searcher with clues as to where else in the card file he might find information pertinent to his interests.

Again, though, as the size of the collection increases within any subject area, headings have to be more specific, duplications proliferate, and the system grows cumbersome and annoying to use. Ractical difficulties, particularly in the retrieval of highly specialised technical literature, led to the search for new and more flexible methods of indexing. The first truly innovative ideas of the century were advanced in the early 1950s. Competitive with each other as well as with traditional methods, they aroused an early controversy which has still not entirely subsided. The hottest winds revolved about systems featuring uniterms, descriptors and key words in context—and about their principal authors and proponents: respectively, Mortimer Taube, Calvin Mooers and Hans Peter Luhn.

Key Term Vocabularies

If any one characteristic distinguishes the unconventional systems from those use by traditional libraries, it is probably the matter of focus. Traditional methods fit incoming documents into preconceived categories (derived, to be sure, from centuries of experience with books and the various subjects around which they are customarily organised). Systems based upon uniterms, descriptors, key words or their relatives take as their starting point the information in a document itself. The information content of the document suggests the appropriate vocabulary—or key terminology—by which it is indexed.

The uniterm concept grew out of research by Dr. Taube and his associates at Documentation Incorporated to develop a method for indexing the heterogeneous collection of the Defense Documentation Center. The essence of their technique, which they called the Uniterm System of Co-ordinate Indexing, consists of analysing a document to select as indexing terms those words that best represent the content of the document. Depending upon the depth of indexing required, an average document might be assigned as few as two or three uniterms or as many as twenty or more. Each term by which a document is indexed provides an access point to the information the document contains. Conversely, each uniterm in the system provides access to all documents indexed by that term.

To retrieve information, one searches for documents indexed by the combination of terms representing the content of the information desired. Thus a document on the subject of "management information" would be located by coordinating the terms "management" and "information." The searcher might expect a document whose accession number was filed under both terms to deal with the coordinated subject of "management information." (The fact that it might also indicated a document on "information management" is a shortcoming of the original uniterm system which several modified versions get around by "pre-coordinating" terms likely to produce ambiguities). In addition to providing flexibility and multiple access to information, systems based on uniterms claim the advantage of a certain economy of operation. If indexing terms are lifted directly from the text of a document, people without extensive library training can be employed as indexers.

Systems based upon descriptors require more analytical indexing, but claim the advantage of a smaller, more easily controllable vocabulary. Descriptors are broader terms, descriptive of particular fields; they are derived by analysing a collection of related documents to determine the set of key terms sufficient to cover the field. As in uniterm indexing, multiple access to a document is provided by assigning to it all the descriptors related to its information content.

Control in both systems is achieved by constructing a system thesaurus—or list of all terms used to index the collection together with their synonyms. The thesaurus serves to relate terms of near similarity and standardises the indexing vocabulary.

As originally developed, both systems were operated manually. In the case of uniterms, for example, coordination referred to actual physical coordination of document numbers entered on matching columns of different vocabulary cards. Even so, the wide adoption of key terms systems was due to the fact that they were obviously suited for automation. The search and compare operation can be performed very rapidly by the computer. Given a list of index terms of computer can locate and print out in a few seconds the titles, authors and other relevant bibliographic data on all documents indexed by those terms.

Many of the variations suggested to expand key term indexing utilised the computer to keep track of the additional information. A number of information scientists sought to increase the pertinency of key terms by appending to them indicators of semantic or syntactic relationships: *roles* to indicate which term was on the giving and which on the receiving end of the action; *links,* denoting sequence or conceptual relationships; *prefixes* to specify generic levels; and numerical *suffixes* to indicate the relative importance of the key term in representing the content of the document.

The Keyword-in-Context (KWIC) concept pioneered by the late Hans Peter Luhn attempts to make the computer go a step beyond search and retrieval.

His "auto-abstracting" programmes have the computer select, by statistical methods, the significant words in an article. The computer then prints out the sentences with the highest density of these words. The words surrounding the key words act as modifiers. Seeing the key words in the context of their use helps the user to judge whether or not the article will be of interest to him.

As developed by Luhn and subsequently by follow information specialists, the original KWIC ideas have found two divergent applications.

A number of researchers have continued to experiment with statistical methods of analysing the text of a document to determine its subject content. Their long term aim is to programme the computer to act as indexer. Underlying these techniques is the assumption that the author of a document, consciously or not, reveals the key concepts in his paper simply by naming them an above-average number of times. If it were possible to develop a model of expected use frequency of all terms, the computer could count the actual word frequencies in any particular document, compare results with the model, statistically analyse the apparent differences, and with this data compute the document's proper indexing terms.

Statistical techniques have already achieved partial success toward this goal in cases where the experimental collection of documents was limited to a narrow range of subject matter. Whether or not the techniques are extendable to broad-based collections is still a moot question. Meanwhile, however, techniques growing out of experiments in machine analysis of natural text have made computer aided human indexing a present reality.

The second application of KWIC techniques emphasises the rapid listing capability of the computer. What are generally referred to as KWIC indexes are simply lists of document title terms (no ands, ifs, therefores, etc.) KWIC indexing works on the premise that a document title is a good indicator of document content. In the case of scientific articles, this premise is generally true, and KWIC techniques are widely used to construct fast and "quick and dirty" guides to technical reports and current periodical literature.

A Great Library at Your Fingertips

Of all the potential advantages of storing information from and about documents in machine-readable form, one that will have particularly striking impact on information gathering customs of the future is the potential of someday placing the contents of the greatest libraries in the world at the fingertips of people in their own offices or homes. While full realisation of this dream still lies a considerable way into the future, prospect for man-machine communication making bibliographic reference files available to remote users has already arrived. Users of the pilot SDC ORBIT system and the INTREX project at MIT, for example, are able to search library files by teletype. Cooperative projects being planned or implemented by other libraries include capabilities for one searching the contents of the other libraries include capabilities for one searching the content of the other by remote computer query.

The technique which makes this mode of operation possible is called on-line or interactive computer use. On-line techniques enhance computer utilisation by enabling people to control their own programmes directly, at the time the computer is processing them. This mode differs substantially from off-line usage, in which a user, ordinarily a programmer, turns his programme over to a specialist to process on the computer, receiving at some later time the results of the computer processing. With on-line usage, the user sits at a terminal device of some kind, usually a teletype machine or a cathode ray tube scope, and tells the computer directly—by typed commands—what to do with the data stored in its memory.

In the case of a document retrieval system, as developed at the present time, the user can formulate his search request at the teletype machine, specifying documents with a given list of characteristic—index terms, dates, subject areas, etc.—and receive a list of all documents in the collection that match the given description. Not only does such a system save the searcher time in going to the library and searching the card catalogue, but it gives him information above and beyond what he would get from the catalogue, thereby enabling him to make his search for more specific. The favourable results being reported about pilot man-machine systems lead to the expectation that opportunities for more people to deal directly with machines will expand rapidly. This expectation is further enhanced by recent progress in overcoming the two outstanding disproportions in the man-machine working partnership: the mismatches of speed-cost and of language. To resolve these mismatches between machine and human abilities, programme developers have brought forth, respectively, time-sharing techniques and interactive languages. A time-sharing system allows many users to share virtually simultaneous access to a single large computer. In the bargain, they share the cost of operating it. Concurrently, newly developed interactive languages are bridging the language barrier. "User-oriented," the new languages allow the non-programmer to communicate with the computer in a limited but growing number of natural English phrases.

The Information Machines

At the equipment end of the documentation system, many other technological advances just appearing on the horizon promise to have significant effects on the ease and pleasure and economy of retrieving information from future systems. For one thing, the practice of borrowing and lending is likely to decline as new copying machines continue to argument the quality and speed of reproduction, while simultaneously lowering its cost. Last year sales of copying machines topped $500 million. Increasingly, in industry, government, schools, wherever the same material has to be read by a number of people, the individuals are getting their own personal copies—markable, disposable or storable in personal files. If adequately protective copyright laws are worked out, copy machine manufacturers predict that books will be sold in vending machines long before the end of the century.

A second factor that will help to bring that possibility about stems from recent success in the development of micro imagery techniques. (Although the idea of reducing photographs for storage and subsequently enlarging them for viewing dates back nearly a century, it took the information "explosion" of the twentieth century to give the idea solid business appeal). Today, with a size reduction of 48,000 to 1, the entire Bible has been encoded on a tow inch square of plastic. The reduction process is expensive at present, as are magnifying devices for viewing. But prototypes exist, and predictions that entire library collections will one day fit into the space of a small box no longer seem absurd. At the more manageable reduction proportion of 20 to 1, the present federal standard, an increasing number of documents are being stored on microfilm, with resultant economic advantages in reduced storage space, transportation costs and reproduction. (To copy a microfilm record of 20 pages costs a few pennies more than duplicating one standard pages of text, but significantly less than copying 20 paper pages).

The major producers of copying equipment are also expanding rapidly into the facsimile transmission business. In contrast to the projection of a major encyclopedia publisher who foresees a future in which every family owns a pocket-sized set of encyclopedias, the transmission-oriented companies are predicting a day when a single set of reference books will serve an entire community. In their view, standard telephones of the future will be equipped with screens; whenever a person desires reference information he will be able to dial the local information utility and quickly get a display of the appropriate pages from documents pertinent to his interests. If he wants a permanent record of any pages, he can switch the signal from the display screen to his home printer and have an adequate reproduction in a few seconds.

The mechanical equipment required for such a system is well within the present state of the art. In fact, optical scanners have already been built that, working on principles similar to those of the familiar TV camera, can transmit facsimiles of anything over telegraph and telephone lines.

Pacing factors in the progress toward feasible electronic display systems are threefold: the availability of communications lines, the cost of microwave transmissions and the development of easy-to-use input/output equipment.

Within the next decade or two, laser pipelines and satellite rebroadcasting stations are expected to be well along the way toward solving the first two problems. And even now developers of consoles through which the human communicates directly "on-line" with the computer are adding rapidly to the range and flexibility of input/output devices. Available today are tele-typewriters that permit communication through the medium of typed symbols and cathode-ray screens using the medium of light. In the latter case, letters, numbers or line drawings can be displayed by the computer, changed, erased or redrawn by the human hand wielding a pen that emits light instead of ink. Under development in the laboratories are super models which add to present devices the capability to sense and display both sound and colour.

What potentials for the process of information transfer will be created by the new dimensions in hardware programming and systems techniques are still conjectural. The availability of advanced equipment and programming languages will not only make document storage and retrieval more feasible, but will help to create the pressures of demand which are the starting forces for implementation.

Focal Point: The Information User

In the total context, however, it is important to keep in mind the fact that acquiring the components and putting them together in an efficient configuration are two different matters. A collection of advanced components no more constitutes an advanced system than a set of strong inks forms a strong chain. At least one other necessary condition must be satisfied. As SDC's study team for the federal Committee on Scientific and Technical Information phrased this requirement: "The system must provide a *needed facility* for its users through which they can attain objectives that otherwise are attainable less economically, or with greater difficulty, or not at all."

The whole point of collecting documents in the first place is to make their contents available to some user or group of users at a future time. From a utilitarian standpoint, the collection is valuable only to the extent that the serves this purpose. Therefore system design efforts have to be directed toward satisfying the information needs of the future system users.

To get a better hold on what these needs really are, a comparatively new branch of research is focusing attention on "users studies." Through interviews, observations and theoretical analyses researchers are attempting to measure and relate such variables as the factors that influence user satisfaction with a library and to evaluate present methods for indexing and retrieving information.

To a certain extent, studies of how people use information overlap with investigations directed toward the fundamental nature of information transfer — or communication—through the medium of the written word.

Philosophical and semantic problems are no more absent from these fields of inquiry than from any others. Indeed, Dr. Carlos Cuadra of SDC, in the introduction to the *First Annual Review of Science and Technology,* observed that "There is not, truth to tell, even clear agreement on what the word `information' itself means and particularly on whether it implies a creative act of the intellect or a commodity that can be embodied in documents, transported and exchanged.

"Distressing as this ambiguity and lack of agreement may be," he continues, "they need not and do not preclude a constructive review of topics of current interest to users, designers and students of information systems and services." Neither do ambiguous terminology and a certain amount of grouping for directions deter an increasing number of individuals of diverse professional background from joining forces in an interldisciplinary attack on the problems of documentation.

Applying to documentation science the concepts, methods and experimental findings of their own specialised fields are psychologists with theories on cognition, sociologists investigating patterns of communication, philosophers formulating theories of meaning, philologists and linguist analysing language, mathematicians developing models of information storage and retrieval, electronic engineers producing new devices for information transmission, computer engineers developing the hardware and programmers the software of data processing, librarians contributing their long experience in document handling systems, and system analysts and designers defining the goals and operations of information management.

Their successful endeavours will hasten the day, foreseen by Dr. Bush, when lawyer, historian, chemist, physician and even private citizen can sit at his memex-type desk and construct trials of reasoning "through the enormous mass of the common record."

Each step toward this ultimate system, by lifting from us slightly the burden of having to discover for ourselves the documents which are the sources of knowledge, enables us to devote more time and mind power to the discovery of the knowledge *stored* in the documents comprising the common record of man.

Documentation and Computer Output Alternatives

The earliest alphanumeric microfiche recorders were intended to replace line printers in applications requiring the timely production of voluminous printed reports from machine-readable data. Such impact printer replacement applications, remain the largest, and most straightforward, market for COM. For the production of circulation lists, serials holdings lists, union catalogues, and other batch-processed reports from machine-readable library data bases, COM recorders are invariably faster, generally more versatile, and often more economical than impact printers.

Recording Speed

The most widely-used line printers are impact-type output devices featuring a printing chain consisting of characters represented on embossed metal slugs linked in an endless loop. The chain rotates horizontally at high speed. Paper and an inked ribbon move vertically between the chain and a bank of hammers equal in number to the available print positions. As characters on the chain rotate into their appropriate print positions, individual hammers are activated to impact the paper, thereby driving it against the embossed metal characters. Since several hammers are activated simultaneously, the device appears to print entire lines at one time, hence the name. Other line printers employ drums rather than printing chains. Basic line printer operation is well-described in a state-of-the-art review by Wieselman (1977). Despite recent interest and advances in alternative printing technologies, line printers remain the most widely-used paper output device.

The rated, or maximum speeds of line printers have increased over the years to the current high of approximately 2,000 lines per minute. Actual speeds depend on several factors, including the size of the printable character set, and may prove significantly lower than rated speeds. The popular IBM 1403/N3, for example, is rated at 1,500 lines per minute but actually prints about 1,100 when equipped with a sixty-four character chain. The effects of larger characters sets are discussed later in this section. Multiple copies are generally produced on four-or five-ply interleaved carbon form sets. For copies in excess of form set size, the print programme must be re-executed. Five-ply paper may reduce the number of re-executions required to produce the desired number of copies. Four-ply paper, however, is generally preferred for legibility although the fourth copy itself may be of questionable quality.

The combination of low actual printing speed and multiple copy production via carbon paper can result it excessively long printing times for reports intended for distribution to many use-points. A two-hundred page, computer-processed list of items in circulation, to be distributed to twenty use-points in a multi-branch academic library, will require five printer runs on four-ply paper. Using the IBM 1403/N3 line printer described above, each run would require twelve minutes of printing time, plus time for decollating, bursting, and binding of printed copies. Well over one hour would be required to complete the entire job. By way of contrast, COM recorder rated speeds range between 10,000 and 50,000 lines per minute. Although actual speeds vary with page lengths and the method of input preparation, throughput rates of 15,000 to 20,000 lines per minute are realistic for the faster recorders.

A Kodak KOM-80 or Bell and Howell 3700 COM recorder, for example, will convert circulation data on an appropriately-formatted magnetic tape to latent images of two hundred pages of human-readable information on microfilm or microfiche in less than two minutes. Allowing time for microfilm processing, diazo or vesicular duplication, and any additional output preparation—such as the insertion of microfilm into cartridges—an in-house COM recorder could produce a circulation list, ready for distribution to twenty use-points, within half an hour. Even more dramatic throughout improvements can be achieved with the COM recorder/processors described in the preceding section. With its greater speed, a single COM recorder like the KOM-80 offers output capacity equivalent to about a dozen line printers—without a twelve-fold increase in cost. COM recorder speeds greatly exceed the capabilities of the Xerox 1200 Computer Printing System, an electrostatic printer rated at 4,000 lines per minute, and compare favourably with the IBM 3800 and Honeywell Page Printing System, two non-impact paper-output devices with printing speeds in excess of 12,000 lines per minute. In replacing line printers with COM recorders, computing centers and service bureaus translate increased recording speed into cost savings which can, in turn, be passed on to libraries and other customers in the form of lower output charges.

Economy

Several libraries have reported substantial cost reductions in the conversion of line printer reports to COM. Anderson (1973) describes such an application at the lost Angeles Public Library, where a 22,000 page patron directory required twelve printer runs to produce seventy-one distribution copies. Conversion to COM saved 82,000 dollars in the first year with projected subsequent annual savings in the 100,000 dollar range. While few library applications are so large proportional savings have been reported by Simmons (1975), Stecher (1975), Buckle (1974), Spencer (1973), and Buckle and French (1971).

The several factors that influence the cost-effectiveness of COM applications have, however, seldom been clearly delineated. To set anticipated COM cost savings in perspective. The application requires twenty distribution copies of a 200 page report to be produced fifteen times monthly. The cost comparison assumes paper output prepared on four-ply carbon interleaved forms by an IBM 1403/N3 or equivalent line printer equipped with a sixty-four character print chain. The printer is operated by an institutional or commercial computing center or service bureau at a charge of fifty dollars per hour, including decollating and bursting of output. Four-ply paper is priced at thirty dollars per thousand sheets.

Leaving aside discussion of the appropriateness of the microformat and reduction, the analysis of COM costs assumes the use of a service bureau equipped with a minicomputer-controlled COM recorder capable of creating 24:1, sixty-three page microfiche from a library-supplied print-tape. The cost per frame is 2.5 cents. Partial fiche are billed at the rate for sixty-three frames. Duplicate distribution sets, each consisting of four vesicular fiche, are priced at one dollar per set ($.25 per fiche). A modest charge is include for the preparation of a print-tape on the library's host computer. While the recording costs given in this example are realistic, they are subject to considerable local variation and should not be taken as a measure against which libraries can validly compare the cost they incur for similar services. Some libraries may pay a higher per-frame charge for preparation of an original COM fiche but a lower price for duplicate fiche.

The intemisation of COM costs includes a charge for microfiche display equipment, lamp replacement, and related maintenance. The analysis assumes the purchase of twenty high-quality, desk-top microfiche readers at a price of 225 dollars each. The total purchase price of 4,500 dollars is conservatively amortised over a three-year useful equipment life.

In this example, COM's substantial cost advantage is a factor of report length, frequency of updating, and the number of required distribution points. *As a general rule, COM will offer a substantial savings over line printer output for long reports, updated frequently for distribution to many use-points.* Line printer costs exceed COM costs beyond three updates per month. The cost differential widens rapidly with increased update frequency. At five updates per month, COM offers a 30% cost reduction. At ten updates per month, the cost reduction potential increases to 47.2%. At thirty updates per month, COM reduces output costs by 58.3%. This example assumes that the two other determinants of cost-effectiveness—report length and number of distribution points—remain constant at 200 pages and twenty copies respectively.

Line printer costs exceed COM costs where the number of distribution points reaches four. As with update frequency, the cost differential widens rapidly as the number of distribution points increases. At five distribution points, COM offers a 33% cost reduction. Cost reduction potential increases to 45% at ten distribution points and 59% at thirty distribution points. As indicated above, it is assumed that report length and update frequency remain constant at 200 pages and twenty times per month respectively.

Assuming that the number of distribution points and update frequency remain constant at twenty use points and fifteen times per month, line printer costs exceed COM costs for reports longer than about fifty pages. The longer the report, the more the comparison favours COM. At eighty pages, COM offers only a 9.5% cost reduction. At 100 pages, the cost reduction potential is 32%. At 300 pages, COM reduces output costs by 60.7%.

Output Quality

From the added-value standpoint, COM offers the additional advantage of greatly improved output quality at a significant cost savings. As noted, the third or fourth copies of a carbon-interleaved form set are typically of fair to marginal quality and utility. All COM duplicates, however, are made directly from the master microform and are of uniform quality.

Printable Character Sets

As noted in the introduction to this section, COM recording offers line printer users the advantage of increased output versatility, especially typographic versatility. Most line printers are equipped with a standard print chain of about sixty-four characters, including the upper-case alphabet, numeric digits, and selected punctuation symbols. This standard printer character set may prove unacceptable for library catalogues and other applications requiring the recording of bibliographic data. *Books: A MARC Format* (Washington, D.C.: Library of Congress, 1970), defines a printable set of 175 characters. While extended print chains—the ALA print chain, for example—have been developed, any expansion of the printable character set necessarily results in a reduction in printing speed.

The IBM 1403/N3 line printer, rates at 1,100 lines per minute with a sixty character print chain, will print only about 560 lines per minute with a 120 character chain. The user must weigh the value of enhanced output appearance against this severe reduction in work throughput. Like line printers, all COM recorders will print the upper-case alphabet, numeric digits, and frequently-used punctuation symbols. The basic COM character set totals sixty to seventy characters. Most alphanumeric COM recorders offer an optional extended set of ninety to 128 characters, including the lower-case alphabet and additional special punctuation and mathematical symbols.

The 128 character set is generally considered the minimum required to produce library catalogues and similar bibliographic products intended for patron use. Spencer (1973) emphasises the importance of upper—and lower-case output in overcoming the reluctance of COM users in public and academic libraries. The basic characters set furnished with the Cal Comp 2100 Series COM recorders corresponds to the IBM sixty character PN print chain, but an optional extended set of 136 characters includes the upper and lower case alphabet, six diacritical marks, twenty-four special characters, and sixteen European characters.

There is a trend toward extended character sets in newer alphanumeric COM recorders. In some units—the 3M Beta COM 700H and 700S, for example—the extended character set is standard. The DatagraphiX 4550 and 4560 feature a standard set of 128 characters expandable to 160 and 190 characters respectively. By way of contrast, the older DatagraphiX 4360 could print only sixty-four characters. Most COM recorder manufacturers will create one or more special symbols to customer order.

Both the Library of Congress and the New York Public Library have worked with COM service bureaus to develop extended character sets containing special diacritical marks and other symbols essential to the recording of bibliographic data in a large research library. Malinconico (1976, 1977) provides an excellent discussion of the nature of these extended character sets. The ease with which special symbols can be created, as noted in Section Two, depends on the method of character generation employed in the recording process. Character set changes or additions in DatagraphiX alphanumeric COM recorders require modification or replacement of the character-forming matrix located in the neck of the Charactron™ CRT. Character set expansion in dot matrix recorders in necessarily limited by matrix size—the greater the number of available light points, the greater the character-forming capability. The Memorex 1603, with its five by seven dot matrix, will print only sixty-four characters. The Quantor 105, 3M Beta COM 700S, and Bell and Howell 3700 employ a larger six by nine or seven by ten matrix to produce extended character sets. Character set expansion in stroke-generation alphanumeric COM recorders, such as the Kodak KOM-80 or 3M EBR, is technically simple, requiring a hardware change consisting of a minor modification of character-generating circuitry. Graphic COM recorders, like the Information International FR-80 or Cal Com 1675, also create individual characters by stroke-generation from pre-stored definitions. The FR-80, for example, stores from 128 to 242 characters definitions. As in stroke-generation alphanumeric COM recorders, these character definitions are represented in hardware, but in graphic COM recorders, an essentially unlimited character set can be generated through software modification. The generation of characters through software is, however, much slower than hardware generation.

The 3M EBR will print fifteen Greek symbols useful in mathematical applications, but large research libraries and smaller specialised collections may require entire non-Roman alphabets. The Cal Comp 2100 and DatagraphiX 4500 Series COM recorders offer optional Japanese Katakana character sets Chart II. DatagraphiX also offers a Cyrillic character set and will create Charactron™ matrices, to customer order, for virtually any language. Com manufacturers doing business in Eastern Europe and the Middle East have produced recorders with Arabic and Farsi character sets.

As might be expected, the increased cost of the hardware and software required to develop the extended character sets essential to the printing of bibliographic data necessitates higher prices on the part of service bureaus equipped with such special COM recorders. Malinconico (1977) cites frame prices in the range 4.5 to 9.3 cents for extended character set work. Note that, as described above, the extended print chain decreases line printer speed by a half and doubles printing cost. COM costs, however, increase in only a relatively minor area—the production of COM master fiche. The cost of print-tape preparation, fiche duplication, and display equipment remain unchanged. Greater savings would be realised with increases in report length, update frequency, the number of distribution points, or the size of the character set to be printed.

Type Face, Size, and Intensity

A primary goal in COM type face design is to preserve legibility, often through several generations of duplicates, while striving for compatibility with optical character recognition (OCR) equipment. While there is no standard COM type face, the National Micrographics Association (1976) recommends, and many COM manufacturers employ, the European Computer Manufacturers' Association's OCR-B Alphanumeric Character Set, which is also available in an IBM Selectric element for typing source documents. Other popular sans serif type faces include Gothic, used in the Bell and Howell 3700 and 3800 COM recorders, and the NMA Microfont, one of three type faces that are standard and interchangeable with the Information International FR-80 recorder. Where typographic quality is essential, the Information International COMp80, an enhanced version of the powerful FR-80 designed for rapid and economical photocomposition of lists subject to frequent change, will print the three COM type faces offered with the FR-80; additional Roman, Gothic, Italic, and utility type faces commonly used in technical publications; and over three hundred graphic arts type faces. COM and utility type faces are created by the minimum number of strokes necessary to shape individual characters.

Graphic arts type faces are painted as a series of vertical strokes. Recorder software permits the interchange of type faces within a single microimage. The use of graphic arts type faces, however, greatly reduces recording speed. While the simplest alphanumeric COM recorders, like their line printer counterparts, can print characters in only one size and intensity, the 3M Beta COM 700H will print the Times Roman type face in four intensities. The Bell and Howell 3700 and 3800 will record characters at fifteen per cent larger than regular size. Users of the Kodak KOM-80 can select regular, bold, italic, or italic bold characters. Graphic recorders again offer the greatest type size versatility. The Applicon AP75 Micrographic Plotter, for example, offers an optional hardware character generator that will print eight character sizes, from six to thirty-two points. The Information International COMp80 will print graphic arts characters in sixty-four sizes from four to thirty-two points. Through software, sizes can be varied within a microimage—an important feature that permits, for example, the printing of the main entry portion of catalogue data in one size and the collation and tracings portion in a smaller size.

Page Formatting

As noted earlier, the most prevalent COM page format emulates an eleven by fourteen inch computer printout page consisting of sixty-four lines of up to 132 characters each. Certain COM recorders, however, permit modifications in this basic format. For greater information compaction, the number of lines per page can be increased to seventy-two by the Cal Comp 2100 Series COM recorders; to eight-six by the Bell and Howell 3700; to eighty-eight by the Kodak KOM-85 and DatagraphiX 4500 Series recorders; or to 102 by the Kodak Komstar recorders.

The number of characters per line can be increased to 160 by the Bell and Howell 3700 and DatagraphiX 4500 Series COM recorders. The Kodak KOM-85 will record 172 characters per line.

When equipped with an optional five by seven matrix, the Kodak Komstar is capable of recording 207 characters per line. Alternatively, line lengths can be reduced to eighty characters, producing the equivalent of an 8.5 by 11 inch document image and increasing the number of images on a standard microfiche to ninety-eight (in seven rows and fourteen columns) at 24:1 effective reduction; 325 (in thirteen rows and twenty-five columns) at 42:1; and 420 (in fifteen rows and twenty-eight columns) at 84:1. At 24:1, the 8.5 by 11 inch imaginary document results in a COM microfiche format that is compatible with the NMA standard for source documents.

For 16mm roll microfilm applications, the 3M EBR has a variable frame advance that allows users to significantly increase information compaction by reducing the gap between frames. When imaginary eleven by fourteen inch documents are recorded at 24:1 effective reduction, the normal advance leaves a gap of 5.4mm between cine-mode frames and permits slightly less than two thousand microimages per one hundred foot roll. By reducing the gap to.6mm, for example, an additional eight hundred frames can be recorded. In the comic-mode, the width of frames can be reduced to accommodate catalogue card images and other bibliographic data formatted in lines of less than 132 characters. This flexibility permits the expansion of library catalogues and other dynamic data bases without unduly increasing the number of rolls, cartridges, or cassettes the user must handle.

Within frames on roll microfilm, the 3M Beta COM recorders provide a number of special page-formatting facilities including proportional spacing, underlining, overlining, subscripting, and superscripting. The extensive formatting software of the Information International COMp80 permits both fixed and proportional spacing, ragged or justified right margins, automatic centering, and columnar printing.

COM vs. Online Systems

In addition to functioning as a line printer replacement for the production of batch-processed, computer-generated reports, COM-represents a viable, economical alternative to on-line systems in library applications without real-time information requirements. Where the real-time requirement is modest, COM can be utilised as one information storage medium in an economical hybrid system that combines microform displays with CRT or printing terminals. Where real-time information is essential, COM can provide continued access to important data in the event of on-line system failure.

COM as an Online System Alternative

There is an obvious and direct relationship between the accuracy of information and its value. In transaction-oriented applications—such as library circulation control, acquisitions, and cataloguing—the accuracy of information depends on its currency. In batch-oriented computer systems, data reflecting the occurrence of a given transaction is processed and reported some time after the transaction itself. In a batch-oriented computerised circulation system, for example, the machine-readable master circulation file is updated, and circulation lists printed, on a pre-determined schedule. In such systems, the currency of reported information depends on the frequency of file updates and report production.

Because batch-processed reports cannot reflect transactions occurring in the intervals between file updates, a circulation list produced fifteen times per month can be used with greater confidence than one produced five times. Because of the relative slowness of line printers, computer centers and service bureaus may not be able to schedule and guarantee the frequent and timely production of the very long reports characteristic of many library applications. In some cases, sufficient printer time may not be available. Veaner (1974) has further noted that libraries have rarely been accorded priority status by the computer centers that serve them. Academic computer centers in particular may be uninterested in the relatively straightforward, output-oriented applications characteristic of library automation. Faced with the inability to obtain printers output on an acceptable schedule, libraries requiring access to computer-processed data that is no more than a specified number of hours old may turn to an on-line, real-time information system. In such a system, a machine-readable circulation or other data file is maintained on magnetic disk, drum, or other direct access storage device. Unlike off-line systems which batch transaction data for processing against a master file at pre-scheduled intervals, *real-time* systems post transactions to the master file as they occur. File updating is simultaneous with the event rather than occurring at some time later than the transactions it records. Using a remote display or printing terminal, the master file can be examined on demand with assurance that the information it contains reflect the most recent transactions.

While on-line, real time systems offer the advantage of currency, with its implied accuracy, they can be very expensive. Although prices are dropping steadily, disk and drum storage still cost more than the magnetic tape used for master files in batch-oriented systems. Actual storage costs will vary from one computer installation to another and depend heavily on local accounting practices. Malinconico (1977) suggests a charge of $10,000 per month for a files of two million bibliographic records maintained in direct-access storage.

On-line access requires a terminal at every use point. Programming requirements for on-line, real-time systems are complex, with long development times. In many applications, printed reports are still required to provide information during times when the computer is down or otherwise unavailable. To minimise costs in applications where currency of information is important but access to up-to-the-minute information is not essential, COM can be used to produce batch-processed reports at more frequent intervals than would be possible with slower line printing equipment or other paper output devices. With their greater output speed, COM recorders can produce long reports several times daily, providing the user with information that is no more than a few hours old in the worst case. COM's demonstrable cost advantages, detailed above, permit significant increases in report production frequency without comparable increases in cost. Indicates that, for approximately the same expenditure, the hypothetical 200-page circulation report could be distributed to twenty use-points thirty times per month on microfiche or twelve times per month in paper form. COM report production at half-day, or possibly more frequent intervals, would not approach the costs of an on-line, real-time system for an application of this size.

While many applications can be satisfied with information that is no more than one-half day old, on-line real-time systems may offer superior performance in fulfilling certain information management requirements. On-line, real-time access to a machine-readable library catalogue, for example, provides the user with information about the most recently acquired and catalogued items. Batch-processed holdings lists, as noted above, cannot reflect items acquired and catalogued in the interval between report printings. Some libraries consider access to the most recent machine-readable records an essential feature of a computer-based catalogue. In such cases, COM can interface with on-line, real-time access in an economical hybrid system.

As an example, the heart of such a hybrid system would consist of a COM-generated catalogue reflecting the library's holdings at the time the catalogue was printed. New items are added to a machine-readable disk or drum file as they are catalogued. At pre-determined intervals, these new items are batch-processed against a master catalogue file on magnetic tape and a updated COM catalogue produced, duplicated, and distributed. Cataloguing information prepared in the interval between catalogue updates is fully accessible on disk or drum via remote terminal. The user seeking information about a particular item would first consult the COM catalogue. Failing to find it there, the disk or drum file would be consulted to determine whether the desired item had been acquired since the catalogue was printed. Users seeking information about very recent imprints would circumvent the COM catalogue and consult the new items file first. The system is more economical than a completely on-line system in two ways:

1. The required amount of expensive disk or drum storage is reduced. A minicomputer located in the library might be used for the on-line file of newly catalogued items, with batch-processing and COM catalogue production occurring at a remote computer center or service bureau.
2. Because most information needs will be satisfied by consulting the COM catalogue, fewer printing or display terminals will be required. Although prices have come down, terminals remain from five to upwards of twenty times more expensive than microfiche readers.

Such hybrid systems permit many variations. An entire brief entry catalogue might be maintained on-line with full bibliographic information available on COM-generated microfilm or microfiche. The brief entry catalogue would require less disk or drum storage. Alternatively, an author/title catalogue might be accessible on-line in its entirety with subject and classified catalogues printed via COM. Such an approach both reduces direct access storage requirements and eliminates the complex task of programming an on-line subject-access application.

Backup

On-line information systems are vulnerable to hardware malfunction. Such malfunction may occur at either the central processing facility or at the remote terminal site. Hardware malfunction typically results in the partial or complete unavailability of machine-readable files. In the case of library catalogues and other applications where the continued availability of information is essential to daily operation, COM can serve as a relatively inexpensive back-up information storage medium. COM can also serve a useful back-up function in applications where limitation on available disk or drum storage do not permit the continuous maintenance of large data bases on-line. Because silver halide microforms, when properly processed and stored, have archival potential, COM is an appropriate medium for the long-term preservation of information. Periodic recording of library data bases on microfilm, combined with off-site storage of COM masters, can form the basis of an effective, but inexpensive, protection programme for library catalogues and other vital operating records.

COM shares some of the limitations of microforms produced from source documents. A reader is required. Microimages cannot be annotated. User resistance may accompany the elimination of paper reports. As already indicated, COM is generally not cost-effective for short or infrequently updated reports with few distribution points. Likewise, reports that are divided into separate parts for the use of various individuals may be best retained in paper. Paper output is generally preferred in applications requiring frequent reference between two pages or the comparison of pages from two or more reports.

Microfiche Indexing

Information from alphabetically-arranged library catalogues, call number lists of items in circulation, and other sequentially-ordered microfiche reports can often be retrieved successfully without indexing. Many COM applications, however, require an index to associate desired data with its location in a particular microfiche frame. The most prevalent COM microfiche formats provide for an index as the last frame on a fiche, positioned in the lower right hand corner. Placement of the index frame in this position is essential in applications anticipating the use of automatic fiche retrieval and display equipment such as the Bruning Model 95 or Image Systems' CARD reader. As with microfiche titling, software is utilised to extract class numbers, authors, titles, or other user-specified index keys from each data frame and list them in the index with their associated microfiche grid coordinates, expressed as an alphabetic row designator and numeric column designator. The ease with which this is accomplished varies with the software package. Cal Comp's Microfiche Management System, for example, permits extraction of index data regardless of its specific location on a page.

Vendor-supplied indexing packages, while very versatile, are written for the straightforward applications encountered in most report production environments. As noted in Section Two, special indexing requirements must be programmes by the user. If more than one index frame is required, they customarily occupy the last few corner frames. The best COM software automatically provides for a variable number of index frames. Instead of, or in addition to, the corner index, there is an increasing trend toward the placement of index frames at the top of each fiche column. These column indexes may be identical with, or more detailed versions of, the corner index. The column index technique sacrifices a few data frames to facilitate retrieval by keeping the user in close proximity to an index.

Another increasingly popular technique provides for a randomly-recorded microfiche or microfilm data base—of catalogue entries, for example—controlled by a master index on one or more separate fiche. Each index entry delivers a roll number and frame number or a fiche number and grid coordinates. If both the data base and index are on fiche, a dual carrier reader can be used to facilitate rapid referral from one microform to the other. For data bases on 16mm microfilm with a fiche index, the COR 701 reader will accept a cartridge and a fiche simultaneously. The microfiche master index technique, with a non-cumulating microfiche data base of catalogue entries, is used by MARCFICHE.

In addition to functioning as a viable alternative to line printers and on-line information systems, COM can interface with equipment for the economical production of paper reports. In addition, the development of computer-input-microfilm (CIM) technology offers potential for extending a wide range of data processing capabilities to COM-recorded information.

Printing/Publishing

Several options are available for libraries requiring multiple-cope full-size paper output from microform data bases. The DatagraphiX 7000 Microfilm Input Platemaker will project enlarged COM microimages onto nine by twelve inch Datalith silver emulsion plates suitable for off-set printing of up to five thousand copies. The DatagraphiX 7000 accepts 16mm or 35mm roll microfilm, in either cine or comic mode. Magnification ranges from 3X to 36X. The Information International 800 Projection Platemaker produces off-set masters from 16mm or 35mm microfilm in sizes ranging from 8.5 by 11 to 12 by 18 inches. The 800 automatically searches for specified frames using image count marks. The LogE COM Printer automatically makes electrostatic offset plates or paper copies from 35mm microfilm at enlargements of 7X to 20X. Maximum print size is twelve by eighteen inches. For COM applications requiring a few paper copies for annotation or other reasons, the Xerox 970 is a programmable enlarger/printer capable of producing single or multiple plain-paper copies from all or selected microimages on standard microfiche in several formst.

14

Automation and Data Collection Management

Primarily, Digital Collections Selection Criteria are applied by organizations creating a digital library to decide what material to include. A strategy with defined selection priorities for digitization is critical, and should consider both preservation and access.

Main factors to consider are:

* the value of materials;
* the condition of materials;
* use of materials; and
* material characteristics ensuring a high level of success.

For the Library of Congress, items of national interest were prime candidates both to improve access and reduce wear and tear on the physical copies. In the early discussions about digitization of library materials the selection decisions were often proposed based on a desire for better access to that item's content, and not on the condition or value of the original item. In 2001, Paula De Stefano wrote that a use-based criteria was promising, as it is "fundamental to collection development and is the common thread in all selection decisions". In practice, however, her study showed that most digital projects focused on special collections, which are generally not the most popular items in the overall collection. The persistent risk of disappearing "last copies", and the declines seen in the condition of national treasures, as exemplified by the 2005 Heritage Health Index Report on the State of America's Collections provide the rationale for establishing priorities and balancing access with preservation needs. The transient nature of electronic information can contribute to a phenomenon called "memory loss." This is a result of data extinctions as technologies become obsolete. There is also a drift away from original bibliographic contexts as time passes. A 1998 Council on Library and Information Sources white paper identified the following comprehensive considerations for selection:

* assessment of the intellectual and physical nature of the source materials;
* the number and location of current and potential users;
* the current and potential nature of use;
* the format and nature of the proposed digital product and how it will be described, delivered, and archived;
* how the proposed product relates to other digitization efforts; and
* projections of costs in relation to benefits.

Collection Management and Electronic Resources

In fact, "Access rather than ownership" has become virtually the motto of the library profession. Dougherty and Hughes (1991) refer to the "transition from the physical library to the logical library" and Michalko (1991) stresses that the research library "must move with minimal disruption from a library model directed pirmarily at ownership of materials to one in which access and delivery play a more central role." This message has been presented, in one form or another, by others prominent in the library field. For example, Penniman (1993) argues that libraries must be active, not passive, emphasizing the delivery of information rather than its storage. Line (1993) agrees that libraries should be evaluated in terms of the services they provide rather than the collections they own, and Dowlin (1993), refers to the need to transform the library from a "fortress" to an information "pipeline." Hitchingham (1996) sees the transition as one from the library as place to the library "as many places."

It is obvious that electronic technologies have already had considerable impact. Virtually all libraries, at least in the most-developed countries, are now members of networks that greatly facilitate the location of sources of information and the gaining of access to them. Card catalogues have largely been replaced by online catalogues and these are being expanded through the addition of materials not previously included.

The whole idea of what a catalogue should be is changing; it is no longer seen as a tool bounded by the collections of a single library but one that reveals the availability of resources in a network of libraries or even one that is essentially a gateway to a universe of information resources in printed, electronic or other forms. Use of terminals or workstations to access databases of various kinds is now routine for many libraries, and most now add electronic resources to their collections in CD-ROM or other forms.

Remarkably, these developments have occurred with surprising speed, suggesting that the changes of the next decade will be more dramatic and rapid than those of the past decade a point made clearly by Govan (1991):

> *It is startling to realize that in 1983, as I recently read, no library owned a CD-ROM... When one thinks of the widespread use of them today, one wonders about the future proliferation of other forms of digitized information: intelligent workstations, optical scanners and optical discs, expert systems, artificial intelligence hypertext, broadbands and satellites, and local area networks (LANs) and other kinds of networks, as well as devices yet unknown...*

That this electronic revolution in libraries has occurred, of course, is due to developments over which the library profession has had little direct control, most obviously the growth of electronic publishing and of networks that facilitate scholarly communication. Of course, some libraries have been much faster than others in turning the technology to their advantage and thus offering innovative services to their users. One that has been at the forefront is the Butler Library at Columbia University. Its Electronic Text Service (ETS), established in the 1980, integrates electronic primary research materials into the library's collections and services.

The ETS includes several thousand texts and hypermedia research tools in many languages (Lowry, 1990,1992). Similar in scape is the Electronic Text Center at the University of Virginia Library, which has also assumed the responsibility for the SGML-tagging of certain texts that lack such encoding (Seaman, 1993). Several other major universities now have centers of the same type. Gaunt (1995) has discussed their organization and functions. Other libraries or consortia have taken the lead in archiving or providing access to electronic journals.

Now, we will highlight some salient features of collection management and electronic resources.

Electronic Publishing and Scholarly Communication

What happens to the library in the future will depend to a very large extent on developments in related sectors, most obviously the publishing industry. One must assume that the proportion of the world's publications issued in some electronic form will increase and, thus, the proportion issued as print on paper will decline. Less clear is the form that the electronic publishing will take. How much will consist of resources that can be accessed only through networks and how much will actually be distributed, for purchase or lease, as CD-ROM, videotape, videodisk, electronic book or formats yet to be devised? Of course, what happens to the format depends on what occurs in the creative process itself. Electronic publishing is still in a largely "simulation" stage of development in that most authors tend to think in terms of the static printed page and the static illustration. Hypertext and hypermedia capabilities free the author from static representation, allowing publications that are dynamic and interactive.

It seems likely that future authors, whether research scientists or poets, will increasingly exploit the full capabilities of the electronic media (sound, movement, animation, simulation, colour, and so on), thus changing the nature of many publications and determining the format in which they are best issued (Lancaster, 1996).

The truly dynamic and interactive publication brings with it other important implications, not least of which is the fact that it cannot be printed out on paper.

The subject of electronic publishing cannot be divorced from the broader issues of scholarly research and communication. Scholarly endeavors are being profoundly affected by technology. As Shreeves (1992) points out. "The emergence of machine-readable texts, of computer-based networks, and of all the attendant technological apparatus, has provided the means to alter radically scholarly communication and scholarly method."

He was speaking specifically of the humanities, but the observations are also true of the other disciplines, perhaps even more so. The influence of technology on scholarly research extends much further than the obvious effects of word processing capabilities. Scholars now use a variety of networks to access sources needed in their research, to exchange information with colleagues, and to collaborate with them in research and publishing activities. Some more subtle changes are also taking place. The scholarly journal in paper form has not yet been replaced by electronic journals, although more and more journals are beginning to appear only in network-accessible form (Clement, 1994; Woodward, 1995) and electronics obviously offers the potential for more effective dissemination of information—for example, journals tailored to individual interests.

Network resources have also caused a significant increase in informal communication—informal "journals" now exist within electronic mail and computer conferencing facilities. Such resources diminish the role of the conventional printed journal as a vehicle for the dissemination of research results; increasingly it exists solely to satisfy social (publish-or-perish) and archival requirements.

One obvious sign of the increasing importance of the informal electronic sources is the fact that they are now frequently cited in the conventional printed journals. The existence of text in electronic form even alters the nature of scholarship. For example, Shreeves (1992 has mentioned how the ability to manipulate text by computer has changed the types of research that can be undertaken and the types of research questions that can be asked. This point has also been made strongly by Gaunt (1990) :

> *The potential research activities using the electronic version of a text are limited only by the interest and ingenuity of the individual researcher. As social science data in machine-readable form is valuable to the researcher for analysis of trends, for hypotheses and conclusions, so too is the literary text in machine-readable form for similar ends, and for particular work perhaps even more valuable.*

Further, the changes in scholarship that have occurred so far may be merely cosmetic compared with changes that could take place in the future. Most radical is the possibility that networked scholarly publication could become the direct responsibility of the universities and other research institutions.

Role of the Library

The library profession does seem to be fairly unanimous in the belief that libraries and librarians will continue to have important functions to perform vis-a-vis electronic resources. Indeed, several writers have warned that, unless the library takes a lead in this, its role will be usurped by other bodies—other departments on a campus or other organizations entirely. Here it is apt to quote Johnson (1990a) who has said:

> *"Libraries, in their central role as providers and organizers of information, cannot afford to ignore computer files or to approach them in a piecemeal fashion. To do either places the library at risk of becoming less valuable to and less supportive of the academic community. Libraries will no longer be regarded as the focal point for information as more of it slips outside their purview. Researchers will not longer think of the library as the first resort because they will be unable to depend on its catalogues, collections, and directional tools to provide access to the universe of information resources. The library's significance to the administration will diminish as well."*

A similar message has been delivered by Alberico (1991):

> *If we don't become involved at all levels, there is a very real possibility that resources will shift to other segments of the economy that can deliver the electronic services that academic and post-industrial organizations will need to survive. It is already happening in some places.*

Lewis (1988) has also pointed out that users will demand more from the library than they have in the past :

> *Students may expect the library to be as powerful and easy to use as electronic teaching tools. Unfortunately, libraries are rarely easy to use. If analysis with new computer tools becomes easier and more productive than library research, students can be expected to use the new tools rather than the library. If libraries do not improve their services so that they remain an essential teaching tool, they risk becoming irrelevant to the teaching process. If this is allowed to happen, it is easy to predict a decline in library funding.*

The compilers of one influential report seem to deal that it is almost inevitable that the academic library will decline. Martyn et al. (1990) suggest that individual academic departments will provide their own electronic resources and the library will decay into little more than a study hall.

Management and Collection Development

Given that the library *must* continue to take a lead in the exploitation of information sources in electronic form, what exactly does this imply for collection development Obviously, electronic resources, particularly those that can only be accessed when the need for them arises, present a set of problems that have not been encountered by librarians in the past. As Alberico (1991) points out "Collecting' electronic information is more problematic than collecting printed texts. And, as we all know, collecting printed texts is not without its own problems." Welsch (1991) warns that the entire approach and philosophy of collection development must change: "Simply duplicating the collection practices we evolved for print materials in the network environment does not seem responsive to current needs or capabilities." Nevertheless, collection development, whatever form it takes, still requires policies, as Summerhill (1991) has noted: "The advent of networked resources does not eliminate the need for a formal policy governing the acquisition of electronic resources."

Obviously, a challenge is the problem of how to integrate electronic resources with more traditional forms. The need for complete integration seems taken for granted by librarians and library users alike, at least in the scholarly community; as Dougherty and Hughes (1991) report : "Provosts and librarians... Prefer a future in which there is universal access by faculty and students to multiple information sources in all possible media via a single multifunctional workstation."

Ghikas (1989) points out that the future library must be a combination of "actual" and "virtual" materials:

> *The twenty-first century collection will, I believe, be an accumulation of information—bearing objects—printed, aural, graphic, digital—housed within the physical library,* and also *indices, abstracts and catalogues through which, using electronic channels, the library user has access to* pre-identified *resources held by other libraries and information providers. The twenty-first century "collection" thus combines the actual and "virtual"* collection. *The "virtual collection" is an* electronically browsable *collection. In contrast, tomorrow's library, like today's, will go beyond the limits of its own collection—both actual* and *virtual—in response to specific information requests. In this case, neither location nor delivery time an channel will be preidentified. (Page 123)*

The integration issue is also dealt with by Welsch (1991):

> *"Technology and technological resources need to be integrated as closely as possible with traditional resources within a unified approach to information founded on principles derived from studies of information seeking and use. Users want to be able to identify information through one access point and not through a series of separate catalogues or information utilities with varying search strategies and command structures that complicate as much as they help. Until a search device, a dynamically updated online guide, or satisfactory resource guides are created, we will have to continue to depend on that hypermedia, intelligent (but not artificial), semi-robotic system that is known as a "librarian."*

Further an obvious problem in collection development is that of the costs involved in acquisition or access. Haar (1988) has pointed out that reference sources in optical disk form are very popular with library users, yet they tend to be more expensive than their print counterparts. The addition of several optical disk systems might well mean that monograph purchases would have to be further reduced, perhaps drastically, in many libraries. Moreover, one must recognize the fact that different formats actually interact with each other. For example, an index to periodicals in CD-ROM form may increase demand for periodicals in printed form.

It is true, of course, that electronic resources, particularly network-accessible resources, are economical in space. However, the saving in space is unlikely to compensate for cost increases elsewhere. Moreover, while the costs of computer telecommunications technologies have obviously declined dramatically, and are likely to continue to do so, such cost reductions do not apply to all the technologies of concern to libraries. Another consideration is that, in the electronic world, libraries have much less to show for their expenditures.

Some resources are leased rather than owned, and others do not exist within the library at all. The bodies that fund libraries must recognize and accept this fact. It is undeniable that access to electronic resources reduces the funds available to acquire other formats. As Shreeves (1992) indicates: "Taking the cost of electronic information from current resources is not a pleasant prospect, but it may be the only strategy available for many."

It is Govan (1991), however, who has been most forceful in warning of the economic dangers facing the library in a research setting :

> *If any transformation of our present intricate system of acquiring materials should come about, it would change drastically both the practices and the structure of academic libraries. The larger point is that the present system is not working economically for those libraries. The combined costs of assimilating electronic technology, recent printed materials, and preservation, have eaten deeply into their infrastructures. For all the professed recognition of information as a commodity, legislators and university administrators have offered little relief and much of the new funding seems to have gone to computing services elsewhere on campus. Any prognostication about libraries future would be irresponsible if it did not lay heavy emphasis on their perilous fiscal state today and the economic problems that lie ahead. All that we have discussed carries a large price tag, and the parent institutions must face the question squarely as to the very considerable costs of supporting a contemporary academic library in a world awash with information.*

Van Gils (1995) speaking of the Library of the Royal Netherlands Academy of Arts and Sciences (KNAW), is another who has recognized the need for substantial additional funding and for the recovery of costs through sale of services:

> *For the library it is a mater of a radically changing situation, both in terms of expenditure as well as receipts. Looking at the budget and the operating turnover of the Library KNAW I come to the conclusion that for the past two years, and also in the next two years, substantial extra budgets are needed in order to keep up at all with the developments in the field of digital information supply. Achieving a leading position in this, which is one of the objective of our organization for the biomedical disciplines, demands even more money.*

> *All this together entails an enormous increase of our annual expenditure, roughly estimated at 15% to 20%. We will have to work hard to recover these costs via existing services.*

But costs are not the only issues facing the collection development librarian.

Gaunt (1990) identifies other significant problems:

1. Finding out what is available,
2. Evaluating the sources available, and
3. Acquiring and servicing the sources required.

As she explains, electronic resources are not adequately controlled bibliographically, they are not easy to identify, and they are not well reviewed. The problem has also been recognized by Shreeves (1992):

> *... a major obstacle for the selector of electronic texts is the difficulty of defining the available universe. The usual selection tools (reviews in scholarly journals, national bibliographies, publishers' catalogues, etc.) do not cover such resources effectively, nor is there a developed system of publication and distribution. Finding out about electronic texts requires attention to a number of specialized sources of information.*

The critical problem, of course, is access and what collection development rally means in an electronic environment. Reed-Scott (1989), for example, sees the role of the collection developer as altering dramatically:

> *Because electronic texts are fluid and interactive and are changed frequently, it will be difficult to capture information. Building collections will move from a static process of acquiring library resources to a more fluid position of providing access to information.*

Creth (1991) claims that the collection development librarian will continue to do many of the things he or she is now doing, at least in the foreseeable future, but will also take on new responsibilities:

> *The context for the future library suggests that rather than relinquishing functions that are currently an integral part of university library activities (e.g., selecting and organizing materials, assisting and educating users in allocating information) these will continue, although in different ways, along with new activities that will emerge.*

In dealing with electronic sources that are distributed, of course, the collection development role is little different from the situation in the print-on-paper world, even though some of the sources acquired may not really be "owned" by the library. It is in dealing with the remote sources, those that can be accessed only through telecommunications, that the collection development function becomes ambiguous.

Atkinson (1990), for example, raises the important question: "What role does the research library play, if most research consists primarily in the searching and downloading of information from a distant database by a scholar at a personal workstation?" He hopes that libraries will restructure their operations around three basic functions: mediation, primary record definition, and secondary record definition. *Mediation* involves helping users to identify needed information and to download this to locals storage facilities. In a sense, this can be considered as a kind of deferred collection development operation—locating information sources as they are needed rather than trying to predict the needs in advance.

Nevertheless, some prediction will be required, according to Atkinson. The *primary record definition* role he identifies would consist of identifying resources that are likely to be of greatest interest locally and downloading these to a local database. His *secondary record definition* function is the most unconventional; it is and uploading rather than a downloading activity. In essence, the library becomes the publisher and disseminator of scholarly information.

> *When a scholar at an institution has written something which is deemed by a select group of peers to be worth communicating broadly to other scholars, that communication should take place by the library's uploading that publication into the library database, thus disseminating it to other libraries, and thereby to other scholars, throughout the nation and the world. The ultimate purposes of the academic library is to provide bibliographic support for education and to serve as a basis for communication among scholars—in short to disseminate significant information. In the predominantly paper era, we rely heavily upon commercial publishing for that purpose, but such commercial publishing is merely a means to achieving that ultimate end—and already that particular means is becoming economically prohibitive and technically unnecessary... The library—in conjunction with the computer center and the academic press—must assume directs responsibility for disseminating information among scholars. Providing scholars with the channels through which to communicate, working with scholars to establish the technical and bibliographical standards and procedures for online publication in this fashion—these are responsibilities which*

> *should therefore also be assumed by the library in the online era.*

The mediation role, in one form or another, is one that seems to be fairly widely accepted. Welsch (1991) describes it as:

> *This is where librarians should find their niche: identifying resources regardless of format and encouraging suppliers of network information to make their products readily and easily available. Focusing their future role not on being a warehouse of electronic or printed information, but on becoming an information utility that locates data in diverse sources seems more appropriate.*

The view that libraries should build local databases from network resources elsewhere, however, is not one that appears to be widely held. More commonly, the library is seen as more of a switching center, possibly also having such value-added responsibilities as user education.

For example, Britten (1991) has said: "Libraries should not think primarily in terms of collecting information stored on networks, but should instead pursue strategies for teaching users how to locate and retrieve this information." This agrees with several prominent librarians who see the library of the future as primarily a node in a vast information network. Kilgour (1993), for example, believes that a major function of such a library node will be to build local indexes to aid users in accessing remote sources.

Atkinson (1990), on the other hand, claims that the view of the library as a switching center is a shortsighted one:

> *What we have perhaps failed to recognize, however, is that the library must also continue to maintain its responsibility for record definition—for collecting, i.e., for moving a carefully selected assembly of graphic utterances from the environment into a library database, and thereby stabilizing that information for future reference. The most serious error the library could make at this time would be to assume that its role in a predominantly online environment will be mainly that of a switching point. That role as switching point belongs not to the librarys side, but rather to the computer center side of information service. The library's function has always been—and will remain regardless of changes in technology—to select, stabilize, protect, and provides access to significant or representative graphic texts.*

Atkinson is supported in this by Summerhill (1991):

> *Clearly, groups of local users will have an ongoing need for the proximate location of heavily used data. Thus, achieving*

> *a balance between local "collections" of heavily used electronic resources and the provision of network access to less frequently used resources should be the goals of the library acquisition process in a networked environment.*

A few other writers agree with Atkinson's view that the library in association with other segments of the research community, should become publisher and disseminator of information. Welsch (1991) has said:

> *Yet, the concept of individuals and organizations, including libraries, as self-publishers of new information, who would then make it available through networks, is so tantalizing that I am reluctant, despite obstacles, to surrender it.*

Alberico (1991) is more specific :

> *The "electronic book" of the future is as likely to be a composite as it is to be a single coherent entity. Scholars will compile their own electronic books by gathering separate pieces of information from different parts of the network. Libraries may become publishers simply by using the network to build customized multimedia documents for clients or by providing the technology, training, and facilities to allow clients to build their own composite documents.*

To become an effective creator and disseminator of new information composites, the library must be more active than it is now. In the words of Welsch (1991): "Unfortunately, the image that emerges for me when I think of scholarly societies, universities, and libraries and their roles in the creation of information systems of all kinds is, with rare exception, one of passivity."

One specific problem to be faced in the future is how to deal with electronic journals, assuming that these journals are accessible through networks. Stoller (1992) identifies three options:

> *In simple terms, those options are: first, to print the journal either directly from the online file or with the intermediate step of a download and manipulation by word processing software; second, to download the online file to an electronic medium, usually a diskette, manipulate the file with word processing software, and provide access through personal computers; third, to maintain the file on a mainframe computer and provide access through a local area network.*

Further, he goes on to discuss the pros and cons of each of these options. Unfortunately, he seem to assume that electronic journals will be little more than print on paper displayed electronically. If, as seems likely, completely new forms emerge—e.g. with analog models or other forms of animation—certain options, such as printing out on paper, remove themselves from consideration. The University of Pennsylvania Libraries (1990) concluded, perhaps not surprisingly, that there is no one best method of providing access to electronic resources. All forms of access—remote time-sharing, CD-ROM, and locally mounted files—are needed. Factors influencing the choice for a particular set of data include timeliness, expected volume of use, the probable number of simultaneous users, and whether remote access (from offices, laboratories, classrooms, and so on) is required. One library that has already gone a long way toward the adoption of collection development policies for electronic resources is the Mann Library at Cornell University, as discussed by Demas et al. (1995).

They identify various levels or "tiers" of access, illustrated. Note that some high-demand items may be downloaded from the national network to the campus network while others are merely accessible from the national network on demand (possibly through the aid of "pointers" provided locally).

Archiving and Preservation

As we all know, the preservation of materials is an important facet of collection management. What are the library's responsibilities for preservation in an electronic environment? Summerhill (1991) seems to believe that libraries collectively should strive to preserve almost everything communicated: "Computer conference logs, electronic serials, even archived exchanges of electronic mails transmissions may all be appropriate for a library to acquire and preserve, given sufficient interest on the part of the user community: "

Tier 1

Delivered over the campus network via the Mann Library Gateway. Anticipated high demand and need for quick response and manipulation time dictate the use of media and software, which will provide very fast response time.

Tier 2

Delivered over the campus network via the Mann Library Gateway. Must be interactively available, but a relatively low number of simultaneous uses is expected and slower retrieval time acceptable. Therefore a slower storage medium, such as optical platter, may be acceptable.

Tier 3

Resources that can be delivered online via the Gateway on demand, but are not continuously available online. Tier 3 resources may be mounted on request for Gateway access or may be used in the library at any time.

Tier 4

Resources that are available in the library only (i.e., not delivered over the campus network) but that are available from many public access workstations within the library over a local area network.

Tier 5

Resources that are available in the library only, at single user stations

Summerhill goes on to defend the position that even "ephemeral" communications need preservation:

> *Those who doubt the suitability of personal exchanges of electronic mail might consider what value such materials would be to a historian of the twenty-first or twenty-second century faced with the task of reconstructing the correspondence of an individual (or organization) who ceased writing letters on paper late in the twentieth century. (Page 185)*

Notably, very similar claim has been made by Stoller (1992), but not everyone holds such a view. For example, Shreeves (1992), quoting a speaker at a Symposium on Scholarly Communication held at the University of Iowa in 1991, introduces the argument that not all communication among scholars is scholarly communication and that much of what is transmitted by electronic mail or computer conferencing is nothing more than "high level, high-tech cocktail party conversation"; only peer-reviewed communication can be considered scholarly and thus worth preserving.

Brichford and Maher (1995) suggest that the library and archive professions may be to preoccupied with techniques and standards for the preservation of physical media. Preservation should be more a matter of access to information than the survival of any particular storage media. It is the information and the access points that need to be protected and preserved.

They identify three options for ensuring the ongoing accessibility of electronic resources:

(i) Printing onto hard copy once use has tapered off and interactive access is no longer essential.

(ii) Retaining the original storage media, software, and hardware.

(iii) Continual conversion of the data, with appropriate verification, to newly developed hardware and software.

While the last option is preferred, it is obviously the most expensive and could only be justified if the information involved continues to have high value and to be of interest to a large community of users. In the case of the second option, the library would become a cross between a modern information center (embracing the newest technologies) and a museum (preserving the old).

Notably, Graham (1995) is one of the writers who has stressed that libraries must continue to take a major responsibility in the preservation of resources :

> *It will be important to establish standards for the number of repository locations necessary to assure long-term existence of specific electronic information and access to it.*
>
> *Nothing makes clearer that a library is an organization, rather than a building or a collections, than the requirement for institutional commitment if electronic information is to have more than a fleeting existence.*

The policies of several major research libraries regarding electronic journals (Parang and Saunders, 1994a, 1994b) also suggest that these institutions recognize the needs to preserve and archive these resources and not just to provide remote access to them. While Europe appears to favour the idea of a central depository for the preservation and archiving of electronic materials, the U.S. approach is more decentralized, with the responsibility shared among a variety of national, public and university centers (CEU addresses... 1996).

Luijendijk (1996) and Nisonger (1996) have both discussed responsibilities in the archiving of electronic journals. The former considers that this could be undertaken by libraries, publishers or vendors; the latter mentions libraries, publishers or cooperatives as alternatives. Participants in the recently completed TULIP Project (Hunter, 1996; TULIP, 1996) have pointed out why the library community, rather than the publishing industry, should take on the task. Costs and problems associated with the archiving of electronic journals by individual research libraries are discussed in some detail by Duranceau et al. (1996). They recommend that their institution, MIT Libraries, should store locally ("archive") only the electronic journals published there. Access to others would be provided by "pointing" to them, perhaps through some other library-maintained system such as CIC-Net.

Neavill and Sheble (1995) provide another useful discussion on several related issues relevant to electronic journals: archiving, preservation, storage, and "authentication of content." The JSTOR project, supported by the Mellon Foundation, is making significant progress in preserving back issues of important journals by creating high quality bit mapped images (DeGennaro, 1997).

Conway (1996) has dramatically highlighted the "dilemma of modern media," which refers to information density versus life expectancy—the more efficient the medium in terms of storage capacity, the shorter its life expectancy.

Resource Sharing

No doubt, technology has already had a profound beneficial effect on resource sharing activities. What form will this take in the future. Few doubt its importance. Dougherty and Hughes (1991) report: "It was also observed that libraries and library services were no longer individual university problems and that a collective approach is now absolutely essential." In a similar vein, Clinie (1994) has pointed out that "Alliances will be increasingly important to libraries in the networked environment."

Summerhill (1991) has elaborated as follows:

> *"Striking the delicate balance between local ownership and network access will be added by, if not achieved by, a formal acquisition process that accounts for network access. Librarians must shift the focus of their acquisition policies from the collection of materials by and for an individual library to policies that weigh the merit of acquiring the same resource by consortia of local libraries, regional library cooperatives, and/or state library networks. The funding agencies that back libraries must come to accept this type of cooperative venture. At the same time, vendors of commercial data products must understand the imperative facing libraries to enter cooperative collection development agreements. Accordingly, they must develop fee structures that accommodate such ventures."*

The topic is dealt with by Stoller (1992):

> *Finally, on the access level, interlibrary loan must be considered as a potential method for ensuring reasonably universal availability of electronic journals. This seems, on its face, to be a preposterous notion. Electronic text, by its nature, does not seem "loanable." But bibliographic control will invariably result in requests by individuals who either do not realize the title they have discovered is a computer file or who harbor the hope that the host library will consider printing out that file's contents on their behalf For libraries that approach local access by printing out the journals, of course, such requests would be easily met. For others, the level of service they are willing to provide over interlibrary loan will need to be determined, much as has been the case*

> *with CD-ROM products. In a world where online computer access is still not universally available to students and scholars, such determinations will have important implications for access to a scholarship in a format that is likely to become increasingly common.*

Even since 1992, when these remarks were published, the situation has changed considerably and it is probably no longer true that "online computer access is still not universally available to students and scholars," at least in the most developed countries. Moreover, Stoller is making the assumption that future journals will still be "printable." In fact, it seems likely that the electronic journals of the future will incorporate dynamics and hypermedia features that precludes their reproduction on papers. Ra (1990) was more realistic when she pointed out that, while technology at first increased resource sharing, "it will probably make interlibrary loan obsolete within a generation." Of course, resource sharing involves more than interlibrary lending. The major research institutions that are members of the Committee for Institutional Cooperation (CIC) have taken a lead in exploring the possibilities for resource sharing in a network environment (Dannelly, 1995; MacEwan and Geffner, 1996). Cochenour (1996) reports that the CIC-Net Web server, which makes over 8oo titles available, is now accessed about 35,000 times each day through the Internet. Cataloguing, bibliographic control and the provision of a user-friendly interface are other services provided by the CIC libraries. CICNet does not "archive" all 8oo titles (most are accessed by pointing to their location at publisher or other sites) but has established a smaller managed" electronic journal collection (50 titles in 1996) for which "consistent archiving" is provided.

Thus, at present at least, CICNet is more a provider of access than an archiving center. One possible model for resource sharing in a virtual library environment is exemplified in the initiatives of the Virginia Academic Library Consortium (Hurt, 1995), of which a key element is the recognition of several major academic institutions as regional electronic resource centers.

Libraries will participate in building the statewide virtual library in the following way:

> *All participating colleges and universities in the state will be encouraged to contribute online materials to the virtual library, either by providing them electronically to the appropriate electronic resource center or by linking their online resources directly to the system. Thus we have a system of networked resources using distributed client-server architecture and exploiting the enormous potential of the Virginia Research Network to link libraries and educational*

> *institutions together. Because the information is cooperatively acquired and maintained by the regional resource centers and patrons are assured easy access, libraries will no longer need to duplicate holdings of materials.*

Further, Hurt claims that the consortium will provide "a common system of easy-to-understand menus" and a "powerful search mechanism," the objective being an access system that is "seamless."

Another obvious facet of resource sharing is the development of joint licensing agreements that permit consortia of libraries to share responsibilities and costs of providing access to electronic resources (Gosling et al., 1995).

More than a decade ago, Lancaster (1982) stated that :

> *Electronic sources, at least those remotely accessible, do not need to be acquired, nor do they need selection. Rather, the selection activity is of a different kind: Librarians select what to access to satisfy a known demand rather than what to purchase in anticipation of future demands.*

To a very large extent, he still agrees with this. However, in the last ten years, and particularly in the last two or three, the profession has given much more thought to what collection development and collection management really mean when electronic communication is the focus of attention. As we have seen in this chapter, views range from the librarian as primarily mediator between users and network resources to the librarian as creator and publisher of new information resources. One does not really know what the world will look like even a decade from now. It is possible that the whole system of scholarly communication will be very much different from the situation today. Shreeyes (1992) considers the collection development librarian as primarily a gatekeeper-one who identifies that portion of the universe of information resources that is likely to be of greatest value to a particular user or group of users. Whatever happens to scholarly communication, and whatever happens to the library as an institution, it is clear that gate-keepers of this type will still be needed in the future. Indeed, they will be even more important than they are today.

Data from Automated Systems Management

One could make a strong case to support the claim that the major potential benefits of automated systems in libraries are the data they can provide to improve the management of the library's resources (Lancaster, 1983). In other words, the automated system should be seen primarily as a management information or decision support system. Speaking specifically of automated acquisitions systems, Hawks (1986) has said:

> *Not the least of the benefits of autmating...is the enhanced ability to monitor processes, to collect, structure analyse, and report critical or useful data previously unavailable or extremely difficult or costly to obtain.*

But the Johnson (1991) survey discusses in this study, clearly shows that better management information is not seen as a major objective of automation in academic libraries and that automation is not considered to have had much effect in improving management or decision making. By the same token the vendors of automated systems for libraries do not emphasize this capability and perhaps fail to recognize the true potentials of their own systems in this respect. In 1992, one of the authors sent a letter to the major vendors of automated library systems in North America, requesting information on their "management information" capabilities. Response indicated that vendors tend to see their "management reports" in rather pedestrian terms, providing fairly routine statistical and financial data, of the type common to business systems in general, rather than more sophisticated reports specific to library needs (e.g. to aid in collection development decisions).

Hawks (1986, 1988) provides a useful summary of fairly routine data that can be obtained from present automated systems. She identifies five major types of management reports.

While she is dealing specifically with acquisitions systems, the areas she identifies are applicable, in a broad sense, to automated library systems in general:

1. Fund accounting
2. Vendor performance
3. Collection management
4. Order control
5. Systems management.

Notably, only the collection management reports are unique to the library situation (and even these can be considered as merely special forms of inventory control reports); the other types are widely used beyond the library environment. Systems management reports are reports providing data on the system itself—how much it is used, how it is used, where it is used from, and so on. While Hawks includes collection management reports among the types that present systems can produce, the reports that can be routinely generated by commercially available systems today are relatively unsophisticated. Fund accounting reports (how much money was allocated to a particular fund, how much is already spent how much is committed, how much remains) and order control reports (what items are on order, from where, when the order was placed, and so on) re completely routine today in libraries of all sizes. They are not unique to the library situation and need not concern us further here. The vendor performance reports are less routine and, indeed, it was very difficult to collect data of these kind in a systematic way prior to the adoption of automated acquisitions systems. A vendor record, displayable on a terminal, from the INNOPAC acquisitions module. Note how the data recorded can be used to generate reports relating to vendor performance— wheat proportion of the items order is delivered within X period of time, what proportion is never delivered at all, what level of discount is provided, and so on. Carried to its logical conclusion, a vendor performance module might be used to select a vendor automatically based on past performance in the supply of publications of a particular type. Such a capability would be especially valuable in the acquisition of materials that are less routine— conference proceedings, certain technical reports, publications in certain languages, publications, from certain countries, and so on.

Pontigo et al. (1992) have described a type of expert system designed to select vendors in this way. The system described has a learning capability: the performance factors associated with each vendor are updated automatically as the system gathers further data on vendor performance. In fact, the system is designed to rank potential vendors by the probability that they will be able to supply a particular item needed. A similar system, known as the Monographic Acquisitions Consultant, was developed at Iowa State University (Zager and Smadi, 1992; Hawks, 1994).

The system was designed to optimize the decision on which vendors to go to for particular types of monographs. The knowledge base of the system includes both descriptive and evaluative data on each supplier. Descriptive data deal with type of publisher (foreign, university press, publisher of science materials) and relationship with the library (blanket order, approval plan, standing order, on exchange list), while the evaluative data cover aspects of service (delivery time, accuracy, discounts, shipping and handling charges, and so on). The evaluative elements can be weighted and the system can thus assign a composite numerical score to each vendor based on the company's previous performance for the library. As Hawks (1994) describes:

> *"In the selection process the vendor with the highest score who can supply a given type of material is recommended. Once a certain number of orders has been sent to that vendor in a given time period, the vendor with the next highest rating will be selected instead, supporting the library's goal of using multiple vendors"*

This system and the one developed in Mexico by Pontigo et al. (1992) were implemented as prototypes but have not been used on a full production basis. Hardware problems and the cost involved in updating the knowledge base were mentioned as problems preventing full adoption in Iowa, although it was shown that the system could save a considerable amount of professional time in the actual selection of vendors.

Along the same lines, but somewhat less ambitious, is a system developed at Pennsylvania State University to determine whether or not a particular title is likely to be received through one of the library's many approval plans (Brown, 1993). Criteria incorporated into the knowledge base, and used to determine probability of receipt, are publisher, subject, price, year of publication, and place of publication. Again, while a prototype developed and tested, the system has not been fully implemented. Other expert systems, designed to help library users satisfy their own needs, have also included document ordering aids.

Desirable Reports

If the automated systems now in place in libraries appear rather modest in their management information capabilities, Chaudhry (1993) has gone to the opposite extreme in his list of management reports *expected* (emphasis ours) from automated systems.

Collection Use Analysis

1. Circulation statistics;
   - number of transactions by patron type
   - number of transactions by location
   - number of transactions by type of material
   - number of transactions by call number.
2. In library use;
   - ability to record in building use by scanning labels of materials being reshelved
   - supply of information on utilization of collection for staff scheduling.
3. Photocopy support;
   - statistics on volume of photocopying done
   - provision for photocopy statistics for titles
   - information on number of copies made by titles
   - generation of reports of photocopies.
4. Circulation history data;
   - provision for retention of historical data on title use
   - statistics on the number on times an item (copy or title) has circulated.

5. Use exception reports;
   - reports on items not circulated in a specified time
   - reports on items circulated for less than a specified number
   - reports on items circulated for more than a specified number.
6. Reserve statics;
   - number of holds placed and items recalled
   - reserve statistics by user and material type
   - automatic printing of purchase alerts (when holds against a title reach a specified level)
   - statistics on material booking
   - reports by hour, day, week and month.
7. Interlibrary loan;
   - statistics on requests received and filled
   - statistics on requests sent and material received
   - average turnaround time
   - total number of items loaned
   - lending/borrowing ratio.

Use of Facilities

1. Discussion rooms;
   - inventory of availability of meeting rooms
   - use of special seats/carrels.
2. Equipment;
   - booking and issue frequency statistics by type of equipment: (AV, microforms, etc.).
3. Terminals;
   - amount of time terminals are in active use.
4. Printers;
   - number of records printed online/offline
   - printer use by terminal and/or location
   - printer use statistics by the hour, day, week, etc.

Searching

1. Searching statistics;
   - number of searches performed by search type; author, title, subject, series
   - number of searches by terminal, group of terminals library units.

2. Response time;
   - High, low, and mean response time for each search/type of search.
3. Searches in progress;
   - daily high, low and mean number of searches in progress in any one hour.
4. Public catalogue use statistics.

Collection Development Reports

1. Summary of orders
2. Subject selection lists
3. Selector performance reports
4. Desiderata reports
5. Material notification
6. Reports of order types
7. Subscription lists
8. Standing order reports
9. Aging reports; outstanding orders sand claims
10. Reports on withdrawals and transfers
11. Holdings and new additions: by location, all number, and language and other library-specified formats
12. Gifts and exchange reports.

Cataloguing Reports

1. Online records used for cataloguing
2. Records input from other sources
3. Local/original records input
4. Records created/items processed
5. Records created online
6. Catalogue cards, bar coded labeis, spine labels produced
7. Authority subscription activities:
   - source of authority records, number of authority records input and number of records modified.

Financial Reports

1. Fund control reports
2. Accounting information
3. Payment information

4. Year end processing
5. Next year projections
6. Currency conversion reports
7. Fine reports
8. Missing/lost books cost.

System Transactions

1. Transaction log;
   - activity log automatically printed
   - error messages by terminal/system wide
   - help message by terminal/system wide.
2. Database statistics
3. Dial-up access statistics
4. Down time statics.

Vendor Performance Reports

1. Orders placed and completed
2. Claims sent and responded
3. Delivery time
4. Returns
5. Pricing discrepancies
6. Discount percentages.

Staff Productivity Reports

1. Performance reports
2. Personnel action summaries
3. Staff productivity data
4. Quality control reports.

Chaudhry's checklist is useful because it is comprehensive and serves to remind the librarian of data that might be valuable in support of management decisions as well as that could be generated by an automated system. Nevertheless, the list ranges from data of extreme importance of data re relatively trivial, from data that virtually all libraries now collect to data that are very difficult to collect, and includes data that could not be generated routinely as a by product of the operation of automated systems.

15

Guidelines for Software and System Selection

In fact, the present era of information and communication technology (ICT) places several options in the library planner's hands. Selecting a microcomputer system is a complex and challenging process. The continual changes and new offerings in hardware and software add to the difficulties, but a methodical approach in determining what the system is intended to do and what available systems can meet these requirements will make the process easier. The initial decision in selecting a microcomputer system is to determine exactly what the system is meant to support: acquisitions, circulations, online files, word processing, a combination of these or various other options. The micro configuration will be determined by the kind of work it is expected to perform.

The library must also decide whether to purchase packaged software or to develop its own. Many library applications programmes exist, but few are being marketed.

A major problem in purchasing or sharing existing programmes is the incompatibility of various microcomputers and of applications programmes written on them, although recent developments promise to resolve some incompatibilities. Another option is simply to purchase a micro and experiment; several libraries have chosen this alternative. However, the decision in this case is to purchase a learning experience rather than an application. The library may well discover that its micro is not the best machine for a given application or that desirable software is incompatible with it.

It is apt to note that the library must also evaluate the capabilities of different systems and analyse costs, including those for staff, site and data transfer, as well as for actual purchase and maintenance of hardware and software. In addition, the library must select a vendor and, in many cases, should prepare a contract. Whether to hire a consultant and whether the library is required to request bids for a system are other questions.

Here we discuss these issues, all of which must be addressed in selecting a microcomputer system.

Remember, automating any function should begin with a needs assessment. Such a review requires a difficult and time-consuming analysis of current procedures to determine why each action is necessary. It is often hard to be objective since the staff is likely to see established procedures as familiar and comfortable as well as functional. However, a major purpose of automation is to improve existing procedures or services.

Can any steps be eliminated or combined. Will tasks be less time-consuming? The assessment should result in a current statement of the library's functions and requirements and an awareness of the opportunities that a computer offers. From a management perspective, the bottom line is money: Will use of a micro-computer result in higher or lower operational costs for the library's service's? In determining the fiscal impact of automation, many variables must be considered. A word processing package may reduce the typing time needed to prepare user manuals or library guides. Online preparation of acquisition order forms may eliminate the need for an order card file. A computer index record with multiple access points can replace multiple catalogue cards or various entries in a printed index.

Staff reaction to technology is a major determinant of the success of automation. Although there is often resistance to change, especially change that introduces new technology, a computer system can actually improve job satisfaction. Once staff members gain a basic understanding of the computer, they frequently develop a sense of achievement at having mastered it and having moved into the new era of technology.

This can result in such observable improvements as better morale and subsequent increases in productivity. In contrast, if staff members fear that a machine may eliminate jobs, they will consciously or subconsciously fight against the changes introduced. It is important that staff realise the advantages of automation—how the computer will assist their work and allow them to be involved in other more challenging responsibilities. However, automation is frequently intended to reduce the number of employees required to provide the existing services of the library. Increased productivity or the elimination of many repetitious tasks may reduce staffing needs and provide some very apparent cost savings.

To avoid major staff resistance and lowered morale that can impede productivity, the library must make it clear why cuts are needed. In the case of budget restrictions, the computer becomes a tool to alleviate some of the problems of the reduced staff. Many times, the microcomputer assumes tasks that are clerical and time-consuming and that are often handled by temporary or part-time help, for example, student assistants in educational settings. Since the turnover in such jobs is usually high, the overall impact on morale may be minimised.

It is remarkable, that the most difficult area of cost justification in libraries seems to be embodied in the phrase "improved services." Determining the cost benefit of improved services is difficult but not impossible.

A microcomputer may make a new service possible at a far lower additional cost than would be required to provide the service manually. For example, lists of new titles may be generated as a by-product of an acquisitions system, yet no additional compilation and typing are required. Improved access to information, such as keyword search capabilities to augment the traditional subject term approach, is more difficult to justify.

However, the cost of generating a record, regardless of the types of access points, is high; if greater use of the data base is possible, then the cost of creating the file is better justified. If the accessibility of the information is doubled, the investment in the collection and in the system can be viewed as more cost-effective.

If a public library's services are used by local businesses, one can even argue that their incomes and impact on the community are being supported by the system. An evaluation of current procedures may also reveal that a microcomputer system can reduce the library's operational costs. This may take various forms, including eliminating the need for equipment with expensive lease and maintenance costs such as keypunch machines or minicomputers.

A micro may take up less space than existing equipment, or it may replace manual operations that consumed large work areas. Floor space is expensive, and automation may make room for additional staff or operations. Supplies for micro-computers may be more or less expensive than those used in current operations; the library must look carefully at this aspect since it is a continual cost rather than part of the initial investment.

Upgradation

The decision to automate can take three directions: purchase existing software that meets the library's requirements; purchase software that can be modified or develop the programmes in-house. To determine the best alternative, the library should evaluate existing software to determine what is available and to what extent it can meet the library's needs. For many straightforward or single-function applications, existing software packages may provide the easiest and most economical answer.

Suitable Software

If the library has some in-house expertise with programming microcomputers, the option of modifying existing application packages should be considered. Software that has been developed for library support, but does not quite handle all the desired functions, may be expandable.

Careful analysis should reveal whether some aspects of the design logic in the existing software could prevent the desired enhancements. In many cases, however, it will be more cost-effective to upgrade an existing package than to start from the beginning. While expanding library packages may be feasible, modifying standard business packages is less likely to succeed. Libraries have attempted to modify inventory control systems for bibliographic control on mainframes and minicomputers with limited success; it is not likely that micros would have any greater success.

The major problems in converting business systems are the file structures and the record formats. Bibliographic records require multiple access points or indexes to the record; most inventory or business accounting systems have only one or two. Bibliographic records are also extremely complex; they have variable-length fields of information as well as variable occurrences of fields.

For example, some titles have multiple authors while have only one. By contrast, standard business software has brief records and usually short field lengths as well. If the library decides to modifies existing library-or business oriented software, the costs of modification must be projected. These costs, beyond the price of the software, include the programmer, staff time to specify the necessary changes and delayed implementation until the changes are completed.

Changes may also void maintenance contracts and performance guarantees, and future releases are likely to be incompatible. In short, the library must assume total support responsibility, as it must with locally developed systems. Successful adaptation cannot be guaranteed, but a schedule for evaluating the progress of the software changes should be established. Periodic reviews should document all developments and revise the schedule if necessary. The question of ownership must also be addressed.

The original software developer has a significant investment in the programme, but the extent of the changes determines whether or not the software is considered a new product. In-house software development is a major undertaking. However, it may be the only option if there are no existing programmes that meet the library's specifications. In-house development is generally more expensive than purchasing existing software where development costs are spread over several users. As with modifying software, writing programmes requires not only programming expertise but also considerable commitment by the entire library to define the exact capabilities of the system. There are also no guarantees that the final product will be the one initially envisioned. Additionally, the system will not be ready immediately; in fact, very few programming efforts for complex applications have stayed on schedule.

Delays result in postponed installation, longer use of the manual or earlier automated system and increased development costs because more staff time is needed. In-house development, as stated before, requires programming expertise. The library must determine if that capability exists among its staff or if additional programmers will be necessary. Even if a staff member can do the programming, someone else must assume that person's regular duties. In-house development also increase the number of hardware options which must be evaluated. Selecting existing software often determines the hardware that can be used or at least reduces the number of micros that can be pondered over.

Maintenance and Enhancement

In fact, development or expansion of a system may have an end, but ongoing maintenance and future enhancements do not. Staff support will be required on a continual basis as the library determines that a few changes are necessary, for example, to speed processing or to make the system more user cordial. Reports never quite seem to meet the desires of the staff after the system is installed—requests for slight format changes or inclusion of additional fields of data are inevitable.

Naturally, the library can stand firm and refuse to consider such changes and enhancements, but one result may be that the system will not be used effectively. Further, as new operating systems become available from the vendors, the library may wish to upgrade the system to improve response time. Existing programmes would then need to be revised for the new operating system. On the whole, it is best to assume that ongoing support costs for both maintenance and enhancement will be part of automation.

System Capabilities Agenda

Whether purchasing software packages, modifying existing programmes or developing the entire system locally, the library should first state its requirements in a written subclassification for the desired system. This document should be extremely detailed. A frequent approach is to label the various functions as mandatory, desirable and "blue sky." For an acquisitions system, for example, printing of purchase orders and fund accounting capabilities may be mandatory. An online vendor file might be viewed as desirable, while vendor performance statistics on orders filled, time delays and discounts could be considered "blue sky." Naturally, the ranking of different features varies among libraries. The library should also determine how its work environment will affect the performance of the system and should anticipate the impact of various problems or shortcomings. If the system must be stand-alone for a particular function, determine the frequency of that operation.

Can it be scheduled at a time when the system would not otherwise be in use? Consider the trade-offs between various requirements; some capabilities may be possible with larger systems, but the performance may not justify the larger expense. After the library has defined the desired system, an evaluation of existing packages should be made. This should cover each system's probable lifetime, potential for expansion, reliability and documentation.

The evaluation should also include information from both system vendors and users—each has a different perspective, and each reveals different aspects of the system. By objective and fair. When calling other users, talk to both the library administration and the operators who use the system daily. Determine the role and the perspective of the person giving the comments. For example, if there are complaints of recent downtime, ask if that is a frequent occurrence of simply a recent and temporary problem.

If it is the first major problem in two years, it may not be very important, despite the inconvenience at the time. Actual statistics from a broad time period will ensure a true representation of performance. After investigating several systems, the library may recognises a need to revise its specifications. It may find details that were overlooked, or new ideas may have been sparked by the review of existing systems.

Once the functional capabilities of existing systems are known, the library should evaluate each system's probable lifetime. Of course, no system will last forever. The rapid changes in microcomputer technology have two basic impacts: technical support for current systems may be discontinued as new ones are developed, and new technology may eventually make it more efficient for the library to change to a new system. Therefore, the lifetime of a system should be defined as the probable length of time that the system will meet the library's needs.

A small circulation system may not handle the level of activity that the library anticipates after five years, but if it will last that interim period, the system might be amortised and considered a sound investment. Another aspect is whether or not the system can be upgraded through the same vendor. If the product has many unique characteristics that are tied to the particular micro or its operating system, or if the manufacture of either the hardware or software is not likely to make the future enhancements that you anticipate needing, the library may have considerable problems in transferring to a later system.

This is especially critical in the transfer of data from one system to another. If a new system does not have compatible record formats and file structures, the information may need considerable editing. Creating a data base once is extremely expensive—revising it with every system change would be an economic disaster.

Further, the library must be sure that both hardware and software can be expanded to meet future needs. For example, some systems allow for single stations, while others support multiple terminals. The library should check that the software structure does not prevent adding more indexes or changing the record structure to variable-length fields. The storage capacity of some system cannot be expanded as the data base grows; some may not support hard disks, causing a problem if it becomes necessary to progress beyond the limited storage capacity and reliability of floppy disks. System expandability also involves issues of compatibility among microcomputers and possibly with larger computers when there is a desire to link systems. Some microcomputer vendors have developed higher-level systems that are not compatible with their own more basic systems; therefore the system cannot be upgraded to the larger computer even though it comes from the same vendor.

Despite the dynamic state of the microcomputer industry, problems of compatibility are not likely to be resolved in the immediate future. The library must also determine what peripheral devices can be added to a system. For example, some system do not have letter quality printers, which may be needed initially or planned for the future. Even though a library may not need all the various options and possible capabilities, the selection evaluation should determine what future alternatives do exit.

How Much Reliable?

Reliability should be considered on two levels: the performance of the entire system and that of each component. This is important both in defining whether or not the system is meeting the contractual requirements and in evaluating existing installations. The microcomputer may function, but if the terminal or printer is down, work cannot be done. If the system configuration supports multiple work stations, one terminal may be available while another is not. People have different definitions as to what constitutes the system being down—and vendors tend to consider the system to be working unless the entire configuration is not operational. Concern over system reliability seems to vary among librarians, probably depending on their experiences with technology. A system's performance, however, will have a critical effect upon efficiency, staff acceptance and the library's ability to provide services. In evaluating system reliability at existing installations, it is important to determine whether or not the environment is similar to that of your own library. Much heavier or lighter work loads can have a major effect on performance, as can the size of the data base being supported and the number of terminals used. Analyse the technical expertise of other users. Is it similar to your own?

Is their success or failure due to their own capabilities or misconceptions, rather than to the particular system they are using? Standardise your definitions of terms such as response time and downtime, and be specific. Adjectives such as "fast" or "poor" are relative—determine the number of seconds for various types of functions.

Documentation

The documentation of any system, regardless of type of computer, is crucial to its success and should be valuated carefully. Good documentation is difficult and expensive to write, and it is not readily found. Preparing documentation is likely to be even more of a problem for small companies than for larger ones, which have entire departments of technical writers devoted to producing promotional and descriptive literature.

Basically, documentation must be complete and understandable at all levels—programming, user manuals and hardware. Programming documentation may be the major issue if you will support the system yourself. It is impossible to take on the support or enhancement of existing programmes without understanding how they operate. User documentation is equally important to the success of the system, although it is possible for the library to develop or enhance this type of aid if necessary.

Even if user documentation is available, the library may wish to customise it somewhat. For that purpose, programming documentation is again important for purchasing a package since it provides background to understanding the system and subsequently preparing the user manuals. Hardware documentation is generally standard and available from the manufacturer, either directly or through a second vendor if your purchase a package of software and hardware together.

The major point to watch for is documentation of any hardware modifications by the second vendor. Foe example, terminals may be modified or the bus structure changed to facilitate a particular software package. Such modifications mean that the original manufacture will not provide any maintenance on that hardware—the buyer must rely on the company that made the modifications. Should that second firm go out of business or discontinue that particular piece of hardware, future maintenance can be a problem. In such a case, documentation is extremely important to enable a third party to assume maintenance. (However, this can be very expensive, as the third party will charge for its learning time.) The decision to purchase a microcomputer system obviously requires an analysis of the costs involved. As part of the needs assessment, a cost analysis of the current operations should be done to compare with the cost of installing and operating the computer. Costs can be divided into four categories; all must be considered in determining the library's ability to support the system. Initial purchase price and on-going support and staff costs are discussed in this section. Site preparation and transfer of data from the existing system to the new one are discussed in the sections that follow.

The basic cost of buying a microcomputer plus peripherals is generally the one looked at first. The changes in microcomputer technology have resulted in decreasing costs, making such systems affordable for more and more libraries. As indicated elsewhere, micro-processor chips have rapidly dropped in price and predictions are that the trend will continue. Some peripherals are still quite expensive, but they too are showing a downward trend. Cost analysis should consider the base system that can meet current needs and the costs for enhancing the system if there are plans to expand its use by adding other applications or accommodating more users. Such expansion would require more terminals or storage capacity. The library should develop a timetable for anticipated expansion; if it will take place within two years, expansion costs should be considered and compared among the systems being considered. If expansion is not likely for another five years, then the probability of upgrading the current system is low.

Technological advances will probably make a change to an entirely new system ore appropriate. If the existing system is upgraded in several years, the costs are likely to be quite different that for the same enhancements at current prices. However, because the library may recognise many possible expansions once the system is installed, information on expansion possibilities and costs should be part of any cost analysis. When evaluating systems, consider the costs of hardware and software separately. This facilitates comparisons with other systems, even if the hardware and software are marketed as a combined system package.

Software could be purchased from another library, a private consultant or a retail store, as well as from a system vendor. Knowing the costs of each component of the system enables the library to project future costs for adding more tape drives, terminals, etc. While there are relatively few microcomputer-based "package systems" that specify prices for hardware, software, maintenance and future enhancements, they are starting to emerge. It is important to know the cost of each component as well as overall price in comparing different systems with similar ability to satisfy the library's needs. In such packages, the vendor may cover overhead costs, future maintenance support and profits through inflated hardware prices.

While that is a valid approach, it is important to see where these costs are being covered. Depending upon whether they are included in the ongoing maintenance fee or in the hardware component prices, the ongoing costs and the future costs of expanding the system are affected. The vendor should also be asked to provide costs for adding various components, including some that may not be part of the initial system. Maintenance costs for both hardware and software should be quoted. Many library packages based on mainframes and minicomputers have been marketed with the understanding that future enhancements will be distributed in later releases of the software. If this is the case with a micro system, then the costs should be stipulated.

While the initial purchase costs are important budget considerations, they are often mistaken as the primary costs of automation. Most likely, the ongoing costs of supporting and using the system will exceed the initial dollar investment; thus, the consideration of ongoing costs is very important in preparing the cost justification of the system. Hardware, software and vendor-produced package systems may have monthly maintenance fees. Some software packages have license fees since the proprietary rights are not released.

Naturally, any system requires supplies such as paper and forms, floppy disks or cassettes, and print wheels and tapes. While these expenses are generally much lower than those for hardware or software, they should be compared among various systems. The impact of a new system on the library staff is a frequently overlooked cost. Staff productivity is affected during the preparing, installing, testing, debugging and training for a new system. Possible reorganisation of duties and work procedures takes time to define and implement.

New procedure manuals may be necessary, several staff members may require training, and new problems may need to be addressed. These are all part of the initial costs and presumably cease once the system is functioning properly, but it is important to realise their impact. Libraries that elect to develop their own microcomputer software face significant ongoing costs in personnel salaries. As discussed earlier, even if the software is developed by someone already on the staff, the library is paying that salary, which must then be attributed to the cost of the system. That is true even if that person's previous responsibilities are absorbed by other personnel, incurring no new or increased salary expenditures. Depending upon the complexity of the programmes, the amount of time for software development could vary from a matter of days to several months.

If the software is developed locally, it will probably be maintained in-house as well, Any future changes, improvements or correction of "bugs" will continue to require staff hours. While it would be possible to contract for outside maintenance, a new programmer must learn the package before making any changes or corrections; thus, the library pays for the learning time whenever someone new is introduced. A similar situation exists if the library support staff is replaced. If the programmes were written by a staff member who was not classified as a programmer, the library may need a programmer when he leaves, and this may be a higher level staff position. A full-time, trained programmer may also be advisable if the library plans a complex system in terms of programme sophistication.

As discussed under needs assessment, one purpose of automation may be to reduce staff costs, but a programmer may be more expensive than the clerical staff replaced by the system. The needs assessment and the library's dependence upon the system must be considered in planning the support arrangements. The greater the impact the system has on the library, the more important and justifiable the support of the system by a full-time programmer.

Generally, microcomputers have been hailed as eliminating all the environmental requirements of the larger computers. It is true that the small micros do not generate enough heat to require supplemental air conditioning, and they do not need special wiring. However, the larger microcomputer systems—those that can support large data bases and multiple users—are more susceptible to heat and power fluctuations. Site specifications from the hardware manufacturer should be studied carefully.

Systems that support multiple terminals at various locations will need to have coaxial cable strung from the computer to the different sites. If holes are needed in walls or floors, the library may have to hire a carpenter. The use of the system and its impact on work-flows may even result in some remodelling of work areas. Larger desks or lower tables may need to be purchased to accommodate terminals.

Many of the gains made through automation require changing the approach to accomplishing a task rather than simply imitating the earlier procedures with a computer. However, applications that involve the transfer of data from one system to another pose an additional set of problems and incur additional costs. Manual files of on-order materials or records of materials catalogued and indexed over the last several years need to be keyed into the new system. Such a project can consume many man-hours and may require additional staff during the implementation period. If the library has the information in machine-readable form from another system, it will undoubtedly be more efficient to transfer the data directly into the new system. (The capability of the system to accept machine-readable data should have been considered in the functional analysis of systems during the selection process.) For data on either cassettes or floppy disks, the local system must have the appropriate peripherals to read them. If the file is on larger machine tapes, the best alternative would probably be to download the data to the micro system, since the tapes and disks of the larger machines cannot be mounted on microcomputers for data transfer. Regardless of how data are transferred, the format of the data must be considered. Record formats may change periodically, and programmes must be modified to reflect the changes. This requires programming expertise as well as a knowledge of present and future data formats and any unique characteristics of the data treatment.

It is remarkable to note here that microcomputer systems are available from numerous sources: directly from the manufacturer; from computer shops, which deal in numerous products; from other libraries; and from vendors who have modified the hardware or created specialised packages of hardware and applications software. Whatever the source, the library needs to consider vendor characteristics that can affect future satisfaction with the system.

Many microcomputer firms have already come and gone. Many current hardware and software products will probably disappear gradually as the market is taken over by a few major companies. No one can predict which ones will succeed or fail, but libraries should be aware of each company's financial stability when selecting a system. Ask how many systems have been sold. Contact libraries with existing installations to determine the vendor's reputation for backing the product. It is especially important to evaluate the vendor's commitment to the product if you are dealing with a small independent company or with a new or small division of a larger corporation.

Ask the number of employees. Determine if there are separate staffs to support the management, product development, sales training and maintenance aspects. The downfall of many small companies that have developed microcomputer hardware and software is that everything depends on one or two people, especially if the company started as a side effort rather than a full-time job. Someone capable of designing new hardware or software is not necessarily a good manager or marketing person. Also, if his interests change and he abandons the product for another one, the company may not have anyone capable of providing support or maintenance. This is not to say that all microcomputers and software from small shops should be avoided. Some very good products are available through them, and many of the successful microcomputer systems being marketed to libraries today began under similar conditions. However, the library should consider what alternatives if has should the company discontinue its product. In some cases, a system will involve more than one vendor or manufacturer. The hardware and software may not be from the same source, and each may be marketed by a retail store rather than by the company that made the computers or wrote the programmes. This can make it difficult to get an expert explanation of the capabilities of the system. Salesmen in general computer stores that retail machines and software packages are usually not oriented toward specialised applications. They may be hardware specialists, programmers or marketing staff.

Because few library packages are sold through retail stores, and few salesmen have library background, salesmen tend to promote general package products. Usually with such packages, either the programmes or the library procedures must be modified or compromised. Remember that it is the librarian's responsibility to learn what is available and decide if existing programmes are appropriate. Most library-specific packages are coming from people or companies who understand libraries and information centers.

Many have been developed by library staff or by programmers under the direction of librarians. In these cases, the salespeople may have aided in the development or have access to those who did. Since they are dealing with comparatively few packages, they are well-versed in the capabilities and the types of environments where the packages would be used. These companies are also more likely to include future system enhancements through periodic software releases. In some cases, this option may be tied into the maintenance contracts.

Software is also available from libraries that have developed their own programmes. Some libraries trade or give away software; others sell it to recoup some of the development costs. When obtaining software from another library, it is important to find out how much assistance the library will provide with the programme. Will user instruction and programming assistance be offered? How complete is the documentation, both for programmers and for users? Libraries are most likely to offer their software as an operational system but with no guarantee that problems will not arise if new conditions or types of data are introduced.

The receiving library should make clear whether it wishes to make changes in the software and whether or not it has the programming expertise to understand the programme and make modifications. The original library should clarify whether the software is copyrighted and whether the second library may, in turn, give away or sell its programmes. As with commercially available programmes, there are several other questions to be considered. Will the modifications change the ownership? Will there be future releases and enhancements? If so, how will they be distributed to other users of the programme?

Maintenance support is another important consideration in evaluating a dealer or agency. Usually for micro hardware maintenance, the owner must ship equipment to the vendor or take it to the store where purchased. On-site maintenance is unlikely except for some of the largest micros. If a vendor marketing a combination hardware/software package is willing to provide such support, it will be very expensive, proportional to the total system costs. Plane fares to the site or staff time to perform the repairs cost the some for a micro as for the more expensive minis and mainframes. The maintenance available for microcomputers varies according to the size of the computer. Naturally, the smaller the size and thus the lower the price of the hardware, the lower the maintenance support the company can afford to provide. Maintenance by computer store staff will vary significantly from one shop to another, depending upon the size of the store and the level of support staff it can afford. Generally, there is more profit in sales than in maintenance and most vendors are likely to concentrate their resources on the former.

In fact, Software purchased through retail stores may have similar problems of maintenance support. Relatively few library-specific applications are being sold through retail shops, but general word processing or accounting routines used by libraries are available and frequently require little or no maintenance. An additional problem of retail software is that expandability, resolution of flaws or any further enhancements may not be covered.

Though they may be guaranteed to perform certain functions, such programmes are frequently viewed as one-time development efforts. Maintenance of software by vendors may include continual phone support to answer questions, decipher error messages or solve programme bugs; or it may specify a limited amount of consultation on such problems. Extremely complex problems could result in on-site visits by either software or hardware engineers. Remote diagnostics via phone links to the local system are another possibility. Regardless of the type of support, maintenance is an ongoing expense for the vendor, who must retain staff for as long as the system is supported. This will be reflected in the purchase price and ongoing maintenance fees.

Relative to the cost of the hardware and software, this cost may seem unreasonably high. However, once again, support staff salaries, maintenance equipment and operating expenses are not significantly different from those supporting application packages on larger, more expensive machines. As with hardware, the ratio of ongoing maintenance cost to software purchase price is much higher for micro systems.

Vendors may distribute upgraded software after design or programming flaws are discovered. Some vendors perceive their product as an ongoing, evolving package, and any errors found by users will be corrected and redistributed. Others consider the development a single project with a beginning and ending date; once accepted by the library, the programmer has no more responsibilities.

A major issue in the selection of any system is the contract. Contract terms and considerations will depend on the size of the purchase and on whether the contract covers hardware, software or a package of both. Hardware is generally sold with standard warranties or contracts regarding its capabilities and the type of maintenance support that will be provided. No guarantees of application software performance will be made by the hardware vendor if software is purchased separately. Instead, system capabilities will be defined in terms of number of terminals that the microcomputer can support, the types and amounts of storage, the languages and operating systems that can be used and the type of printer. Much of the discussion here will therefore concentrate on contracts for either software or complete packages containing both hardware and software. In either case, a contract is extremely important. It is the library's only assurance that the product will perform as described—and its only protection if it does not. Only written agreements and guarantees are enforceable. For this reason, the contract should be considered very carefully rather than as an afterthought or as the final procedure of system procurement.

Naturally, however, the library must consider the size of the purchase in developing a contract; the greater the dollar expenditure, the more important the contract for both the library and the vendor. For system packages that include both software and hardware, the contract must clearly identify who is responsible for rectifying any problems. Buying a system from a single vendor is the simplest approach since the vendor, not the library, is then responsible for identifying whether a problem is hardware—or software-based. The vendor should be held responsible for meeting the contract's specifications for remedying problems within a certain amount of time. Libraries that buy hardware and software separately or whose contract does not specify a single party as responsible for resolving difficulties should recognise the problems that may arise with determining maintenance responsibility.

The contract should specify in detail a product description, acceptance criteria, the test period, payment terms and maintenance agreements. Although the library should not be skeptical about the system it purchases, it is best to approach the contract development phase with the assumption that problems will be a normal part of implementation. With a detailed contract, both library and vendor will have a clearer understanding of what the library wants, what the system can provide and what action will be taken in various situations. This understanding promotes more successful implementation and use of the system.

The system profile or product description can be from the vendor or the library. It may be the original or a revised specification document prepared by the library, especially if a bid process is used for the procurement. The contract's product description should address hardware and software (if it covers both). Exact hardware components should be identified, along with their capabilities. The contract may include reference to specific manufacturer descriptions. If the hardware has been modified by the vendor, those changes should be described in detail. Software descriptions should contain a detailed analysis of the functional capabilities and, of course, should meet the library's requirements. Capabilities should be well-defined rather than stated in generalities.

If there are specific requirements as to how a function is performed, in addition to the fact that it is supported by the system, these must be stated. For example, the phrase "online editing" does not specify if an entire field must be re-entered to correct a spelling error or if an omitted letter can simply be inserted by cursor positioning. Such descriptions may be made jointly with the vendor; both parties must agree on the description. In addition to detailing the functional capabilities that the system must support, the document should specify performance criteria. Response time, data base size, quality of print products and functions to be supported simultaneously are good examples of aspects that can be specified.

Performance criteria must also consider the impact of other variables: for example, whether response time will decrease with multiple terminals or a larger data base; or whether report generation programmes can run simultaneously with online editing if more terminals are added or if different storage devices are used.

The contract should define the acceptance tests that will be performed on the system. The length of the test period should be stated. The type of application and the sophistication of the system will be the primary factors in establishing the length of the test, but the library should also require a lengthy amount of time if implementation and training are complex.

If a data base is involved, for example, the system will probably not provide accurate performance statistics until that file is loaded and all simultaneous work stations are operational. The vendor should realise that system capabilities may not be fully appreciated if the staff is not yet well trained and comfortable. If the system supports multiple functions, all should be tested. In order to determine typical response times, various workloads should be simulated and documented. Collect enough data to determine a statistically valid average and indication of the maximums and minimums.

Define response time and the test parameters for applications such as a circulation system or a retrieval package. For example, is response time measured from the time the enter key is pressed until the data begin to appear on the screen or until the entire retrieved information is displayed? Indicate the size of the files, the number of simultaneous users and any other variables that could affect the test results. Then change the type of transaction or the number of users and repeat the tests. If certain functions will be done simultaneously, test them simultaneously.

If reports can be printed while the data base is loading or the terminals are active, determine the performance under those conditions and any other environments likely to be needed once the system is being used. Acceptance testing may also affect when payment will be made, and this should be stated in the contract. If the acceptance test must be passed before payment, the length and details of the test are even more important. The library will have for more leverage in receiving a system that performs as marketed if payment is withheld until the criteria are satisfied. If the system fails the acceptance test, the library can decide whether or not the test period should be extended.

Maintenance and Service

As is obvious from the preceding discussion, various maintenance options may be offered by the different sources of hardware and software. The contract should specify the type of maintenance support in detail. It should include turnaround time for responding to maintenance requests, such as a guarantee to arrive on site within a given number of hours after being notified of a system problem. If there is no on-site maintenance, the contract should state how quickly various problems will be corrected once the equipment is delivered to the vendor. The library must determine whether it will require the vendor to lend or rent other equipment if the library's equipment must be repaired. For example, a circulation system terminal may be more indispensible than one used for data entry or for producing purchase orders because the latter processes do not involve general library users.

The contract can stipulate that identical equipment will be loaned or may allow for comparable machines to be substituted if they are available. If the system is purchased as a vendor package, complete with ongoing maintenance, the contract may tie software maintenance to future enhancements. Problems and programme errors may be resolved in a new updated release of the system that also contains additional system capabilities. In this case, the library should clarify the frequency and the means of determining whether a desired improvement or change will be made. The contract should also address modifications made to the purchased package by the library. Changes made by the library will generally void any maintenance agreement or performance guarantees since the original developer cannot be responsible for the level of work being performed. Changes will also be likely to render the system incompatible with any future updates or releases that the vendor may provide.

Software Development

Practically, contracting for customised software development is very difficult. Specifications of the desired product must be extremely detailed since differing interpretations of a function can lead to an unacceptable system. The contract must stipulate various benchmarks or progress reviews to help ensure that the product is developing in the right direction. Otherwise, misunderstandings may not be recognised until the product is delivered. The contract must state penalties or planned action should the product fail to meet the specifications or deadlines for completion.

These must be amended, however, if the library changes the system requirements once development has started. Future support of the product should also be outlined. If a programmer develops the product as a one-time contract, the library will probably have to provide its own maintenance support or at least contract with another vendor. The contract should also state ownership in such cases.

Since the library is paying for the development, it has some claim to complete ownership and rights to the programmes once delivered. The library should consider the contract as part of its process of evaluating existing systems and should write its own agreement terms in order to protect its interests. Then, after deciding what requirements are important and what the contract should accomplish, the library should examine other contracts, including those offered by the vendor.

Undoubtedly, overlooked issues will be found, and the contract will need revisions. However, this approach avoids the pitfalls of simply accepting a vendor contract without realising points that it may omit. Purchasing a computer system is generally a large expenditure, and the library is in a position to negotiate the contract, especially for larger systems. The vendor may be flexible on discounts, maintenance or other benefits. However, the library must be realistic. The number of available packages and the size of the purchase are the two primary factors in negotiating the purchase, and both the library and the vendors know the marketplace.

FURTHER Many libraries hire a consultant to assist in selecting an automated system. This may be important if the library has no expertise among its staff for evaluating automated systems. However, the library should determine the exact role that the consultant will play. It should select a consultant whom it respects and trusts. However, the consultant is only an advisor; the library is still responsible for the final decisions. To be truly effective in the selection of a system, the consultant should be involved in the project from the beginning. The library should determine what it wants to automate and the basic requirements of a system. Once that has been a accomplished, the consultant can assist in a needs assessment, giving objective comments on existing procedures. He may also be able to provide information on features other libraries have found desirable, may be more aware of existing system capabilities and may have a more realistic approach to what should be sought. Using a consultant in selecting a microcomputer system is somewhat similar to purchasing a maintenance contract for the system: both may seem too expensive relative to the price of the actual system. However, the amount of time and expertise required to select a micro system is a function of system sophistication, not the size and cost of the computer. The impact on the library in terms of service, costs and operations will have to be considered to determine if the added costs of a consultant are justified. If a consultant is retained, it is advisable to have a contract that details what the library will do and what will be delegated to him. The contract should state the amount of time that the consultant should provide, written reports or documents that are to be submitted, the types of advice that are to be provide and payment agreements etc.

Procurement options with microcomputers are somewhat different from those of systems based on larger computers. Many of the packages are developed by small companies or by single individuals who have neither the time nor inclination to respond to Request for Proposal (RFP) documents or to engage in competitive bidding for a contract or sale. In these cases, the sole option is direct purchase. However, as more microcomputer applications are developed, it is likely that more companies will undertake active marketing programmes and begin responding to bid requests.

Libraries must determine first if they are required to use the bid process; many publicly supported libraries, whether academic or city, must use this procedure. However, if there is an option, the pros and cons must be considered. The bid process of issuing an RFP, evaluating the responses and selecting a system may help obtain the desired system at a lower price. However, the process itself is expensive and time-consuming. The library should evaluate the existing marketplace. If there are very few systems that perform the exact functions required, the bid process may not be necessary.

Professionalism in Service Providing

Here we intend to advance a conceptual framework for considering library services. It is not asserted that what follows constitutes a complete framework, but rather an attempt to take a step toward the development of a framework.

The motivation is both intellectual and pragmatic. At an intellectual level, there is curiosity about the nature of things and about how—and why—they work. At a pragmatic level, there is the incentive that a clearer theoretical understanding might bring greater effectiveness in practice. No doubt, theory brings insights, but there is no guarantee that theory will be helpful in practice. Bad theory may bring false and misleading insights, good theory brings helpful insights. However, theory, once developed, can, in general, be tested—and inadequate theory rejected. A necessary condition for progress, then, is to propose theory so that it can be tested. While providing services to library users some questions arise in our mind, like—

(a) Why do library services differ from each other from one context to another?
(b) How do the different facets of librarianship relate to one another?
(c) What is "goodness" with respect to library services?
(d) How do libraries survive?
(e) How big should a library be?
(f) How should catalogues and retrieval systems be evaluated?
(g) Why aren't libraries used more?

It is asserted that it is lack of theory which causes these questions to be and to remain—problems.

It is remarkable to note that there are five key aspects of the provision and use of library services which include:

(a) Inquiries
(b) Retrieval
(c) The process of becoming informed
(d) The demand for library services
(e) The allocation of resources to and within library services.

Although an evenly balanced overview is desirable, some topics must be given more attention than others. This unevenness derives from two considerations:

(a) The development of theory with respect to library services is itself uneven. For example, little seems to be known about how users come to formulate the inquiries which they bring to libraries.
(b) Some topics need a longer and more careful exposition than others in order to describe them adequately.

Not only does the state of theory concerning library services hardly seem ready for such treatment but, even if it were, formal, rigorous treatment would probably have hindered communication with many people who would otherwise have been interested.

We are concerned with library services and, therefore, with both the provision and the use of these services. The intent has been to focus on the theoretical aspects and the emphasis is on developing a framework—on how the parts fit together and into the context in which the services are provided.

Indeed, a suitable subtitle would have been “Toward a conceptual framework for considering the structure and functioning of library services in relation to their sponsors, their users, and their societal context.”

Most of the literature about library services has to do with specific details such as indexing, classification, logistics, and social mission. It is clearly important to have such detailed treatments. In contrast, however, the pages that follow represent an attempt to provide a general theoretical framework. Ideally, the more specialized theoretical work will fit within and into this more general treatment. The one should complement the other.

Circulation Functions

In fact, circulation of books is the pivotal role of a library. The activities of the circulation department involve giving assistance to users in using the catalogue; issuing and receiving books; maintaining borrowers’ records; keeping records and statistics; conducting studies of the use of library materials; collecting fines; and formulating policies and procedures for these activities. The circulation section is, therefore, the most important part of the library and its functions are as follows:

1. To enrol members for the library.
2. To issue books for home reading, official work or otherwise to the borrowers/readers/officials through their borrowers tickets/ Passbooks or requisition slips.
3. To maintain shelf arrangement.
4. To get the suggestions of the readers for the purchase of books and arrange their purchase through Acquisition section.
5. To issue No Demand/Clearance Certificates to the members at the time of their leaving the library membership.
6. To recall overdue books/material.
7. To maintain statistics on the working of the Division.
8. To reserve books/material which have been requested.

Further circulation section usually consists of three parts:

(a) the issue desk where books are charged and discharged, requests and general enquiries are attended to.

(b) the work room where routines such as sending reminders, handling inter-library loans and servicing readers’ requests are undertaken.

(c) the shelves, equipment area.

Most of these tasks require the adoption of a definite issue system on "charging" following certain routines and promoting efficiency. The libraries of earliest times kept simple records in the registers/ledgers when closed access was there. With the expansion and diversification of library materials the use of the library increased, the open access was introduced and new charging systems were invented. For the last several decades various systems have come into use.

First of all, book card file systems such as Browne and Newark were predominant. Then came the Transaction Card File systems with Mechanisation and the Photo-charging systems. Finally, the contemporary technological societies of the developed countries have made strides with the most advanced mechanical device in this field—the Computer.

No single issue system is ideal for all Library situations. While choosing a system, a library has to take into account its own peculiarities. Cost, speed, simplicity, accuracy, security and circulation activities are some of the factors in choosing a system.

The main issue systems are as follows:

1. Browne
2. Newark
3. Bookamatic
4. Photocharging
5. Multiple issue slip system
6. Token charging
7. Computers.

The photocharging system is now most common in many Indian libraries. Except Browne none of the other systems is popular. In some Indian libraries the circulation of books is done through computer's application.

Browne System

Since this system is most popular, it is necessary to explain it in detail. In this system the borrower is given a ticket called Borrower's Ticket in the form of a pocket bearing his/her name and address. The loan is effected by (a) placing the book card each in the borrower's ticket and filing it by date due, sub-arranged by accession number, author or the call No., (b) stamping the book with the date of return. When the book is returned the discharge is effected by

(a) Noting the date due;
(b) searching and retrieving the loan record from the issue file;
(c) separating the book card from the borrower's ticket;

(d) putting the card back in the book and returning the ticket to the borrower.

Merits

The advantages of the system are: (i) Charging is relatively rapid, (ii) the reader does not participate, (iii) errors in the loan are minimum, (iv) economical on stationery, (v) simple to operate and overdues are easily located.

Demerits

In this system main disadvantages are that discharging is slow and only single record of loan is kept. Despite its shortcomings Browne system is really an ideal system for small and medium-sized libraries. With modification, it can be used in almost any type of library.

Registration of Borrowers

For borrowing books for outside the library reading, the readers are registered within rules and regulations of the library. Reader has to fill up the application form providing his or her particulars. Most of the libraries require the signature of a responsible person and in case of government libraries the signature of administrative authority under whose control the reader is working.

The application form should be as simple as possible though there cannot be a same form for every type of library, yet the basic information required to be entered in the form is the same.

It is pertinent to note that Public libraries are open to all the readers but in other types of libraries the membership is restricted to special type of clientele.

Rules

The readers should be asked to read the rules of the library before they are registered as borrowing members of the library.

Reminders

Reminders for overdue books from the borrowers should be sent in time.

Shelving

Shelving of books in a library is most important part of the circulation section. Books should be restored on the shelves as soon as they are returned. The shelving should be accurate and tidy. Once in a while the shelf-reading should be done to see that the books are properly arranged in correct order.

Inter-Library Loans

No doubt, no library is self-sufficient. More often than not there are occasions in a library when books are obtained from other libraries on inter-library loan. The book asked for by the user for urgent use can either be purchased or obtained from other libraries. Even if the book is not out of print and is available in the market, it takes time to get it and to make available to the user. In such situation the library has to borrow book immediately on inter-library loan. Efforts should be made to borrow books from sister libraries which are located in the nearest vicinity.

Basically, an inter-library loan is a transaction in which library material, or a copy of the material, is made available by one library to another upon request. Since a library cannot own all materials, inter-library loan is a means of borrowing materials which users need for research and serious study from local, state, or regional libraries. Each library should provide information to library users regarding the purpose of inter-library loan and the library's inter-library loan policies.

The inter-library loan is not one way. The library has also to loan to other libraries. This should be done with mutual cooperation of libraries and requisition for inter-library loan should be entertained. Rare and reference books may not be loaned.

Requests for Reservation of Books

Generally, except Public Libraries all other libraries reserve books for their clientele, which are out on loan. Where there is lot of demand for reservation of books the formal procedure is adopted. The borrower should be provided with a reservation post-card on which he/she writes the particulars of the required item.

The other side of the post-card is used for the borrowers' address. Each issue system should usually have a built-in device for these reservations.

Shelf Reading

There is need for regular shelf reading in order to provide efficient retrieval of materials. The shelves should be read on a regular basis. Damaged books should be removed for repair and binding. Cleaners/ Farashes should clean the shelves, racks and other furniture daily as a matter of routine maintenance.

No Demand/Clearance Certificate

Practically, when a reader leaves the office, college, university, institution, he/she has to obtain a 'No-Demand' Certificate for the clearance of his/her dues. The readers of Public Libraries may not need such Library's 'No Demand' Certificate. In order to streamline the procedure a simple application form (as per *Appendix 5-VIII)* may be duly filled out by the reader. As soon as the application form is received all the necessary records of that particular borrower are crossed and a 'No Demand'/'No Objection/'No Dues/Clearance Certificate is issued to him/her.

Reference Service

The reference service means helping the readers in their use of the library. It is the reference service that builds the reputation of the library. If a good and efficient reference service is provided to the clientele the usefulness of the library is recognised. Whatever the size of the library, it will receive queries of one kind or the other from the readers, which must be answered promptly within the resources of the library. Some questions can be answered immediately by simple consultation but in some cases, a search has to be made which takes time.

Some pertinent questions may be.

1. *Short Range Questions:* Questions requiring simple consultation are called short range questions.
2. *Longe Range Questions:* Questions requiring more time and the use of more than one reference source are normally called long range questions.

Basically, the following factors are very important in delivering quick and efficient reference service:

(a) Capable and skilled staff

(b) Good collection of Reference Sources

(c) Efficient arrangement and maintenance of the collection.

The staff employed in the Reference section should be intelligent, trained in the use of reference books and reference methods and willing to help readers. A skilled reference assistant, who is knowledgeable of reference sources can make a significant difference in the delivery of reference service.

Reference Books

The work of the Reference Section covers everything necessary to help the reader in his/her inquiries including the selection of an adequate and suitable collection of reference books. The possession of the right books and the knowledge of how to use them are essential to the success of a reference section.

There are two kinds of books.

(i) Those which are meant to be read through for either information or enjoyment.

(ii) Those which are meant to be consulted or referred to for some specific piece of information.

Books of the latter kind are called reference books. These are comprehensive in scope, condensed in treatment and are arranged according to some special order to facilitate the ready and accurate finding of information. This special order may be alphabetic, chronological, tabular, regional, classified or systematic. The books which are not arranged in alphabetical order are generally provided with indexes. Alphabetic approach is needed to find a fact or piece of information.

There are some books, which are so comprehensive, accurate and so well provided with indexes though not reference books yet they also serve as reference books. Experience has shown that formal reference books constitute only a part but there are questions and situations where you have to consult other books. Either there is reference in the reference books for such books or the Reference Assistant feels that a particular book might contain the required information. The arrangement and maintenance of the reference collection is very essential. Even if a library has got the best reference collection but if the books can't be retrieved due to lack of shelf reading then what is the use of such a collection. Proper maintenance is equally important. As soon as the new editions of the reference books are available these should be procured to keep the collection uptodate and current. Old editions may be kept aside for reference in times of need.

The reference collection may also be supplemented by adding vertical reference files, indexes and clipping collections. If need be the catalogue may be supplemented by other bibliographic tools depending upon the type of catalogue a library has. Remarkably, the following books are recommended for reference librarians:

1. Sheehy, E.P. — Guide to Reference Books
2. Katz, W.A — Introduction to Reference Work (2 vols)
3. Cheney, F.W. — Fundamental Reference and Sources
4. Walford, A.J. — Guide to Reference Materials

The reference collection of a library should have the following kinds of reference books: Dictionaries, Encyclopaedias, Year Books, Almanacks, Gazetteers, Atlases, Maps, Bibliographical sources, Directories, Handbooks, Manuals, Bibliographies, Statistical Sources, Audiovisual sources, Supplements to Encyclopaedias, Guidebooks, Globes, Indexing and Abstracting services.

Standard Reference Books

Standard reference books are essential in a library depending upon its budget and need. There are many more reference books but it is not possible to buy all of them for every library. For example there are more than 1000 Encyclopaedias alone.

Other Services

The librarians should not lose time and opportunity in organising various other services.

These services enhance library's role in meeting information needs of its users. The users benefit and are able to save their time in finding information they need. Such services are:

1. *List of New Additions:* A list of new books added to the library may be brought out every month.
2. *Bibliographies:* At regular intervals bibliographies on demand and on topical subject be brought out A bibliography is a list of writings on a given subject or by a given author. As far as possible annotated bibliographies should be brought out. These bibliographies help the readers to provide the background information on the specific subject or author of their interest.
3. *Current Awareness Service (CAS):* It is a system and often a publication for notifying current documents to users of libraries and information services.
4. *Document Back-up:* This service ensures access to documents by the provision of hard copy or microcopy. The purpose of this service is to provide the needed original document to the clientele.
5. *Article Alert:* Latest articles are brought to the notice of library users according to their subject of interest.
6. *Selective Dissemination of Information (SDI):* It provides location of new items from whatever source to those persons/researchers who need them most in connection with their current work or interest.
7. *Indexing and Abstracting:* These services provide access contents and to information located in books, journals and other publications.

The above services can be organised depending upon the availability of staff and the need of clientele of a library.

Important Steps in Service to Readers

1. Reminders for overdue books should be sent promptly on a regular basis.
2. Readers should be enrolled as members of the library and be given borrowers' tickets.
3. Capable staff with helping nature with pleasant disposition should be employed on the reference service.

4. Books and other library material should be restored on the shelves as soon as returned by users.
5. The arrangement of books on the shelves should be kept in order.
6. Daily dusting and cleaning of books, racks and other furniture should be maintained.
7. Staff deployed on Reference work should be trained in Reference service.
8. Old editions of reference books should be replaced with revised and uptodate editions.
9. Reference books should be kept in helpful order. Shelf reading should be done on a regular basis.
10. A good collection of reference tools should be developed.

Model Rules

Working Hours

The Library is open on all the days of the year from — A.M. to —— P.M. in summer/winter (Except on—————). These hours may be curtailed or extended in special circumstances by prior notice on the Notice Board.

Membership

The membership of the library is open to________and others with permission. All persons, entering the premises of the library, are required to show, on demand, their identity cards to the Janitor at the entrance.

Restricted Section

(i) 'Reference and Consultation Books' shall not be lent out of the library.

(ii) Every reader using the reference section of the library shall return the book(s) consulted either to the Librarian or any one of his Assistants at the reference counter before leaving the library.

(iii) Staff of the library working in the reference section will assist readers in locating information and sources on the subject of their study and research.

(iv) Readers in possession of periodicals, reference books etc. should pass them on to any other reader who may require to use them, when such a request is made through any of the library staff members.

(v) If a reader has not finished any book and he wants to continue with it the next day, he should put a slip with his signature and date and inform at the reference desk.

(vi) If a reader wants any pages of a book to be photocopied he should contact the reference desk for permission to get the same photocopied and make payment for the same, if applicable.

Borrowing Rights

Books may be borrowed by all members as per rule 2.

(i) Each borrower can borrow_______________books at a time. In exceptional cases, requests for additional books will be considered.

(ii) Books will be loaned for a period of_______days.

(iii) Books may be re-issued after the loan period of______days, if there is no call for it, at the discretion of the Librarian.

(iv) The Librarian can recall any book on loan, if it is required in the library urgently, even if it is not due to be returned.

(v) Sending of reminders is not obligatory for the library.

(vi) No reader shall take a book or journal or any other material out of the library without having it properly issued to him.

Inter-Library Loan

No library is self-sufficient in itself. Every library has to augment its collection by borrowing from other libraries. To borrow from other library is known as "Inter-Library Loan Service."

The Library will endeavour to borrow a publication from another library, if the same is not available in the Library. If the same is not returned within the specified time further facilities are likely to be denied. In case of loss, the borrower will have to pay the "replacement cost" fixed by the lending library.

Cost of Damaged/Lost Books and Periodicals

(i) If any book or periodical is damaged or lost by the borrower he/she will either replace it or pay its cost. It will have to be replaced by a new book or periodical of the same or later edition, at his/her cost. If the book/periodical is not available then photocopy and binding charges may be charged from the person who has lost it.

(ii) The price of a rare/out of print book will be determined by the competent authority and it shall be paid by the person responsible for the damage or loss of the book/periodical.

(iii) If a volume from a multi-volume set is lost or damaged the price of the whole set will be charged, unless the volume of the set lost can be obtained separately, in which case the cost of the particular volume alone will be recovered.

General Instructions

(i) Every reader entering the library should sign in the visitor's register kept for the purpose at the entrance gate of the library.

(ii) Personal books are not allowed in the library but in certain cases with the permission of the librarian, books may be taken in.

(iii) Writing or making any kind of mark in a book or a periodical is forbidden.

(iv) Cutting or tearing of any photo or page from any publication is prohibited.

(v) Smoking or eating is not permitted in the library.

(vi) Observe complete silence in the library.

(vii) Readers are not allowed to take their belongings inside the library.

(viii) All articles being taken out of the library are subject to inspection at the exit gate.

16

Libraries and the Internet

This chapter looks at the Internet, the library-related implications of which have been put concisely by Weibel (1995b):

> *The rapid development of networking and electronic dissemination of information forces upon us both opportunities and burdens. The opportunity is to provide the greater flexibility and convenience that networked information affords. The burden is to integrate these services with the existing library infrastructure such that users are not confronted with two disjoint information environments.*

The Internet is arguably the electronic resource that is now having the most significant impact on library services and operations and on the professional activities of librarians. This strength of impact is due to its multifaceted nature since it simultaneously fulfils three important roles in library services. First, it is a resource that can be consulted and used like any other reference tool. Second, it is more dynamic and far-reaching than any other resource used in a library setting. Finally, it provides a medium of communication that has extended the potential of librarians for interaction beyond the physical library (to users, colleagues, and other professionals), beyond any previous capacity, and in a host of new ways. This chapter explores the impact of the Internet on library services, professional activities, and relationships with library users.

The Internet is actually a non-network. It is technically comprised of a group of high-speed computer networks that are interconnected by the use of a common communications protocol-TCP/IP (transmission control protocol/Internet protocol). The theoretical simplicity of this scheme, plus the rapid decrease in the cost of computing technology, have contributed to the widespread growth of connectivity to the Internet. What began as a high-speed network linking Department of Defence centres in the late

1960s has grown into a multipurpose public communication/information vehicle, currently with very few formal restrictions on content and purpose.

A concise but rather complete description of the Internet and its resources has been provided by the Library Association (1995):

> *The Internet consists of a large number of linked computer networks forming a global network. This is largely open and free, allowing users to communicate with each other for work and recreational purposes, and for corporate and personal reasons. Because the Internet is so vast and is without regulation or hierarchy, the network is a treasure-trove of information from many sources. Resources are available in all subjects; mailing is possible for all the participants; documents can be forwarded and delivered across the world; and directories and journals abound. Developments such as the World Wide Web* combine friendliness of user interface with enormously powerful information retrieval capability. Electronic mail is one of the most important services offered through the Internet, with each person having a personal mail address, enabling them to link up to another user anywhere in the world and communicate within seconds.*

In late 1991, the High Performance Computing Act, signed into law by President Bush, authorized the establishment of the National Research and Education Network (NREN). Although libraries are specifically mentioned in few areas of this legislation, the context suggests that libraries and information services were intended to comprise a part of the network (Mc Clure et al., 1992). On March 21, 1994 Vice President Gore addressed the International Telecommunications Union meeting, exhorting the participants to support work on building the Global Information Infrastructure (GII):

> *The president and I have called for positive government action in the United States to extend the NII to every classroom, library, hospital, and clinic in the U.S. by the end of the century. I want to urge that this conference include in its agenda for action the commitment to determine how every school and library in every country can be connected to the Internet, the world's largest computer network, in order to create a Global Digital Library. (Gore, 1994)*

It is important to recognize that the Internet's vast capability to enable the sharing of data is largely due to the efforts of individuals or groups to provide software or data files for public consumption, free or at a low cost. This "grass roots" development spirit, and U.S. government funding, is largely responsible for the availability of such a wealth of information. By the same token, this loosely coordinated growth and duplication has created one of the most complex retrieval challenges to users of online systems.

Early work by Lynch and Preston (1990) describes the resources available at that time through the Internet, and discusses the proposed impact on library services and user behaviour. Within a relatively short period of time, libraries and librarians have integrated the use of the Internet into nearly all aspects of current library activities, including :

1. Communication among staff, or with colleagues or patrons, through e-mail (Cromer and Johnson, 1994); collaborative research and publication can be one facet of this (Tillman and Ladner, 1994);
2. Discussion through listservs or other electronic vehicles; this includes using the Internet to share information about the Internet itself;
3. Support of reference services of all types through search of remote databases (Ladner and Tillman, 1993) and through a cooperative approach to the answering of "difficult" questions (Batt, 1996b);
4. Exploiting the catalogues of other institutions, which may offer access points or search features not available locally (Drabenstott and Cochrane, 1994);
5. Gathering information from library users in order to create SDI profiles for them.
6. Interlibrary loan verification, requests, document delivery, and consortial file-sharing (e-journals, images, data, and text file FTP sites);
7. Cataloguing;
8. Book/Journal ordering;
9. Evaluation of competing online systems for purpose of selection;
10. Making locally-produced databases accessible to remote users;
11. Establishing home pages to provide information on the library, its resources, and its services.

In addition, some organizations have formed their own internal networks, modelled on Internet principles and often connected to the Internet. Such "intranets" can be exploited by libraries to make information and resources available (West, 1997).

Several print and electronic journals, newsletters, and listservs are now devoted to use of the Internet and its resources by librarians. The SUNY/OCLC *Internet Homesteader* (1994 on) claims as its mission: "bringing information available on the Internet to individuals with no Internet access and assisting those with access in finding their way." It typically includes a section for those with no Internet access that provides synopses of information from e-conferences and other library and technology-related Internet resources, as well as a section with reviews and training-related information for those with Internet access. The contents of this newsletter provide a particularly good example of the importance that the library profession has begun to assign to professional communication using the Internet. The synopses of e-conferences give those without Internet access the opportunity to follow in print what their colleagues have deemed important professional exchange about current issues in librarianship.

In the first "Internet Librarian" column in *American Libraries,* Schneider (1995) highlights the numerous efforts of librarians to provide organizational and access tools for Internet resources. At the 1995 annual meeting of the American Library Association, the Internet Room, which has been sponsored for several years to provide Internet access for conference-goers, was moved to the center of the exhibit hall. This is an indicator not only of the popularity of network access, but also of the growing importance librarians place on access to electronic communication to support their professional activities. An exploratory study by Mc Clure et al. (1992) discusses key factors that affect public library use of networked resources and the potential roles for public libraries in the networked environment. The top four needs identified by public library respondents in their questionnaire survey were:

1. Awareness of what is available on the Internet;
2. Widespread library connectivity to the Internet;
3. Training in network navigational skills for librarians;
4. Librarian involvement in contributing to and organizing information on the Internet.

Getting connected to the Internet has been easier for academic and government libraries than it has for public and rural libraries, where connectivity has been a major stumbling block to Internet use. Boyce and Boyce (1995) indicate that rural library out reach programs could be greatly facilitated by Internet access such as that made available by Freenets. Holt (1995b) reinforces their point and asserts that the Internet is helping rural libraries redefine their concept of traditional limited access-"computers and networks can help rural libraries act like big libraries on a limited budget. "McClure et al. (1994) recommend that public libraries coordinate their networking activities, including OCLC, regional, and national access to networked information.

Since the early 1995 privatization of the Internet, opportunities for connectivity have expanded considerably, with fierce competition in the commercial sector to market Internet services to businesses, not-for-profit organizations, and individuals. The leading vendors of online catalogue systems have developed modules that incorporate Internet and Web access, including their own customized browsers. In a study of Internet connectivity costs for public libraries, McClure et al. (1995) explore five representative connectivity models that range from single workstation, single library, to multiple workstations, multiple libraries, and multimedia systems. For example, charges for a public library to connect a single workstation with text-based capabilities to the Internet are reported at a one-time cost of $1,475, with a recurring annual cost of $12,635. The study discusses costs for hardware, software, varying levels and methods of Internet connectivity, and the accompanying training and human resources support. This study presents a useful foundation that library managers can employ to establish an overview of what their investment in Internet connectivity could provide for their users.

The involvement of librarians and other information professionals in training for Internet use and in the organization of information to be used on the Internet has also increased markedly. Daniel Dern, a noted technical and networking expert, perhaps anticipated the extent of librarian involvement with the Internet when he remarked that the Internet is "the librarians' full employment act of the 1990s" (Snyder, 1994)

Impact on Library Services

Basic Internet services enable on to accomplish a number of networked information functions: connect with other computers, including library catalogues; move files of text and data using FTP commands; send and receive electronic mail; read news from many different sources; find software; search indexed databases; search for someone. Krol (1994) provides an excellent guide and resource catalogue with extensive background on how these services can be used. The application of Internet services is evolving so rapidly that there is little point in providing details on specific services for functions. Liu's (1995) classified bibliography is a useful resource that examines the impact of the Internet on almost all aspects of librarianship. However, it is important to supplement print resources with information from most current discussions and documents that are available only through listservs, File Transfer Protocol (FTP) archives, and the World Wide Web (WWW), and only in electronic format.

Through access to these services, librarians have found new ways to store, move, find, and communicate about information among themselves and with users. For reference and public service librarians, this access has created many new and different service options. Kluegel's (1995) example of a search in a German online catalogue through the Internet demostrates the vast time savings possible when a librarian or user connects to a remote network to verify the existence and location of a resource. Dalrymple and Roderer (1994) characterize the Inernet as "the most significant telecommunications advance affecting online searching..." in the period of time covered by their review article-1987-1994. Ready reference can be performed with even greater speed since materials such as dictionaries, census information U.S. government documents, and the *CIA World Fact Book* are freely available from numerous sites (Lanier and Wilkins, 1994).

Locating information through the Internet remains a challenge. Access is achieved initially through "browsers," such as the Netscape Navigator and the Mircrosoft Explorer, which lead to various "search engines" that have different capabilities and purposes and operate in different ways. A search on the same topic may give very different results when a user moves from one search engine to another. This whole area is changing very rapidly, with new developments occurring on almost a daily basis. "Metasearch engines" now allow searching using several search engines simultaneously and several" intelligent agents" have been developed to perform various functions for individual users (e.g., watch for new items of a particular type or automatically create specialized databases). Torok (1997) gives an excellent picture of capabilities as of September, 1996.

To aid libraries and other organizations in maintaining consistent user access to Web pages that may change physical location, OCLC has established a service called PURL (Persistent Uniform Resource Locator). Once an institution has registered its URLs (Uniform Resource Locators—the Web address of a document) with the PURL service, software freely distributed by OCLC helps Web managers to keep track of any subsequent address changes so that the user who returns to a URL that has been changed will be seamlessly routed to the new URL (OCLC Makes PURL..., 1996).

Lanier and Wilkins note that the availability of electronic versions of print resources, as well as electronic-only sources, has increased pressure of reference librarians to stay current with Internet resources, but has also increased the likelihood that users will not leave the reference desk empty-handed. They urge that reference librarians must continue to develop their roles as "intermediaries" in the information-seeking process. Abels and Liebscher (1994) are studying the way in which electronic reference provision is changing the nature of traditional reference interaction with users.

Information professionals beyond the library have a keen interest in the development of software tools that have indexed the Web. A recent review of Web indexes places over thirty-five such tools in eight different categories, depending on the type of information desired: search engines; directories, "whats new"-sites that index Web pages that have recently been added; e-mail address finders; gopher archives; software search engines; newsgroup search engines, and metasearch engines (Conte,1996).

The Concept of the Digital Library

The Internet has contributed to the creation of a new information environment— the digital library. At the base of the digital library is the capability to retrieve, manage, store, and publish information in numerous formats. Lucier (1995) describes an effort to build a digital library for the health sciences (DLHS) at the University of California, San Francisco.

He suggests that the current structure of print-based libraries that integrate electronic resources is not sufficient to support a true digital library. He views the DLHS objectives as driven primarily by the expectations of its users, and suggests that it has three primary roles:

1. information storage, retrieval, and preservation;
2. information access and delivery;
3. the online publishing of biomedical knowledge (knowledge management).

Although these roles are consistent with current information transfer principles, Lucier emphasizes that the DLHS is not the :

> *...exclusive performer of these roles. In many functions, the DLHS plays a minor role, while other collaborators, such as publishers and individual scientists, make more significant contributions. However, the DLHS adds value in partnership with others through every step of this cycle.*

To accomplish this evolution to a digital library, Lucier outlines an approach that advocates reduction in physical storage of information, an increase in housing of personnel who manage information, and a collection development policy that focuses on filling users' critical information needs rather than on building a comprehensive collection.

Impact on Professional Roles

As Internet access has spread within the library community, professionals have begun to incorporate use of the Internet into their areas of responsibility. These changes have begun to be reflected in job titles, ranging from direct service positions to upper-level administrative jobs. Titles such as "Networked Information Resources Librarian," Internet Services Coordinator," or "Electronic Resources Librarian" simply did not exist five years ago. Allen (1995) observes that libraries as organizations can adapt to technological change by creating new types of positions that eventually help to integrate the new technology into the mainstream of library operations. Unlike the earlier position of Online Search Coordinator established in the 1970s, Internet and networked resources positions cross over departmental boundaries, and they are equally likely to be found in the Reference or in the Library Systems departments, depending on the amount of technical skill required to perform the job.

An examination of 23 postings for librarian positions in a single issue of the *Chronicle of Higher Education* (September 15,1995) revealed nine position descriptions in which responsibilities that include use of Internet or networked resources is a noted component of the position. Job titles include the following:

- Systems Librarian (I)
- Electronic Systems Librarian (I)
- Law Librarian for Internet Services (I)
- Network Services Librarian (I)
- Public Services/Reference Librarian (with emphasis on Internet resources (2)
- Database Coordinator (I)
- Network Coordinator (I)
- Electronic Information Services Librarian (I).

Four of the nine positions are located in the Reference or User Services departments of their respective libraries and two report to the Director of Library Systems; the other two position descriptions do not indicate a home department. The following statements were found among the qualifications required for the nine positions:

- "Advanced work in computing and information science."
- "Experience with online integrated library systems, campus networks, the Internet, and electronic information resources."
- "Strong public service orientation, experience with searching electronic resources (online, CD-ROM, Internet), and interest in library instruction essential."
- "Expert knowledge of HTML and extensive experience with Web administration and operations."

Bosseau (1995) notes that the changes brought about be the availability of networked information have affected higher level administrative positions in academic settings, resulting in the creation of combined titles for managerial positions such as "University Librarian/Associate Vice President for Information Resources," with library directors being placed in charge of "an expanded set of library and other media responsibilities." Bosseau asserts that this, among other changes, reflects recognition of the library's active role in managing technology and infrastructure services that support the delivery of effective information content to users in academic settings.

He characterizes the change in the library's role in the academic setting as one that has moved from the cliche phrase "the heart of the university" to a more active and critical role as the "cardiovascular system of the university."

The presence of the Internet in the professional library arena has further blurred the traditional distinctions between technical and public service responsibilities. The major distinction may now be between primarily technical development and support skills and those that are used to help provide some method of organization and access to electronic resources. As computer and networking technologies become increasingly sophisticated, and the technical knowledge threshold is lowered, staff with traditionally lower technical skills are able to connect to and navigate the Net without assistance. Concurrently, librarians who now enter the profession seeking reference and public service positions possess more computing and networking skills than those who entered the profession as few as five years ago. This combination of simplified technologies and the increased likelihood that professionals with enhanced computing skills will enter the library market has resulted in increased professional facility with the Internet and networking resources.

Along with a shift of roles within the library profession is the overlap in training and support services between library and computing enter personnel. In a recent survey of library and computing center professionals, Shiller (1994) reported more involvement by computing services staff in providing Internet access and training. However, the survey results also indicated that librarians have considerable involvement in Internet training and support. Some survey respondents reported that team training programs were being offered through collaboration between the library and the computer center. She states that a number of respondents viewed the roles as complementary, distinguishing between "physical access," which was attributed to the computing center, and "intellectual access," which was attributed to the library.

Communication

The Net in libraries has also created the potential for change in the professional communication of librarians and other staff. This change is the result of increased opportunities for communication with individuals or collegial groups-through any number of common channels, ranging from e-mail to listserv and other interactive or asynchronous discussion groups.

While the *potential* for change exists, the expansion of professional communication depends on the administrative commitment of the library to support convenient staff access to the Net and the individual's commitment to learn to use the necessary communication protocols and software (Ives, 1995). Ives includes support staff use of the Internet as an important component of how networking (electronic of non-electronic) can empower staff, and improve library service.

He suggests that use of the Internet, particularly as a communication and a current awareness tool, will enable libraries to accomplish more without increasing staff and other resources. He identifies several types of Internet use that should be of value to library staff in carrying out daily responsibilities:

* E-mail: communication-in-house, group, organization, or committee communication; obtaining evaluative information about products; sharing information about policies and procedures; "electronic mail is the most pervasive means of tapping into a large number of knowledgeable people across the expanse of the planet" (Ives,1995).
* Listervs: electronic discussion groups, usually focusing on a specific topic; there are many devoted to specific library-related topics (e.g., CDROMLAN, LIBREF-L: reference, BI-L: bibliographic instruction); listservs facilitate ongoing, daily discussion about numerous issues, but they are most useful for finding a resolution to a problem when the in-house expertise is not enough.
* Remote access: for free of fee, a large selection of library and information resources is accessible through the Internet, including remote online catalogues, software archives, full-text papers, and other documents, bibliographies, and numerous numeric and bibliographic databases.
* Use-Net newsgroups: discussion and news groups on all topics, including libraries, that require specific software for access—usually installed by the computer center for an organization. Very useful for current awareness, they do not clutter up individual e-mail boxes as list-servs tend to.

Some library administrators harbour concerns that staff will misuse the Internet for nonwork activities, thus lowering productivity. Ives argues, however, that library administrators limit the growth potential of their organizations by not enabling staff to use the Internet to discover potentially useful work-related information. Perhaps the question is not whether to provide Internet access but, rather, what types of access are appropriate to enhance a staff member's knowledge of his or her area of speciality. This issue will likely resolve itself as library staff and administrators alike discover and exchange Internet resources that further enhance their work. Strictly limiting an employee's focus to what is already known to exist prevents the serendipitous discovery of equally or perhaps more useful information. Listservs or e-conferences comprise a substantial portion of the mainstream methods of asynchronous communication among groups on the Internet. Based on a survey of fifty-seven library-related scholarly e-conferences, Kovacs et al. (1995) concluded that library and information science professionals used e-conferences to gather research and professional information for their personal use as well as for information to enhance service to library patrons. They suggest that participants view the information they obtain from e-conferences similarly to the more established sources upon which they rely to find and verify information-journals, conferences, mail, and telephone contacts. Most of the respondents were librarians or paraprofessionals in academic libraries.

Changing Perspectives on Service Provision

McClure et al. (1994) claim that libraries need to rethink the provision of information services for a networked environment. They suggest that libraries will need to change traditional assumptions about their clientele and their information seeking behaviour. They envision that networked library services will become more demand-based than they currently are, citing the point that users will gravitate to the Internet services that best meet their needs, regardless of physical location. McCombs (1994) suggests that the provision of flexible electronic access to information that often has no physical format requires that librarians, especially those in technical services areas, will need to rethink traditional attitudes toward the access and processing of information.

Holt (1993) believes that electronic networks in general can have an important role in democratizing access to library resources. His library, the St. Louis Public Library, has already established "equity sites" in such inner city locations as YMCAs, homes for the elderly, and high schools.

As Holt puts it, these:

> *...Provide access to library materials for those who have trouble getting to their public library and/or those without computers in their homes.*

Nevertheless, for various reasons, public libraries have lagged behind academic libraries in the exploitation of the Internet resources. Speaking from a British perspective, the Library Association (1995) has recommended that, given access to the Internet, public libraries should:

* use their skills to identify information, whether in text, image, or sound, and route it as appropriate to people in need of it;
* Provide network access points, free or charged, as appropriate, & provide opportunities for education and training in the use of the network;
* use open information systems and broadband communications to intergrate use of the network with mainstream library services;

* publish appropriate information e.g. catalogues, community information, and archives over the networks;
* apply their skills to the management of the vast amounts of information on the networks;
* as appropriate and in partnership with the academic sector, provide information from the network to students and distance learners.
* Ways in which the Internet is being used by British public libraries are discussed by Batt (1996a).

Perhaps the best way to understand the impact of the Internet on libraries is not by speculation or through denial, but through examination. McCLure and Lopata (1996) propose a set of evaluative methods for assessing the impact of networking on the academic environment. They suggest using standard social science research methods, such as focus groups, critical incident technique, surveys, observation and site visits, as well as collecting and analysing standard system-generated network performance and feedback statistics. Their manual contains an overview of methods and applications, as well as sample data collection forms and information about software that can be used to measure network services and their level of use. A section of the manual is devoted to online catalogue measures. They pose a series of questions for each area of network use in the academic environment. The overall network and library use questions center on the network's impact on a user's ability to find information, both inside the library and within the broader campus community:

1. Has the network affected your use of electronic information resources (Faculty, student, and librarian perception)? If yes, how?
2. Has the network affected your ability to access information in the library (Faculty, student, and librarian perception)? If yes how?
3. Has the library provided public access to the network (Faculty, student, and librarian perception)?
4. Has the network affected your ability to find the information you need in the library (Faculty, student, and librarian perception)? If yes, how?
5. Has the network affected the types of services provided by the library (Faculty, student, and librarian perception)? If yes, how?
6. Has the library been involved in developing and providing access to campus information resources on the network? (Faculty, student, and librarian perception)? If yes, how?

Their work is further evidence of the Internet's impact in bringing service units like the library and the computer center closer together with instructional units in an academic environment.

Reid (1996) has described a "process model" for the increasing integration of the Internet into library services :

> *The process model is divided into five phases spaning from the acquisition of Internet experience, redesign of library processes for the networked environment to a possible revision of the organization's information management processes.*

Instruction and Training

With respect to Internet instruction and orientation, librarians appear to be finding a unique and useful niche. While Internet access providers normally furnish instructions or training in how to connect, and what general types of information are available, librarians have quickly begun to fill the void of content-based-training—e.g., how to find information on a particular topic. The traditional role of bibliographic instruction has broadened to encompass Internet use as another means for gaining access to information that is available through a librarian's assistance. The recent action by the Association of College and Research Libraries (ACRL), to change the Bibliographic Instruction Section's name to simply "Instruction Section," reflects this broadened approach to instruction and training in the library profession, regardless of whether the tools are print or electronically-based.

Since the early 1990s, several Internet self-help and instructional guides have appeared. A search in the University of Illinois online catalogue, in September, 1995, revealed approximately twenty books published on Internet use since late 1992, with most appearing in 1994 or later. Authors include both computer professionals and librarians. Among the "self-help" handbooks and manuals, works by Krol (1994) and Kehoe (1993) assist all types of Internet users in better understanding how to get connected to the Net and how to locate various resources. Benson (1995) provides a handbook that is tailored to the information searching activities of librarians. Jaffe (1994) provides one of the most complete training manuals that can be used for presenting Internet workshops.

Kalin and Wright (1994) describe an Internet instruction program that exemplifies how librarians have begun to collaborate with computing professionals to offer instruction and training that helps users learn both the technical and content ends of Internet use. Other approaches, such as that of Pask and Snow (1995), advocate the integration of Internet training into overall instruction for research information retrieval, particularly in the academic setting. They point out that librarians can apply their important knowledge of subject classification to the searching of the Internet.

Learning what the Internet is, and why it ought to be used, involves the teaching of database structure, information retrieval, and critical evaluation concepts, as well as the practical aspects of getting connected. Librarians have embraced the challenging task of designing instruction that combines the teaching of skills as well as evaluative techniques. Since the early 1980s, librarians involved in instruction have found themselves training on an increasingly conceptual level about the skills needed to correctly characterize an information need and to locate relevant information, whether in print or electronic form. Perhaps one of the greatest challenges in teaching use of the Internet lies in training learners to employ "work around" techniques when they encounter common communications or other network problems.

Numerous authors have commented that the two critical components of Internet training are the use of systematic search techniques and concepts, and critical evaluative skills. These skills, many suggest, are the ones that will enable Internet users to sift efficiently through the information they retrieve from disparate sources of varying degrees of validity. Connell and Franklin (1994) point out that the Internet has had a significant impact on how work and study is accomplished in academic and commercial settings. They suggest that varied approaches to instruction and training, that incorporate critical thinking and collaboration, will enable users to best locate and exploit Internet resources.

Networking, Data Sharing, and Standards

For libraries, one of the most attractive features of the Internet is its capability to support connections among remote systems. Within recent years, the library community has become increasingly involved with computer and other information professionals to create and implement standards for networking and for data sharing. Since the early 1980s, libraries have been working to implement the basic component layers of the OSI (Open Systems Interconnection) communications protocols. OSI comprises a complex see of communication protocols designed to enable different systems to communicate across a network. More recently, the ANSI Z39.50 protocol suite was developed and implemented by groups of libraries and by vendors of commercial library systems. These protocols provide guidelines and structure so that, for example, two libraries could design software that enables a user from Library to formulate a search using the familiar commands of its own online catalogue, execute the search across the network on Library 2's online catalogue, retrieve the result set, and display it through Library's online catalogue. A number of libraries have implemented Z39.50 in collaboration with reciprocal partners or in consortia as a means to enable users to search across different online catalogue systems without having to learn the commands for the unfamiliar system. Carson and Freivalds (1993) describe one of the first such Z39.50 implementations. Numerous vendors have incorporated

Z39.50 into their current OPAC systems and Z39.50 development continues, with both national and international involvement and an organized group which meets regularly to shape the content of changes and enhancements to the suite. Michael and Hinebusch (1995) provide an excellent analysis of the development of the Z39.50 protocol and its implementation in libraries.

Cataloguing, Indexing, and Metadata

The Internet has begun to affect the ways in which libraries describe and catalogue resources. In 1994 the USMARC 856 field was established to provide for the description and retrieval of electronic materials on the Internet, and there is growing recognition of the need to develop methods for describing electronic sources that are not produced in the same manner as print publications and, therefore, not appropriate to the MARC format.

A critical issue that the library community now faces is that of determining how to describe literally millions of items in their collections (photographs, pictures, manuscripts, video, and so on) for which they can never hope to provide exhaustive cataloguing. While our experience with cataloguing and indexing places the library community in good standing to influence the types of "metadata" standards that are employed in describing Web resources, we have difficulty incorporating new approaches to information description into the existing methods of bibliographic description and control.

Librarians and computer professionals from numerous disciplines have been working to develop sets of standards for description and access to electronic information, including full text, We-based resources, e-journals, and other resources. Current standards used to describe both print and electronic information, besides USMARC, are the TEI (Text Encoding Initiative) Header, developed by humanities computing researchers and used to describe SGML-encoded electronic texts, and the URC (Uniform Resource Citation) standard for accessing Web materials. Gaynor (1994) describes a project at the University of Virginia Library where efforts to provide bibliographic control and access through changes to traditional cataloguing practices have included the use of both MARC records and TEI headers. Access to the catalogued records for electronic texts is now provided through Virginia's OPAC. This process necessitated that catalogers become familiar with the information in TEI headers. Thus, the catalogers involved in the project learned the TEI guidelines and developed a TEI header work form as well as on OCLC MARC work form (on paper) in an effort to centralize all of the available information about the electronic text to be catalogued and described. Results of the project suggested that the creation of both MARC records and TEI headers was labour-and time-intensive, with considerable duplication of work. The study recommended the purchase of better hardware and software, and also the development of an automatic SGML-MARC conversion program to convert TEI headers in to MARC like records.

Dunsire (1995) reports on Project CATRIONA (Cataloguing and Retrieval of Information Over Networks Applications), a project to investigate the cataloguing of electronic information resources and the implementation of Z39.50. The Z39.50 search and retrieve protocol is being implemented so that users of OPACs at one university can retrieve records for electronic resources from another. MARC records are used for the cataloguing of e-journals, CD-ROM's and Internet resources. In principle, a range of Z39.50-based OPACs can be searched server by server, thus making feasible the implementation of a distributed catalogue of Internet resources (Nocholson et al., 1995). In 1995, OCLC, along with the National Center for Supercomputing Applications (NCSA), sponsored a metadata workshop with the objective of defining a simple and usable standard for describing networked information resources (Weibel et al., 1995). Researchers at OCLC have developed an experimental system that automatically translates between MARC, TEI, and the Web-based URC. Vizine-Goetz et al. (1995) have developed the Spectrum system, which allows users to create data records in HTML (Hypertext Markup Language) format, builds a database of user-created descriptive records, and provides search and retrieval capabilities. Spectrum was built from standard Web browser components, including the Mosaic Web browser software. An interesting feature of the Spectrum system is the record creation subsystem, which processes the descriptive information input by the user and generates from it a URC (Uniform Resource Citation), TEI, or MARC record. Vizine-Goetz et al. point out that the TEI And MARC records lack required publisher data. They note that the Spectrum system will be used to create records for inclusion in OCLC's Newton database management system, which is accessible through the Mosaic Web browser software and conforms to the Z39.50 information retrieval protocol. Future plans include integrating Spectrum's functions for creating and retrieving records directly into OCLC's Web Z Server, which is currently under development.

Numerous Internet information providers are also using information organization tools, most of which provide only simple and limited subject or name access, but nevertheless are in popular use.

World Wide Web:Simplified Access to the Internet

In addition to the convenience of the Internet's global connections, the scientific community engineered the World Wide Web (Web)—a method for using graphical user interface software (now commonly referred to as *browsers*) and a form of hypertext programming language (HTML). Users of the Web can view graphical and textual information easily and legibly on the computer screen, and can move seamlessly among disparate sources and formats of information accessible from the same electronic document by means of hypertext links to files stored in various locations across the Net. Web access has popularized the Internet to an even greater extent that before. One of the more profound developments arising from Web access is the capability for individuals to become their own Internet publishers. Any individual with an Internet connection and a computer can occupy space on the Web. The Web has thus brought about the establishment of many commercial, not-for-profit, and private communication and publishing activities on the Internet. Weibel (1995a,b) provides an excellent description of Web structure and services that can be offered through the Web, including publishing. He also reviewed the access and organization tools developed for use on the Web, but developments are occurring so rapidly that his review is already rather out of date.

Commercial bibliographic vendors, including OCLC, have begun to migrate their text-based Internet services to a Web environment. The OCLC First Search system, which provides access to over 55 bibliographic databases, is available through various Web browsers. The search functionality is identical to the text-based First Search database, which supports features such as worldlists, Boolean operators, and search limits.

There is a need for further development of tools that provide consistent and organized access to the disparate resource types on the Internet. An entity called the Internet Engineering Task Force (IETF) was established in the early 1990s to address the formation of conventions that enable the development of these tools. Membership on the IETF includes computer professionals, scientists, and more recently, librarians, with OCLC maintaining an active representative role. While many Web searching engines have appeared, the depth of indexing is limited, with few powerful search filters in operation.

Until recently, the Web suffered from the searching condition known as "statelessness." Once a search is executed and the information from a hyperlink is delivered, the connection to the link is broken, precluding further refinement of the user's search query. Being able to build a subsequent search on the results of a previously retrieved set, as common in many searching systems, makes the Web a model closer to that which we now find familiar with library online resources. Ongoing development work on software called Common Gateway Interface (CGI) is helping to resolve the stateless Web issue in the near term, and makes it possible for the introduction of well-defined classification and searching tools that cut across the Web. CGI programming makes it possible for users to submit powerful database queries from Web browsers. Several Web-based search engines now employ CGI programming in this manner.

Further programming developments, such as the creation of Sun Microsystems Java language, now enable the delivery of "applets" or bits of programs across the network to provide animation, audio, video, and three-dimensional displays, all available through the Web (Gordon, 1996). The impact of these technologies on knowledge management, and on the concept of document structure and content, is considerable. For example, a Web "document" can consist of text, images, audio, and video. The various media that comprise a Web document can come from local, remote, or a combination of network locations. The shape or content of that document can be changed at any time, depending on the interests of its author, or the content of its hypermedia links.

OCLC has devoted considerable research effort to the development of retrieval services on the Internet that allow for the continual verification of electronic resources. One such service, Netfirst, identifies, catalogues, and continually verifies the existence and location of Web information resources. OCLC is also sponsoring the Internet database, an effort to create a shared database of cataloguing records for Internet-accessible e-journals and other electronic resources, and has contributed to research efforts to establish standards for encoding and accessing electronic resources.

Other commercial efforts to provide subject guides and indexes to the Web include Gale (http://us/www.thomson.com/cyberhound.html) and Silver Platter. Efforts by individuals and academic institutions are numerous. Notable among these is the University of Michigan Library School and Argus Associates Subject Guides, as well as the Virtual Public Library. Another source, the WWW Virtual Library, categorizes sources of information by use of Library of Congress subject headings. Ensor (1995) suggests that the Web holds such strong appeal that information sekers will use it regardless of the recognized organization problems. She welcomes the efforts underway to develop effective automatic Web search and retrieval engines, and suggests that librarians can provide needed assistance in Web organization by identifying subjects that are not adequately covered and by providing coverage if this seems justified. In the context of these changes, it is reasonable to state that librarians with access to Internet resources have a professional responsibility to learn to use the Internet effectively, and to evaluate whether and how it can enhance their work and service provision. That being said, it is equally important for libraries to provide the training and administrative support that librarians and library staff need to learn and evaluate Internet access for their work-related needs. Some libraries have already begun to develop their own guides to network resources.

While a vast amount of literature has already appeared on the subject of libraries and the Internet, surprisingly little of this is at the broadest management level —e.g., how Internet implementation and use in libraries should be managed or, conversely, how net use affects management practices in libraries. This is in contrast with the Internet literature dealing with business, government, and academic in general where such broad issues are frequently discussed.

It is legitimate, of course, to ask if the Internet has been oversold as an information access tool, since each technological development introduced into libraries since the 1960s has come with exaggerated claims for labour-saving and work-revolutionizing impact. Many Internet problems exist. Network communication problems are often encountered by Internet users regardless for their expertise in searching. Retrieval problems are common, due to lack of standardization and poor organization, and some Internet search engines cannot provide the depth of retrieval that is currently offered by many OPACs. Moreover, the rapidly increasing volume of use is creating significant degradation of performance and response time in some cases. All these weaknesses notwithstanding, the rapid assimilation of the Internet into all aspects of library activities suggests that it will continue to develop as an important information resource and means of communication among libraries and their users.

Nevertheless, it is important to recognize that networks will continue to grow and to become more complex by virtue of their sheer size. A report from the American Association for Artificial Intelligence (Weld et al., 1995), dealing with the National Information Infrastructure, describes the situation as follows:

> *Current trends in semiconductor density, processor speed, and network bandwidth suggest that the infrastructure will be thousands of times larger than existing systems such as the Internet; the array of services supported by the NII will be unimaginably vast.*
>
> *The NII will be orders of magnitude more complex than current systems; it could easily become a labyrinth of databases and services that is inconvenient for experts and inaccessible to many Americans.*

Already, many scholars are frustrated by trying to find information on the Internet. Palmer (1996) quotes on research chemist as follows:

> *It doesn't matter how marvellous the stuff is that is out there if you can't get at it-except if somebody says, "By the way, I was talking to a guy when I was at a conference last week land he says that if you go onto this computer here you can find an address to go to that computer over there where you can get what you want". Now what kind of nonsense is that?*

The Weld et al. report emphasizes that the field artificial intelligence has much to contribute to improving access to information within this vast network, but it is equally obvious from the report that most intelligent systems are not sufficiently robust for real life applications on a large scale. It seems, then, that librarians and other information specialists will not be replaced by know both in the foreseeable future.

Evaluation of Automated Systems

As libraries and their services grow and change, so do their automation needs. Evaluation of the performance of an automated system, whether it be for new purchase or ongoing refinement, can provide several useful types of management information on: (1) whether new or updated systems meet contract requirements; (2) whether the system is living up to the performance and output standards of its user community; (3) the point at which a new system or system refinements are needed; (4) possible future resource consumption. This chapter explores research for, approaches to, and types of data that can be used in the performance evaluation of on-line systems.

Evaluation Criteria

It is obvious that a computer system can be evaluated according to different types of criteria—ease of use, cost, reliability, integratibility, and so on. In her survey of 54 major research libraries in North America, Johnson (1991) discovered that ease of use by patrons was a major consideration in the selection of a new system—above cost and, perhaps surprisingly, ease of use by staff. The weight given to ease of use by patrons agrees with her findings that these same libraries considered improvement of user services as the major objective of automation and improved service to users as the major accomplishment of automation.

Purposes of Evaluation

Peters (1988) identifies three types of systems evaluation: (1) functional—to determine whether a system's features meet the library's needs; (2) economic—to determine the affordability of a system; and (3) performance—to reveal whether the system capacity can meet present or anticipated future demands.

These evaluation factors interact, based on the needs, political climate, and the economics involved in a library's decision to make a new purchase or to upgrade an existing system. Peters comments that a significant amount of importance is placed on performance evaluation due to the maturity of the library automation market place, which encourages healthy vendor competition. The reasons are numerous, but they can be grouped into two general categories, the first associated with buying or designing new systems, and the second with improving existing systems, summarized by Peters as follows:

> *We are interested in performance evaluation because we are concerned about the long-term price/performance profile of the systems we are buying. First, we are interested in assessing whether the systems we buy meet the performance requirements expressed in our contracts and regulated through our acceptance tests and system management instruments. But we are also interested in upgrading our systems. Let's face it, we all want to add more terminals, get gifts from heaven that allow our recon programs to exceed their most optimistic projections, and otherwise receive good news that places new demands on our library automation systems. We need to know precisely whether our existing systems can be expanded to handle the load or whether new systems will be needed. We also need to learn answers to such questions in an orderly fashion.*

While the expression of needs in performance evaluation may seem straightforward, Lynch (1988) cautions that interpreting the myriad of data that systems generate in order to identify appropriate measures and criteria is neither simple nor precise, and should not be based on subjective or administratively motivated aims to justify investments or change. He points out that:

> *One of the greatest difficulties challenging system managers of large, complex public access information retrieval systems. Where the system services a wildly varying set searches from one day to the next, is the identification of meaningful measures of system behaviour.*

There are obviously many possible ways in which approaches to the evaluation of automated systems can be categorized. For the purposes of this chapter, two major approaches are identified:

1. Evaluation without user involvement or with less than full user involvement.
2. Evaluation with fill user involvement.

The second type assumes a fully operating system in which one can evaluate not only system characteristics per se but also how a particular community makes use of the system and with what degree of success. The other type of evaluation, while it may involve user input, is concerned with the system in a more abstract sense. Indeed, this type of evaluation may be undertaken before a system has actually been selected, before it has been accepted, or before it is fully operational.

Although the terms are not completely accurate, we will refer to this class of evaluation as "user-free" and the second class as "user-involved."

User-Free Evaluation

This category of evaluation focuses on system features rather than on how these are exploited by a particular group of users. It may be used in the selection of a system, the acceptance of a system, or decisions relating to system enhancement or replacement.

One useful tool that can be used in the selection of system is a checklist to determine the features present in a particular systems or, more particularly, to compare the characteristics of two or more systems. Typically, checklists of desirable system features are developed, and evaluators study the system(s) interest, noting the presence or absence of the features under investigation, and any other pertinent information. The results are frequently entered into a grid in which marks, numeric or symbolic, indicate the presence or absence of features. A point value may be assigned to each feature, and a differential weighting scheme may be established to place emphasis on features that are considered more important than others. In other cases, features are assigned an equal rating of 1 or 0. System scores can be derived from the grids, with subtotals to indicate system strengths in particular areas, and total scores to indicate overall performance.

The checklist method of evaluation is useful for several reasons. In the case of a single system review, it helps one to arrive at a list of desirable features, and to identify the strengths and weaknesses of a particular system. In the case of a multiple system review, a comparative checklist can help to verify the existence of features across systems and thus to identify comparative strengths and weaknesses. Where a weighted scoring scheme is used. One can compare several systems on the basis strengths and weaknesses in areas determined to be most important in meeting the needs of a particular library. The use of a checklist ensures that the same questions about system features are posed consistently across systems.

Weighting of system features is always desirable. Otherwise, the checklist scores can be deceptive. Without weighting, a system with many "superfluous" features may obtain a high overall score, but may actually be weak in features that librarians and users rate as most important. Similarly, a flat rating scheme may obscure the fact that a particular system is strong in features that users prefer, even though it may be lacking elsewhere. The challenge, then, lies in obtaining consensous on what weighting scheme equitably represents a library's preferences for system features, and in implementing the weighting scheme consistently.

Cherry et al. (1994) employed a checklist to survey features in the OPACs of twelve Canadian academic libraries. Data on each system were collected twice, by two different researchers, and the two datasets were checked a third time against the systems to resolve any disagreements. One hundred seventy features were included in the checklist, grouped into ten functional categories:

1. Database characteristics
2. Operational control
3. Searching
4. Subject search aids
5. Access points
6. Screen display
7. Output control
8. Commands
9. User assistance
10. OPAC usability via remote access.

This checklist is unique among library-oriented checklists because it is based both on similar checklists for the study of OPAC features and a checklist designed for evaluating the usability of human-computer interfaces. It was found that most of the OPACs, as implemented in the libraries, possessed more than half the features that were listed as desirable on the checklist. All systems scored well on "screen display," and were weakest in "subject search aids," "output control," and "operational control". Overall, Cherry et al. observe that, in spite of the many improvements in OPAC design, "... there is still a wide gap between the systems evaluated in this study and the ideal OPAC system suggested by researchers." They also recommend that the study be replicated every two to three years, and that the results in each category be compared to measure improvement in system design over time. They admit that the study would have been improved by the use of weights to reflect the relative importance of each feature, and recommend that further studies should survey online system users to determine the relative importance that they assign to specific system features.

Because their checklist is so comprehensive, and thus of potential value to other librarians in conducting this type of comparison.

Acceptance testing or *benchbmarking* is a process often used by libraries to verify that the new or upgraded system meets the contract requirements. Often the conditions of acceptance in a contract indicate clearly what type of performance is expected, and the acceptable level of performance, to determine whether a system works in the manner agreed upon in the contract. Although acceptance testing usually has legal implications, Lynch (1988) notes that it is difficult to bridge the gap between the contract language and the types of tests that both parties (vendor and library) agree will demonstrate whether or not the system is acceptable in all aspects. An interesting series of three articles tracks the experience of Boston University's stress test with a particular system, providing perspectives from a librarian, the system designer, and a consultant. Brown (1988) presents the library's perspective on stress tests designed to determine system performance at a 100-terminal capacity. The results indicated that immediate improvements needed to be made by the vendor; they also suggested more realistic testing parameters acceptable to both parties. Brown believes that acceptance testing may need to be made an actual part of a contract. Salmon (1988), representing the perspective of the systems designer, points out some of the unrealistic conditions that drove the strees test, although those conditions did not appear overly demanding in the contract language. Epstein (1988), the consultant for the project, focused on response time concerns, emphasizing the importance of distinguishing between response time and throughput of actual transactions to achieve the most direct searching and retrievel results for users. He also pointed out that the significant cost of acceptance testing causes vendors to enter into it only when they are interested in upscaling their operations to larger or more complex systems.

In recent years, acceptance testing has evolved into a more feasible part of systems implementation. More emphasis on trials of system performance with realistic usage loads and operating environments has succeeded in making acceptance testing less a politically and emotionally charged conflict between library and vendor and more a productive collaboration for their mutual benefit.

Once installed, monitoring of the ongoing performance of a system is crucial to the detection of subtle problems or system degradation. The installation of changes, including addition of new components, necessitates checking not only the new portion of the system, but the interaction between that and existing modules and programs. Ongoing monitoring of system performance usually takes place in the form of regularly generated system reports. Libraries typically review response time, input/out-put information, and network throughput on a regular basis for signals of system degradation in any one or a combination of these areas. In the case of response time, several authors have emphasized the need to perform careful ongoing system analysis before concluding that poor or decreased response time is attributable to any one factor. It is usually the case that several factors contribute to system performance degradation. When system changes or new features are added, the acceptance or stress test is normally used to evaluate the system under various conditions. Libraries, usually in consultation with vendors, develop scripts of search commands and strategies that are executed during a set period of time by an agreed upon number of participants stationed at terminals in predetermined locations.

At times, public or staff users identify problems or make suggestions for system changes designed to refine its operation or its interaction with users. The feedback for making these changes can come from word of mouth or from the periodic review of performance logs generated by the system. For instance, librarians may observe searches failing at a critical point where the insertion of an automatically invoked help screen could render assistance. Similarly, a new version of the system software may be installed periodically, usually containing code that tunes or refines existing features. When changes are made to features of functions within an existing system, some means are needed to test how well these changes work. Stress tests are commonly used to test implementations of new features.

Capactiy planning is another important element in overall evaluation. The timely allocation of resources to support the growth of a system is critical to its continued optimum performance. By tracking the size of the database, and estimating its growth rate, projections can be made about when to increase capacity, and whether this increase in size will degrade or otherwise affect response time and other performance factors. Precise capacity planning is difficult because it involves projection and prediction based on numerous complex performance factors. Lynch (1988) claims that capacity planning "usually involves a good deal of inspired guesswork." Unless there is a clear understanding of how all performance factors interact on a day-to-day basis, it is difficult to predict how they will interact in the future, given the introduction of increased, new, or different uses of the system.

Schmidt and Pobuda (1988) developed a capacity planning model for the RLIN system that they used to support hardware upgrades to the CPU. The information used in the model was based primarily on the number and types of transactions made, the resources required to process these transactions, and the "varieties in the mix of transactions over time." They obtained projections from RLIN users of the amount of cataloguing, interlibrary loan, acquisitions, and reference use they would make during the time period in question. These projections, as well as actual usage statistics for the three previous years, were analysed using a PC spreadsheet program that was capable of time-series analysis.

Schmidt and Pobuda's model makes projections for "budgeted activity" (expected level of use based on data from three previous years) and "maximum activity" (worst case highest projected usage). These figures on projected activity are then translated into projected system resource utilization. Projected resource utilization is further divided into several categories to take into consideration not only maximum projected usage, but also the projected usage during peak system load periods, which are defined as the busiest times of the day when libraries in all time zones were using RLIN. In order to validate their model, they compared their projections with an actual response time graph of the RLIN CPU that occurred during FY 1987, and obtained a fairly close matchup.

Capacity planning models can be implemented within a library environment through a combination of the information generated regularly by most online systems and the statistics normally collected within the library. Changes in transaction volume during peak and other usage times can signal the need for system expansion, involving the addition of various hardware and software resources. First, steady increases over time in the overall system usage, especially the number of simultaneous system transactions, can signal the need to increase system capacity. Secondly, increases in the aggregate numbers of transactions at specific locations can serve as indicators for a need to add more terminals.

Capacity planning has yet another facet—planning for the provision of adequate access to the online system whether through onsite terminals or remotely. Determining whether the number of physical connections to the system adequately supports the library's user base is an important component of planning. A review of system resources exploited by various user group, and in specific locations, can assist in providing this information. Several studies have employed queuing theory in analysing the frequency of terminal usage, and determining how many and where to place terminals. It is important to examine where increases in usage are occurring by user type, with public, staff, dial, or network access. Kaske's (1988) research demonstrates how usage patterns and levels can vary significantly within a large, decentralized academic library system.

User-Involved Evaluation

For over twenty years, a growing body of research base on information science and cognitive psychology has been performed to gain a better understanding of how users interact with systems, and how the results of that interaction can be evaluated. One practical goal of this type of research is to collect and analyse information that can be fed back into better system design. A growing body of literature in this area places heavy emphasis on the central role of the end user in the evaluation process. Benefits include the ability of librarians and systems designers to view the use of a system from a perspective that they, for all their technical or content knowledge, could not anticipate. Obvious drawbacks arise with data collection and analysis that does not include a group or groups that are representative of a system's actual user population.

The interaction between the user and the system can be the subject of study for a number of purposes. The studies discussed in this chapter are carried out to learn more about how a system is used and to improve its performance. Many possible methods are applicable. Unobtrusive measures gather data while library patrons are actually using the system.

Users may or may not be aware that their keystrokes, or other actions, are being recorded or observed. The methods are unobtrusive in the sense that users are not being asked any questions and are not required to do anything they would not otherwise be doing. Obtrusive measures are used primarily to obtain feedback on user preferences for various system features and their opinions on system performance.

A primary goal of unobtrusive measurement is to be able to record and evaluate user activity in a natural environment without intervention from the researcher. Data thus collected can be useful in revealing how specific system features are exploited and in identifying features that appear to be giving users significant problems. At least three types of approach are applicable: review of transaction logs, direct observation of users operating at terminals, and video and/or audio taping of user performance. Unobtrusive data can be used to re-create exactly what occurred in a patron's encounter with the system and can complement more subjective data gathered form library users. Nielsen (1986) points out that differences may exist between what users say has happened and what actually occurred as determined by a more objective observation of their behaviour.

Transaction log analysis (TLA) has been defined as the "...study of electronically recorded interactions between online information retrieval systems and the persons who search for the information found in those systems" (Peters et al., 1993a). After its initial application in the 1960s as a tool for evaluating system performance, transaction log analysis gathered momentum in the 1970s and 1980s as a means of analysing the interaction between users and online catalogues. Peters (1993) lists approximately ninety studies of online systems that, since 1980, have employed TLA although he points out that relatively few researchers have performed more than one study. Many TLA studies gather information on how frequently system features are used: choice of search type, use of help screens, how may hits users are willing to review, how often a search results in zero hits, the number and type of error messages that users receive, and so on. A few studies have employed TLA in conjunction with other methods to examine the affective and cognitive searching behaviour of user interaction with online systems (Tenopir et al., 1989).

Several studies have analysed user errors in searching online systems and have suggested system changes or enhancements that would assist in avoiding the occurrence of these errors. Dickson (1984), in an early analysis of user errors in searching an OPAC, found that a significant number of searches failed through a combination of spelling errors, the omission of initial articles from title searches and failure to invert surnames. Jones (1986) used TLA to identify such problems as keying errors (typographical errors, or putting information in the wrong place), slow response time for known item searches, and problems following the general search path structure. Walker and Jones (1987) tested two versions of an OPAC at two different locations. One version contained additional features that provided for automatic stemming, spelling correction, and cross-reference tables to enhance subject retrieval. They found that neither group of users was aware of the corrective features that had been installed in one of the test systems, even though searching failures had decreased there.

Peters (1989) used transaction logs to examine “no-hit” search results, finding that 39 percent of the items sought were not owned by the library and 21 percent of the failures occurring were the result of typographical errors. Flaherty (1990), in an examination of the reasons for search failures, tested the value of automatic space adjustment, automatic term flip (word order correction), soundex, and a spell checker, and found that the introduction of these features could correct 63 percent of the “no-hit” search failures that occurred in the OPAC. The results of these studies have yielded a set of commonly recognized system problems, many of which have been remedied by most vendors and system designers.

TLA has also been employed to determine implications for bibliographic instruction programs and further system enhancement and design. Wallace (1993) studied transaction logs of eleven public access terminals in an academic library and found that the use of system-supplied help varied, that a high percentage of subject keyword searches produced ten or fewer hits, that users persist in scanning lists of titles, even in searches with large retrievals, and that system design improvements need to be complemented by increased emphasis on searching skills in bibliographic instruction programs. An annotated bibliography by Peters et al. (1993b) and a review article by Simpson (1989) serve as two excellent sources of further information about TLA. Borgman et al. (1996) provide a valuable and thorough discussion of online monitoring as a research method based on extensive experience with an online catalogue for children.

Despite all of its potential benefits, transaction log analysis does have limitations. In many systems with transaction log monitoring facilities, it is either difficult or impossible to delineate individual user searching sessions. Further, the transaction log is only able to show the “footprints” of the user on the system—it cannot provide an explanation for why a searcher made the search choices that are reflected in the transaction log. It has also been shown that it is difficult to perform transaction log analysis across systems. For example, Larson (1983) attempted to compare transaction log data from four online catalogues and showed that differences in command and system structures make cross-system TLA of doubtful value.

Another problem is that of cost. A comprehensive monitoring module can add a significant overhead to the cost of operating the system. Some institutions, including libraries, have discontinued use of such modules because of the additional cost of applying them and because of the fact that library managers lacked time to analyse the data on a regular basis.

Transaction log analysis collects data about system use in the aggregate and deals only with the quantitative—which commands are used how often, which headings are consulted, how much time is spent per session, and so on. But more individualized and qualitative data can also be obtained unobtrusively online. The most obvious example is the monitoring and analysis of use of a *help* command. Knowing what types of help are requested by users, especially in the case of a new system or one that has recently added new features, can be of great value in identifying problem areas that may not have been anticipated in the system design but may, in fact, be rather easy to correct.

Although it is rarely acknowledge, *direct observation* is perhaps one of the most commonly employed techniques for collecting information about online system users. Critics often suggest that observation is an unscientific way of gathering only the information needed to support one's own views. The technique need not be flawed; it is the degree of consistency in what is observed, and at what intervals it is observed, that determines the reliability of the data collected. Observation of user behaviour at online terminals is perhaps the easiest technique to employ because it is often a mere extension of a librarian's responsibilities in a reference or other public service setting. Observation is often the technique employed in queuing studies to determine the number of terminals that are needed in certain areas to support an optimal level of access at peak usage times. It is important to employ valid sampling techniques in conjunction with observation in order to obtain reliable data on which management decisions can be based. For example, if one wants to know how many times users have to wait in line to use terminals in the reference room, one obviously cannot rely solely on the observations of a single librarian who only staffs the reference desk fifteen hours per week, between 8 a.m. and 5 p.m., Monday through Friday. Direct observation can be useful, on its own or to supplement other methods, when appropriate sampling methods are employed and input is received from more than one observer.

A number of studies have analysed the results of *video and/or audio taping* of the speech and actions of users during search sessions. The technique has been used to examine whether the cognitive, affective, or attitudinal behaviour or users affects their performance and the outcomes of searching. Methods like protocol analysis, which employ a per-determined framework for analysing user comments (asking a user to "think aloud" while searching, then recording the resulting behaviour and comments), can be used to classify and evaluate the relative effect of user decision-making and behaviour on the success or failure of searching. Janosky et al. (1986) performed one of the first studies of this kind applied to an OPAC. Their subjects, university students, were given several searching tasks to perform. Their "thinking aloud" was recorded on tape and their interactions with the system were captured and analysed in order to identify types of errors made. Tenopir et al. (1991) employed audio taping, in addition to transaction log analysis, in their study of users who were searching a full-text database of magazine articles. They found that users pursued mainly "single-minded" search strategies. Sandore and Ryan (1994) employed audio taping, a survey questionnaire, TLA, and the method of protocol analysis to analyse the activity of searchers of a journal citation database. They found that users who encountered zero or one-hit retrievals often commented that they felt their searching skills and/or subject knowledge to be inadequate to undertake the searching task.

Survey questionnaires enable the collection of data about user satisfaction with a system or specific aspects of it, searching preferences and attitudes, demographic data about users, and the level of skills or knowledge that users possess. Questionnaire surveys involve contact with users; therefore, the evaluator must share with the user some information, however brief, regarding the intent of the survey, how the data will be analysed and used, and what steps the library has taken to insure that no data will be used in such a way that it reveals the identity of individual users.

The published literature includes several studies in which online questionnaires were applied to record user attitudes and preferences for system features, or to make possible a "critical incident" approach to studying searches recently completed by users. Two such studies were completed using the University of California MELVYL system. The first, by Larson and Graham (1983), linked transaction log data to online questionnaires to determine what proportion of the searches performed were subject searches. Horres et al. (1991) used a combination of two online questionnaires, transaction logs, and a printed questionnaire to analyse user satisfaction with the MELVYL implementation of MEDLINE at several campuses. System designers wanted feedback from users on general satisfaction with the system and on the use of specific system features. Both online questionnaires used only multiple choice questions. The first received a 45% response rate, and the second, applied one year later, a 33% response rate. The printed questionnaire, used to supplement the online questionnaires by collecting open-ended comments, had a response rate of 73%. The evaluation results reported high satisfaction with and high overall use of the system. The questionnaires and the review of the transaction logs also revealed that many of the advanced searching features were rarely used. Effects on library services were also measured, and these included significant increases in reference transactions and interlibrary loan requests, with a significant decline in mediated search services (Horres et al., 1991).

Hancock-Beaulieu et al. (1990) describe online system evaluation using OLIVE, an interactive front-end system, which enables the collection of transaction log data, full-screen logging of search sessions, administering of online and offline questionnaires, and interactive questionnaires during search sessions, at specified points. Belkin et al. (1990) employ a combination of transaction log analysis, online questionnaires, observation, and interviews in their study to assess goals, tasks, and behaviour of users of libraries and online catalogues. A modified version of the OLIVE front-end software is employed in their study. Sandore and Ryan (1994) administered an online questionnaire for a critical incident study of searching and to measure the working knowledge of library users on the logical elements of online bibliographic searching.

The advantage of online questionnaires over printed questionnaires is the ability to collect critical incident data about a search session immediately following the session. Response rates in the range of 30-45%, reported in some studies, are comparable to response rates for many surveys using printed questionnaires. Online questionnaires remove the problems associated with distribution and return of the instruments by mail or by other means.

In comparison with questionnaires and transaction log analysis, *interviews* can provide a more intimate view of the user's perspective on the system under examination. Interviews may be conducted on a one-to-one basis, either over the telephone or face to face. They can be structured, with specific questions and pre-specified categories in which to slot answers, or unstructured, with open-ended questions that provide the subjects with more opportunity to provide unsolicited information about the system. A study by Nitecki (1993) to identify a taxonomy of user criteria for evaluating the effectiveness of an online catalogue employed unstructured interviews and used a qualitative approach in analysing the resulting information. Another type of interview-the focus group interview-may be conducted with a small group and one or more interviewers, with video and/or audio taping, and/or assistants transcribing notes and statements during the group discussion. Focus group interviews are regularly used in marketing research to gather information from a particular, per-selected group of users about products or potential products. The emphasis in the focus group interview rests with identifying the range of attitudes or opinions from a group of users who have certain demographic or otherwise significant points in common (gender, socio-economic status, race, age) about a series of questions related to system use. This technique helps to identify characteristics of identifiable user groups, along with attitudes. Researchers working on the NSF/ARPA/NASA-funded Digital Library Initiative at the University of Illinois have carried out focus group interviews with engineering faculty and students to determine what features they felt were important to include in a digital library for an engineering community. Further, they observed the online searching behaviour of patrons working in the University of Illinois Grainger Engineering Library, noting that users experienced difficulty searching existing systems (Sandusky, 1995). The Illinois research team used this information to design a transaction log that will track the searches performed on the trstbed for the project—the full text of over twenty engineering journals (Sandusky, 1996). This work is significant from the standpoint that it will enable the unobtrusive study of specific uses of networked information.

Some online systems offer the option for users to send *unsolicited comments* to librarians or system designers. In some cases, system administrators post an e-mail address to encourage users to report bugs or anomalies they encounter while searching the system. Some of these anomalies may be bibliographic in nature—typographical errors in the bibliographic record—or related to cataloguing policy. Other anomalies, such as screens that are missing placeholders or are incorrectly formatted, may not be discovered in the regular system beta testing or debugging process. Therefore, the comment option is a valuable tool in problem identification. Pennsylvania State University's LIAS online catalogue was one of the first systems to offer the "oops" command, which users could invoke in order to send a brief message reporting either system or bibliographic anomalies to the systems and library staff. Current systems commonly offer an option that enables users to send mail messages from within the system to system administrators or other staff who work closely with various aspects of the catalogue.

For over a decade the library of the University of illinois at Urbana-Champaign has maintained a user comment box in the public catalogue area of the main library. Users regularly deposit recommended corrections for typographical errors to bibliographic records, suggestions for adding subject or name headings to particular records in order to enhance access, or general recommendations about other system needs. Once a month a librarian reviews the comments and forwards them to staff in appropriate units or to an online system advisory committee for appropriate action. Various system enhancements have been made as a result of comments received in this way.

In any study that elicits specific information about use of an online system, it is important at the outset to provide the user with a written statement on the institution's policy regarding human subjects research. Those conducting the study must do everything possible to ensure that the publicly-available results of the analysis will not disclose the identity of an individual user, or link that user with information specific to his or her information-seeking behaviour. Analysis of the use of online *help* features was mentioned earlier as an unobtrusive source of information on problems encountered by users. But users can also go to members of the library staff when they need help, and their interactions with staff members is a further source of information on system problems and weaknesses.

Many public service departments maintain statistics on the types of reference and other assistance they provide to users, including online system assistance. A recent study of the impact of locally mounted periodical citation databases on library staff, users, and collections at the University of Illinois revealed a decrease in patron assistance in locating journals, since the new system supplied call numbers and library locations with the journal citations. At the same time, however, it showed that new categories of user questions arose-related to assistance in using the citation databases and interpreting the results of searches in these (Sandore et al., 1993).

The Role of Advisory and Working Groups

Online system advisory groups or committees are often appointed to advise library administrators and system designers on what the groups feel should be the development priorities. Frequently they are organized with the intention that the appointees represent, in the organization's policy and operational matters, the perceived needs of both the librarian and user populations. The groups can also provide a forum for staff input on design and problem issues. If a computer center supports the library's online system, the inclusion of one or more representatives from this center maintains a direct channel of communication concerning developmental and organizational priorities between those who design and maintain the system and those who use it.

Groups charged with providing advice on the implementation of online systems may be developed on the basis of need. For example, an ad hoc implementation group might be appointed to assist in the implementation of a new module of an integrated system. Groups of this type have a limited and focused charge, and normally dissolve or, if needed, are reconstituted into a permanent committee once their initial work is accomplished.

Committees and working groups serve the valuable function of providing advice to administrators regarding policy and operational matters related to running online systems in a manner that is effective for users, both within and beyond the library's walls. However, it should be understood that they do not replace the need for direct user feedback on system development and implementation.

Limitations of Evaluation

Although the reasons for performance evaluation are compelling, much of the work done in systems evaluation within libraries is the exception rather than the rule. This situation can be commonly observed for a number of reasons. Sometimes system resource usage is neither the concern nor the domain of the library, but rather of the campus or city administrative computing center. In situations where the management of the computing facilities is separated from the management of the library, it is more difficult to establish a cohesive picture of the factors that affect the system's performance, much less to correct these situations when performance problems arise. Also, online systems typically generate hundreds of statistical reports about the system functions on a regular (usually monthly) basis. Often, information about system resources usage needs to be carefully analysed and translated to adifferent format in order to be usable for library managers. System vendors have moved increasingly to report generation modules that can be customized by libraries in order to avoid this pitfall. The analysis of system performance data requires both skill and a commitment to ongoing analysis. Not all librarians feel they have adequate training in the use of quantitative or qualitative analysis method. Further, it is not always clear where in the library organization the responsibility ought to rest for ongoing evaluation beyond the annual budgeting process for equipment, software, and online contractual services. The published literature reveals that this analysis is now being performed by many different people-systems, reference, collection development, technical services, and administrative librarians.

Evaluating the Digital Library

The developments discussed in some of the earlier chapters strongly suggest that the library of the future will be dealing more and more with information resources that are network-accessible and less and less with those owned as physical artifacts. Although the evaluation of library services per se is outside the scope of the present book (the subject is covered in detail in Lancaster, 1993a, and Baker and Lancaster, 1991) it is appropriate to consider in what way the evaluation of such a "digital library" may differ from the evaluation of the more traditional library.

Traditional models for evaluating library services are largely based on whether or not the library, its resources and its tools can assist users to find the items or information they need. Technology has enabled libraries to expand access to information resources beyond the physical walls, both for library staff and for users. In some cases this has meant that the library no longer plays the role of intermediary in the delivery of information. As the locus of information resources traditionally associated with a trip to the library becomes increasingly decentralized and remotely accessible, the role of the library in providing these services will inevitably change. So too will the library's ability to evaluate its performance directly. How will the traditional model change as we move increasingly into a digital and networked environment, where users have direct access to remote infor-mation, and rely less often on the library and its resources for answers to their questions? What will become the role of the library as we now know it, with its quantifiable resources and collections? How can the library use technology to understand the needs of library users more completely, both in the traditional and the evolving digital library setting?

This traditional evaluation model has identifiable components, such as user characteristics, reasons for using the library, the size of the library collection, staff efficiency and accuracy, and whether user needs are satisfied within the necessary time frame. Characteristics, behaviour, and needs of users can now be observed, to some extent at least, because most of the services offered by traditional libraries require that the user enter the library at some point to receive them. Little is known of the characteristics, behaviour, and needs of nonusers in most communities.

The input predictors of the library's performance include the size of the general and reference collections and the rate at which new materials are added. Within the library, the interactions among staff processes, the library's resources and tools, and the user processes combine to produce outputs and, ultimately, outcomes. Measures of output and outcome indicate whether the information or item was obtained, whether used, and whether it had short-term (ST) or long-term (LT) impacts on the user. The most obvious output predictors of performance are circulation, number of reference questions answered, and number of literature searches performed. Libraries normally collect these data on a regular basis, either manually or through electronic monitoring. Such data quantify the services provided. True output measures relate to the effectiveness of the work done, in terms of correctness, timeliness, desired amount, and so on. While commonly accepted output measures exist (e.g., shelf availability), they require some effort to apply. Outcomes are rarely looked at: very little is known about what use is made of publications or information after users leave the library.

Some changes are needed in order to build a working model for evaluation in a digital library environment. First, it is clear that user groups will change, as will the library's ability to monitor their needs and behaviors. Since users will no longer need to come to the library to obtain access to library materials, they will be more remote, and more anonymous. It is likely that the group of users may widen to include previous non-users. This could occur because the library may provide convenient or costeffective electronic access to information that formerly was not available in the library, or because the resources are now perceived to be more accessible than they were before. Secondly, the purposes for which users seek information may change in the digital library environment. Users will have access to the electronic tools needed to build and organize their own databases of information, to create new documents incorporating or referring to that information and to find people to communicate with or to collaborate with on future projects. Thirdly, the role of the library in information provision will change, although it is too soon to determine in what ways, and to what degree these changes will occur. In a networked environment, a library may become merely a switching center, a switching center providing valueadded interfaces and indices to electronic information, or a database builder, selecting electronic information of greatest interest to users and building databases incorporating that information.

Lastly, and perhaps most obviously, the nature of the library's "collection" will change. Resources are becoming more dispersed and intangible as the concept of a collection beyond the library's physical walls is extended. The nature of the library's "control" over the contents of these collections is also changing. Items in collections, once considered discrete pieces of information, are developing fuzzy boundaries, due to the ability of authors and users to provide hypermedia links among textual and other items in a networked digital environment. Documents can now be dynamic and interactive in nature, and may not be printable. The content of collections, or items within collections, may also change rapidly.

It is clear that such yardsticks as size of collection or number of items acquired annually have little meaning for the digital library. Also of little meaning are all output measures that relate to ownership of physical items, "shelf availability" being perhaps the most obvious example. Presumably, "items accessed" replaces "circulation" as a quantitative measure of use. However, if the actions of users can be monitored (some form of transaction logging as discussed earlier), finer measure of use become possible: how much text is accessed, how much is merely viewed, how much is downloaded to personal databases, and so an.

The fact that many users will be "remote" and "anonymous" makes evaluation more difficult. The fact that some of their actions are susceptible to monitoring makes some types of evaluation easier to implement.

If the digital library is used for the same purposes as the traditional library—to find a particular item, to find the answer to a question, to find information on a particular subject-the evaluation criteria also remain more or less the same. Nevertheless, the digital library may present special problems in evaluation, as suggested earlier; e.g., "items" may have rather fuzzy boundaries and some text may lack stability (databases, and perhaps even individual items, may be updated frequently).

If the digital library is used for other purposes—e.g., to build composite documents from several sources scattered throughout the network, to locate people with similar interests, and so on—different evaluation criteria will be needed. In a highly developed digital information network, one can visualize a situation in which a scholar builds a personal database by downloading from network resources the text and graphics of most direct interest. This scholar may be supported by some form of institutional library (maintained perhaps by a university, college, or company) which has also downloaded from the broader network the text and graphics most likely to be of value to the institutional community. If an important role of the institutional library is to "feed" the personal databases of its users in a dynamic way (e.g., through some form of profile matching), the most obvious evaluation criterion would relate to the frequency with which an individual needs to go beyond personal and institutional resources to satisfy a particular need. Presumably, if the institutional library was doing an excellent job, most of the individual's needs would be satisfied from his/her own database, some from the institutional database, and very little from the wider network resources.

The digital library environment is one in which there is a high level of interaction between users and documents and perhaps between users and users. The fundamental definitions of traditional terms used to describe the library's role in information organization and delivery are being challenged, and institutional boundaries are becoming fuzzy. Many communities are developing their own databases of organized information resources in ways that enable them to access and manipulate this information optimally. Emphasis in data sharing is placed on the most convenient format for the user's needs, as opposed to the standard data formats that libraries employ in order to facilitate data exchange. The term "library" is being extended in the metaphoric sense, to the point where it will not simply refer to the traditional physical structures and collections organized and managed by library professionals. In the most basic sense, users are the builders of their own digital information environment.

Whereas the traditional library enables users to interact simultaneously with the same materials at one physical point in time, the digital library increases the opportunities for users to make serial as well as synchronous use of the same materials in digital format, as well as enabling them to communicate with each other about the material at hand.

A debate held at the 1995 annual meeting of the Medical Library Association raised several important questions for library administrators, including one that suggests that more stringent evaluation criteria may be appropriate to the digital library environment:

> *To better serve clients, do we need to change their expectations of instant gratification—i.e., information on demand-to a response time that permits more thoughtful and thorough results as is typical of other professions. (Nagle, 1996)*

The development of digital libraries is accompanied by a multi-disciplinary interest in evaluation. Evaluation in the six NSF/ARPA/NASA-sponsored Digital Library Initiative projects incorporates qualitative methods developed by researchers from various fields— sociology, phycology, communications, computer science, and engineering. Researchers in these projects are working to find out what are the most significant factors affecting use of electronic information in various areas of activity. Online system transaction monitoring is being employed widely to study the searching patterns of users, along with interviews, questionnaires, video taping, and other methods. Ironically, we may soon know more about user behaviour and preferences in the digital library than we do about user behaviour and preferences in the traditional library.

Artificial Intelligence and Expert Systems

Much Research and development work has already been undertaken toward the implementation of system able to perform many of the intellectual tasks now performed by professional librarians. This work falls in the area of research on "artificial intelligence" and "expert systems." Any discussion of applications of artificial intelligence (AI) is complicated since no universally accepted definition of the term seems to exist. Indeed, several of the books written on artificial intelligence make no real attempt to define it.* An even worse problem is the fact that the term is used so carelessly, often referring to operations (e.g., human selection from a computer-displayed menu) in which no machine intelligence is involved at all. While perhaps not a formal definition, Fenly (1992) has offered a clear and concise statement that illustrates what AI is, or should be, all about:

> *...computer programs have been developed which exhibit human-like reasoning, which may be able to learn from their mistakes, and which quickly and cleverly perform tasks normally done by scarce and expensive human experts.*

In other words, one can say that AI attempts to develop systems that perform some of the tasks normally performed by experts in some area; perhaps the most obvious example is medical diagnosis. For this reason, systems of this type are frequently referred to as *expert systems*. The terms *knowledge-based systems* and rule-based systems seem now to be used more or less interchangeably with *expert systems* because systems of this type must be given a body of knowledge (e.g., symptoms and signs associated with a particular disease state) to work on and some of these knowledge bases would consist of rules, such as rules for descriptive cataloguing. In the literature of library science, the term "expert systems" is frequently linked to the term "artificial intelligence". This is somewhat misleading: a system can store and exploit knowledge or expertise without exhibiting any real intelligence (e.g., without learning from its mistakes).

Expert systems approaches to various library activities have been mentioned already at various points in this book. This chapter gives a brief overview of developments so far, and attempts to assess the promise of expert systems techniques for the immediate future. More complete surveys can be found in Alberico and Micco (1990), Bailey and Myers (1991), Drenth et al. (1991), Lancaster and Smith (1992), and Morris (1992).

Cataloguing Applications

Because descriptive cataloguing is rule-based, one would think that this activity would be a prime candidate for an expert systems application, and some work has been done in this area. Fenly (1992) claims that the results have so far been unconvincing. He feels that a cataloguing system with genuine expertise is an order of magnitude more difficult to implement than one that merely casts cataloguing rules in an automated format. As he points out:

> *...genuine expert systems, with the depth and power to solve substantial and meaningful problems, are time-consuming and costly to develop.*

Fenly does suggest, however, that there may exist certain descriptive cataloguing problems that require an unusual amount of intellectual effort and that problems of this type might justify the expense of a full expert-systems approach. One such application is that of the cataloguing of series.

Weibel (1992) seems to agree with Fenly to a very large extent. Although he, himself, has performed research at OCLC on the feasibility of automatic descriptive cataloguing from images of title pages, he sees a "thread of unreality" in much of the research performed in this area so far. He claims that there exist "large obstacles to implementation of production systems." However, like Fenly, he seems to believe that certain specialized tasks in cataloguing might benefit from an expert-systems treatment; one example is the detection of duplicate cataloguing records, In his view, it is more important that automated approaches to cataloguing should be "intelligently implemented" than that they be "intelligent."

Subject Indexing

The assignment of terms to documents, to represent the subject dealt with, is another activity that might benefit from the expert system approach. While subject indexing cannot be as rule-based as descriptive cataloguing, certain rules do have to be followed. In very large systems, such as those operated by the National Library of Medicine, these rules can be quite extensive. For example, one set of rules prescribes which subheadings are to be used with which categories of main headings.

An interactive program, MedInEx, has been developed at the National Library of Medicine, using expert system principles, to assist the indexer in using *Medical Subject Headings* to represent the subject matter of biomedical articles. Work on this system is reported by Humphrey (1992). In essence, the system can perform two major tasks: (1) prompt the indexer to assign a particular term or type of term, and (2) correct the indexer when a term is used inappropriately. For example, an indexer who assigns a neoplasm (cancer) term reflecting the site of the disease (e.g., *bone neoplasms*) can be prompted to assign a companion term representing the histologic type of the neoplasm (e.g., *adenocarcinoma*). r, the indexer who assigns an inappropriate combination, such as *femur* and *bone neoplasms*, can be informed that the correct term is actually *femoral neoplasms*.

Other approaches to automatic indexing or computer-aided indexing, described in the literature, also claim to use artificial intelligence or expert system techniques. However, many merely assign terms to documents on the basis of similarity between words occurring in the text (e.g., titles and abstracts) and in word "profiles" associated with each index term. While such systems could be considered "knowledge-based," they can hardly be regarded as involving artificial intelligence. On the other hand, artificial intelligence could be involved if the indexing system learned from its mistakes and was thus able to improve its own performance.

Database Searching

Much work has been done on the development of "intelligent frontends" or "intelligent interfaces" to aid the exploitation of databases through online networks. For example, Hu (1987) has evaluated one such interface designed to help someone select the database that appears most appropriate to use to satisfy a particular information need. Hu's study indicates that this particular interface operates almost entirely through the use of menus, from which the user makes a selection, and that it exhibits no evidence of any real "intelligence" in database selection.

Other interfaces are designed to help users construct search strategies that appropriately reflect their information needs. Several interfaces of this type have been reviewed by Vickery (1992) and by Alberico and Mico (1990). Some of these operate largely through menus, some prompt the user by asking questions designed to limit the scope of the search in a useful way, and some will accept input from the user in the form of a narrative statement of information need. While many of these are ingenious and useful tools, it is not clear that they can actually be said to involve the use of artificial intelligence. Denning and Smith (1994) present some general design principles to guide the implementation of intelligent interfaces. Several are demonstrated in their prototype, ELSA (the Electronic Library Search Assistant).

Question Answering

The Association of Research Libraries survey of the use of expert systems in research libraries (Bailey and Myers, 1991) indicates that reference service is the area that has received most attention. Waters (1992) considers question answering to be an obvious application of expert system approaches because similar questions are repeated time and time again and because some libraries record questions received and answers supplied, thus creating an appropriate "knowledge base." The subject has already been thoroughly discussed and reviewed in the literature (e.g., Parrott (1986, 1989, 1992), Richardson (1989), Vedder et al. (1989), Alberico and Micco (1990), Davies et al. (1992). The systems developed range from those restricted to highly specialized subject areas, such as AquaRef (Hunfman, 1989), to those attempting to cover the whole range of questions dealt with in a general library. Most of the systems developed operate by means of menus, but at least one does permit the use of questions in natural-language form. Typical of the general systems are Reference Expert, developed at the University of Houston (Bailey, 1992), and SourceFinder, which was developed at the Undergraduate Library of the University of illinois at Urbana-Champaign. They do not answer questions directly but attempt to lead users to sources that will provide answers.

SourceFinder (SF), which was originally designed to support that research strategy class (Allen, 1989b), is intended to help undergraduate students to find sources top answer their reference questions when no professional librarians are available. The database contains over 2100 reference sources. SourceFinder operates through a series of menus, the first of which offers 24 broad subject categories (e.g., Art, Biographies, Law, Religion) from which a user can choose. After the subject menus lead the user to the most specific subcategories available (e.g., Performing Arts leads to the choice among Costume, Dance, Film, Musical Theatre, Television, and Theatre), further menus ask the user to restrict by type of information needed and then by type of source (e.g., handbook, dictionary). Usually, several possible sources are suggested for each question and in some cases the list may be quite long. Although the sources will usually be printed tools, the user can also be referred in other ways (e.g., to use the online catalogue or a CD-ROM database).

The database of Reference Expert (RE) is much smaller-340 reference sources in printed and CD-ROM form; almost 150 are indexes and the remainder are other types of reference tools. Reference Expert operates in a way that is very similar to the way that SourceFinder works. Menus lead a user down to an appropriate level of subject heading, then offer the user various possible content types (e.g., definitions, addresses, biographies) and, possibly, formats (print or CD-ROM).

Acquisitions and Collection Development

The systems are able to rank the potential sources to reflect probability of success in acquisition. In the case of the system described by Pontigo et al., a learning capability is claimed. Brown (1993) describes a system designed to determine whether a particular item is likely to be received through an approval plan, and Bianchi and Giorgi (1986) and Waldstein (1986) describe expert systems to aid library users in a variety of tasks, including document ordering. Systems designed to aid materials selection are dealt with by Rada et al. (1987), Sowell (1989), and Meador and Cline (1992).

Achievements and Promise

Despite the activity and interest, there has been little in the way of systematic evaluation of the systems developed. This is also true of expert systems developed in other fields (Adelman, 1992). Moreover, the evaluation that has occurred has tended to concentrate on the internal functioning of the system (e.g., the completeness of the knowledge base or the logical consistency of the inference engine) rather than on the system outputs. To establish the true value of an expert system, one must compare the results achieved with the results obtained without expert system aid, using effectiveness and/or cost-effectiveness criteria (Lancaster, et al., 1996). The few evaluation that have been performed suggest that achievements in the library field have so far been quite modest. For example, Su and Lancaster (1995), in their evaluation of two expert systems for the selection of reference sources (Reference Expert and Source Finder), conclude that they might improve the performance of only the most inexperienced of library users. Somewhat better results are reported by Richardson and Reyes (1995) in their evaluation of two expert systems but their searchers were experienced librarians, rather than unsophisticated users, and they were dealing with systems restricted to a single domain-government information. Hu (1987), in her evaluation of an interface for database selection, discovered that it could help less experienced individuals approximate the success rate of experienced searchers in the selection of databases appropriate to particular information needs, but neither the experienced searchers nor the system-aided inexperienced users performed at very high level.

It must also be recognized that, while many prototype systems have been developed, there are few that can be considered fully operational in the sense that they have replaced previous practices or staff positions.

Fenly (1992) has usefully summarized the potential benefits of expert systems as these have been identified in the literature. They include:

1. Make scarce expertise more widely available, there-by helping nonexperts achieve expert-like results.
2. Free some of the time of human experts for other activities.
3. Promote standardization and consistency in relatively unstructured tasks.
4. Provide incentives for creating a database of knowledge in a permanent form (e.g., not dependent on the availability of particular individuals).
5. Perform at a consistently high level (e.g., not influenced by fatigue or lack of concentration).

These benefits are very real and there seems little doubt that carefully designed knowledge-based systems could be of great value to the library profession when applied to highly specialized activities that are now accomplished only through the expenditure of significant amounts of the time of expensive human experts. They could also be of value in tasks, such as the document ordering activities dealt with by Pontigo et al. (1992), that can obviously benefit from learning capabilities. However, there is little to support the belief that machines with "intelligence" will soon be able to take over many of the intellectual tasks now performed by a well-trained and experienced librarian, and many writers on this subject seem much too optimistic on this point. For example, Metzler (1992) has said: The library of the future may be able to provide a far richer access to, and utilization of, the knowledge contained (often implicitly) in its collection. The most immediately feasible development along this line would be content-based information retrieval. This, of course, would require a far more general and robust brand of artificial intelligence and natural language understanding than what we have available now. The step beyond that would involve not only understanding text well enough to determine whether it is relevant to a general information need expressed by a user, but to understand it well enough to actually extract information that can be used by a program. A recent report from the American Association for Artificial Intelligence (Weld et al., 1995) suggests that the field of AI is ready to make a significant contribution to solving the information retrieval problems posed by the Internet and its successors. However, the authors of the report exaggerate the achievements of AI in such applications as medical diagnosis while, at the same time, acknowledging that many of the intelligent systems that have been developed are not sufficiently robust for transfer to a real-world environment. The report is more of a wish list, identifying areas that require further research and funding, than an accurate picture of what AI can contribute to the National Information Infrastructure today.

The enthusiasm for artificial intelligence or expert system approaches that exists in some segments of the library profession today is reminiscent of the enthusiasm for machine-aided diagnosis that existed in some segments of the medical profession about twenty years ago. Machine-aided diagnosis has not been widely accepted by the medical community, and the performance of computer-based diagnostic systems has been less than inspiring. It is now realized that the problems are much greater than they once appeared to be. Human experts operate through a combination of knowledge, experience, and intuition. Capturing the knowledge in some electronic form is possible, if not exactly easy, but recording human experience is a problem of a greater order of magnitude, and the replacement of human intuition is unlikely to be achieved for a very long time. Most of the activities performed by librarians require less knowledge, experience, and intuition than does medical diagnosis. Nevertheless, the problems involved in automating even the "simplest" of intellectual tasks are frequently underestimated. Outside the library field, disillusionment with expert systems now seems fairly widespread (No more expert systems, 1994). A large component of "expertise" is informal and experiential in character (Bainbridge, 1991); the recorded knowledge, however detailed and comprehensive, still requires evaluation and interpretation, People do not become experts merely by having an expert knowledge base available to them. Indeed, the very availability of such a tool can be dangerous, for it puts decisions and actions that are properly the domain of the expert into the hands of the less qualified. One of the major deterrents to the further development of expert systems in medicine is malpractice—the danger of incorrect diagnosis and treatment-with its attendant litigious consequences. The true expert is a very rare individual. There are probably less than a dozen expert neuroradiologists in the entire United States. There are rather few expert reference librarians, and they are becoming fewer. We can not use machines to replace the true expert in neuroradiology, or the truly expert reference librarian, although we may be able to design systems that would allow the worst of them to perform better. Lancaster (1993b) has asked why we refer to these systems as "expert" and suggests that "systems of mediocrity" would be a more apt description; he warns that, if our library schools concentrate on teaching students how to use such systems to exploit this mediocrity, the true expert—the expert cataloguer, the expert indexer, the expert librarian—will disappear.*

It is fashionable today to claim that an important role of the librarian in the future will be that of a teacher—teaching people how to exploit information resources. Will we still have the knowledge needed to fulfil this teaching role, or will it be lost through the process of deprofessionalization as suggested by Harris (1992)? Deprofessionalization might well be accelerated by an over-reliance on expert system technologies.

17

Collection Management and Electronic Resources

Library-Vendor Relationships

Technology and shrinking acquisitions budgets have had an important effect on the relationship between vendors and libraries. In the 1980s, the advent of online systems for ordering, receiving, and tracking the acquisitions process introduced a crucial service component into what was once a simple transaction between libraries and vendors. Today, vendors are no longer judged solely on their ability to supply books, but also on the added electronic services that libraries believe will make the work of ordering and obtaining books more efficient and cost-effective. Further, vendors, publishers, and academic institutions are grappling with the challenge of providing access to electronic publications, and developing adequate and reasonable pricing and delivery structures to support their production and maintenance. This chapter examines the impact of technology on the relationship between libraries and vendors.

Relationships and Roles : Publishers, Vendors, and Libraries

> *...libraries (as well as other organizations) have been transformed through automation..... Libraries, publishers, and vendors have all had to deal with this change, sometimes because they wanted to, sometimes because they simply had to in order to remain competitive.*

This technology has also had two other effects on libraries that changed their relationship with publishers and vendors. First, we have seen the creation of a whole new brands of vendor, the automation vendor. Second, as funding leveled off or even decreased for libraries, much of this technology had to be acquired at the sacrifice of book/journal funds. The question is quickly becoming one of allocating funds by type of information format (print, CD, online) regardless of the product, by type of product (book, journal, map) regardless of the format, or some other method. Publishers will not only have to compete with their print counterparts, but they will also needs to be aware of what is happening electronically and how that is impacting their market share, Vendors will have to carry more lines and have personnel that can help their customers select the right format for their clientele.

Effects of Change on Vendors

> *...became as much of a victim of the changing times as the libraries. Not only were publishers increasing their prices but they were also not giving the vendors as much of discount, and in many cases, as with Bowker and UMI, they deliberately refused to deal with vendors and forced the library to order direct. In other cases, publishers undercut the vendors and encouraged libraries to order directly by offering a better price than they could possibly get through a vendor... Of course, the overhead of dealing with orders, claiming, and following up on address changes, etc., is a tremendous cost, but it is an indirect cost that does not show up in the cost of subscriptions on a materials budget line.*
>
> *There were several needs for automation services. One was that as the cost of library materials continued to escalate, libraries needed information and measuring tools to determine exactly which materials were increasing in price, in what areas, and by how much. From vendors, we needed more sophisticated management reports that not only gave us information on specific accounts and expenditures, but also information on the holdings of area institutions, and information on how the economic situation was being projected for publishers and the economy as a whole. This need included current and dependable analyses of the national economic forecasts. Also because of the fluctuating dollar and the high price of foreign publications, libraries needed predictions and services based on global and international monetary exchanges. This was particularly important for libraries that did not have sophisticated in-house automation resources and systems. (Presley, 1993).*

Impact of the Internet on Communication and Vendor Services

> *Whether a vendor becomes a source for Acquisitions depends on many factors: the type of order, the vendor's speed of*

> *supply, the discount the vendor provides, the vendor's service and responsiveness, whether the vendor can accept electronic orders, and communicate via electronic mail. While Acquisitions is always interested in learning of vendors in its fields of interest, the choice of whether to use a vendor or try them out is an individual decision.*
>
> *Once Acquisitions adds a vendor to its vendor list, that vendor is subject to regular monitoring of its speed of supply and, for U.S. vendors, its discount levels. Vendors who fail two remain competitive among Acquisitions' sources may be relegated to inactive status, whether they are high-discount but slow vendors or fast vendors with poor discounts. (Stevens, 1996b)*

Outsourcing

> *... these models could entail authorizing library users to access library or jobber systems for ordering titles directly. The librarians could place price limits and designate the acquisition accounts. This would contribute to a user-centred selection and acquisitions system. In the distributed model, the library's system would track to preapproved accounts and send to preapproved vendors. Applications of artificial intelligence embedded within the library's system could add sophistication to this process The vendor systems model implies that the vendor would maintain records of the order and track library accounts, although an alternative might be to download the vendor record to the library's system to show what is on order.*
>
> *This experiment gave us the opportunity to implement an intellectual shift in the way we view and process approval plan titles..We call this process monograph check-in rather than copy cataloguing, allowing us to move these titles thorough technical services very quickly, with little handling, and with entry-level staff. (Campbell, 1994)*

Ready to speed the interchange among systems are the EDI standards for communicating business information now being developed and implemented. Whether full contracting for acquisitions becomes commonplace rests with technology, communication standards, and the collection development practices of libraries.

Combined Effects of Technology and Role Changes

> *As a result we: adopted Prompt Cat as the means for obtaining cataloguing for our approval materials; consolidated all our*

North American business with a single vendor including standing orders, approval and firm, so our vendor could catch duplicate items for us before they were shipped; began having the vendor do some processing of the books for us such as applying barcodes before shipment; began activating forms in the approval plan via talent rather than mailing the forms in; and numerous other innovations.

There has been no area of our operation that has not been affected and changed. There has been no aspect of our relationship with our vendor that has not been impacted by the increased use of technology. (Harsin, 1996)

As an Acquisitions Librarian I am disturbed by the lack of personal attention given to our orders. These days if a book with a particular isbn is not in a vendor's system they report it as unavailable OP, etc. They do not pursue an alternative edition by searching by title or author. e.g. Tom Sawyer or Grapes of Wrath are all available in paperback but the printings may change and as a result a new isbn is issued. The vendors report that these are outs of print when in fact if they searched by author or title they would locate another printing. They are so dependent on automation that only an isbn hit is worth pursuing.

The Future

Technology, combined with other forces, has caused the roles and responsibilities of acquisitions departments in libraries and vendors to blur. The information examined in this chapter suggests that technology has enabled vendors to simplify the ordering, accounting, and claiming process for libraries, and to supply access to increasingly complete electronic files of their materials. In turn, acquisitions vendors are able to team up with cataloguing vendors to simplify the searching and cataloguing process, especially in the cases of approval plan materials. Secor (1996) believes that four values will help to determine whether some vendors survive in the short term. These values include competitive pricing, technology leadership, a clear understanding of customer needs, and operating excellence. He suggests that both libraries and vendors are driving the technological changes that are occurring in the area of materials ordering and processing. He emphasizes that the most mutually beneficial relationships can be established by libraries and vendors teaming up to develop and test new products and services, as opposed to operating on the assumption that "cutting edge" technology ought always to be superior to current practice and support. Secor predicts that the current market cannot continue to support the number of vendors currently in business, and that the field will seen an increase in "strategic alliances" with companies collaborating to develop both technology and marketing approaches.

Distinctions between types of vendor are becoming less precise also. For example, firms that were once considered as primarily subscription agents are now taking on other roles such as providing access to the full text of certain journals.

Atkinson's (1992) approach to analysing future scenarios for acquisitions within the electronic library posits an active role for acquisitions librarians in the procurement and delivery of information. He advocates that acquisitions departments ought to assume significant responsibility for delivering scholarly publications and that they ought to develop increased expertise in the technical aspects of networked information delivery. Atkinson suggests that traditional operations that are currently not linked, such as acquisitions, interlibrary loan, publishing, and networking, should all be linked within an electronic library environment, with the primary focus on the acquisition, creation, delivery, and mediation of use for electronic texts and other bibliographic information. He argues that the library is in the best position to assume responsibility for scholarly publishing in the electronic library environment :

> *If the library is truly to serve the interests of scholarly communication, it must appropriate increased economic responsibility for scholarly publishing. The economics of scholarly communication cannot be left solely in the hands either of the information technicians or the commercial publishers, although both of those groups—one in the interests of expediency, the other for purposes of profit—have been and will continue to be quite prepared to assume that control. Rather, it is the library that is in the best position to assume responsibility, as it has always sought to do for ensuring that scholarly information is available to all who need it for educational and research purposes.*

Automated Systems in Collection Management

Automated systems can provide data on the use of library collections that are more complete than those available in the preautomation era. Consequently, collection development policies and collection management in general, should now be better than they were in the past. "Better" here implies decisions that are more effective or more cost–effective: buying more of the things that patrons really need, buying fewer that will never be used or used only rarely, buying more items whose cost–per–use will be low.

Various aspects of the use of automated systems in collection management have been dealt with in the literature. Perhaps the most complete overview is that of Nutter (1987).

Analysis of the collection

As Nutter (1987) points out, the online catalogue, representing what the library now owns, can be used to produce a detailed analysis of the present collection. Tabulations can be produced for such variables as language, country of publication, data of publication, subject and publication type and useful correlations can also be made–for example, between subject and language or subject and data of publication. Simple but detailed analyses of this type might in themselves suggest strengths and weaknesses in the collection and the data can be used to monitor changes over time. In an academic setting, the analyses of holdings can be compared with "profiles" of the various academic departments or faculties, where these profiles are defined by numbers from the scheme of classification used to organize the collection.

A good example of the analysis of the holdings of academic libraries can be found in the work of Kountz (1991), who compared holdings data with data on student course enrollment to measure the extent to which collections match "constituency interests."

Comparison with External Databases

Nutter (1987) suggests that one approach to the evaluation of a collection is to compare it with external databases to identify strengths, weaknesses, items that should probably be acquired, and so on. This seems particularly appropriate to the special library situation. For example, a medical library might compare its monograph acquisitions over, say, the last five years with the acquisitions of the National Library of Medicine (NLM) in the same time period, as represented in NLM's monographic database. Comparisons could be made on the basis of class numbers, where the local library makes use of NLM's classification, or subject headings. The ratio of local library acquisitions to NLM acquisitions in various subject areas could be taken as an indicator of areas in which the local library appears strong and areas in which it appears weak.

Another type of holdings/database comparison involves the use of databases searched online on behalf of library users. The bibliographic references actually retrieved in such searches presumably reflect the interests of library users, or at least those who make use of the database searching service. By downloading the references retrieved by all searches performed during a particular period of time, a useful database can be created. Analyses can then be performed on the resulting data. Most obviously, one can produce a list of journals ranked by the number of times they have been retrieved and this may reveal certain titles that should perhaps be added to the collection because they seem to match current community interests rather closely. Again, this type of analysis is likely to be more valuable in the special library than in the general library. Lancaster et al. (1991) present an example of how search results can be used in this way in an academic library setting.

Circulation Analysis

Although it has always been possible to perform analyses of circulation records to study use of the collection, at least on a sampling basis, studies of this kind are greatly facilitated when circulation is automated. Records representing all circulations, rather than a sample, can be manipulated by computer program to produce data on subject distribution of the circulation, to identify the most heavily used titles and (if the data are collected for a sufficiently long period) to measure rate of obsolescence. The most obvious application of circulation data is to produce analyses of use of the collection by subject according to the various subdivisions of the classification scheme in use in the library.

Jain (1965–1969) pointed out that librarians should be less concerned with establishing the absolute use of portions of a collection than with determining "relative" use. What this really means is that one should use circulation data to reveal differences between actual and "expected" behaviour. Suppose, for example, that books on physics make up 12% of a particular collection. Probability alone suggests that physics books should account for 12% of the circulation. If they do, that portion of the collection is behaving exactly as expected. On the other hand, if physics books account for only 8% of the circulation, one can say that the class is "underused" (used less than expected) whereas it would be "overused" if it accounts for, say, 15% of all circulation. An overused class is one in which items are used more than expected (in a probabilistic sense) relative to the proportion of the collection occupied by that class. An underused class is one in which items are used less than expected relative to the proportion of the collection occupied by that class.

If data on the library's holdings in various classes are built into an automated circulation system, printouts or displays can be generated to show for each class what proportion of the collection it occupies and what proportion of the circulation it accounts for. An automated circulation system could be used to generate such data in a more useful format; e.g., identify those classes that deviate most from the expected behaviour–those most overused and those most underused.

The assumption is that the most deviant classes are those that need most attention. The circulation data merely highlight the deviant classes; they do not tell the librarian how to deal with them. One could argue that both overused and underused classes may fail to meet user needs. If a class is heavily overused, the implication is that the library lacks the strength in this area to meet the present volume and variety of demands. The more overused a class, the lower the probability that any particular book will be on the shelf when looked for by a user. Moreover, the more overused the class, the less valuable it will be to the browser because of the phenomenon of "shelf bias." Shelfbias refers to the fact that, all other things being equal, the shelves of a library will tend to display books that nobody wants to borrow. The phenomenon was identified explicitly by Buckland (1972) and Buckland and Hindle (1969), who referred to it as "collection bias." "Shelfbias" seems more descriptive of what is actually taking place. Buckland (1975) expresses the bias in terms of the proportion of the material absent from the shelves at a particular time. Thus, if 80 books out of 240 were absent, the bias would be 33%.

A heavily underused class may be just as disturbing as one heavily overused. The class appears not to be of much interest to the community. This may reflect changing interests over time. On the other hand, it may indicate that the selection of books is just not a good one. Perhaps the library is buying the wrong books (e.g., too technical or too the-oretical) or that it owns too many books that are out–of–date and should be discarded. It is possible that use of the class would increase substantially if it were thoroughly weeded and more attractive, up–to–date items added.

Circulation data can bring "problem" classes to the librarians's attention. It is then the librarian's task to look more closely at such classes to decide why they are behaving as they are and what corrective action appears to be necessary.

The degree of discrepancy between holdings and circulation can be expressed in several ways. The simplest, perhaps, is the "circulation/ inventory ratio" (C/I) used by Wenger et al. (1979), which is nothing more than the number of circulations occurring in a class during a particular period of time divided by the number of items in that class. Thus, a class with seven items and twenty circulations receives a C/I ratio of 2.9 (20/ 7), i.e., approximately 2.9 uses per item per x period of time (usually a year). Dowlin and Magrath (1983) also use this but refer to it as "inventory use ratio." The Public Library Association (PLA), in its output measures for public libraries (Van House et al., 1987), uses the term "turnover rate" for the same measure (i.e., uses per item per year). Following the recommendations of the PLA and of various state library agencies, many public libraries in the United States collect turnover data, although few seem to make intelligent use of them. In fact, the turnover rate for a complete collection is of very little interest (except, perhaps, in comparing the performance of similar libraries). What is of interest is the turnover rate for various parts of the collection. The turnover rate for adult nonfiction as a whole (1.11) masks the fact that the turnover ranges from a low of.51 (about one half of a use per book per year) for class 800 to 1.84 for class 400. For example, class 400 has high relative use (circulation is almost twice what probability suggests it should be) and the highest turnover and class 800, with the lowest turnover rate, is used at exactly half the level expected (10% of the collection and 5% of the use).

Day and Revill (1995) discuss a variant on turnover rate in which recent acquisitions only are related to circulation. While this makes sense, it would make even more sense to compare circulation with both total holdings and recent acquisitions.

Nimmer (1980) has used the measure "intensity of circulation" — number of circulations per 100 titles held. Bonn (1974) proposed a simple "use factor" (renamed as "degree of use" by Gillentine et al., 1981), which is the proportion (or percentage) of the circulation accounted for by a class divided by the proportion of the collection occupied by that class. With this type of ratio, as used by Jenks (1976), the higher the figure the greater the overuse. For example, a class accounting for 3.49% of the collection and 4.79% of the circulation receives a score of 137.25 while one that accounts for .36% of the collection but only .16% of the circulation gets a score of 44.44. Metz (1983) refers to this measure as the "proportional use statistic" and Aguilar (1986) as "percentage of expected use." Aguilar derived his use of this measure from Mills (1982).

Trochim et al. (1980) use the *difference* between holdings percentage and collection percentage for each class as an indicator of overuse or underuse. Mills (1982) is critical of this: a difference of 0.2 would apply equally to a subject occupying 0.5% of the collection and getting 0.7% of the use as it would to one occupying 2.5% of the collection and getting 2.7% of use, yet the proportional discrepancy between holdings and use is very much greater for the smaller class.

Mostyn (1974) uses the term "supply–demand equality" in referring to the relative use relationship; an overused class is one in which demand exceeds supply and vice versa for an underused class.

Mills (1982) has applied the relative use principle to the problems of collection development in a film library. In a typical film library, films have to be "booked" (i.e., reserved) in advance, so it has an advantage over most other types of library in that failure rates (i.e., "denials" –cases when particular films or films of a certain type are not available to the requester) are easy to identify and record. Mills makes use of this failure rate, as well as a measure of relative use, to make decisions relating to future acquisitions. The percentage of holdings related to the percentage of bookings gives a percentage of expected use. Thus, art films account for 1% of holdings and 0.88% of bookings, so the percentage of expected use is 88. The denial to bookings ratio brings in further data. A high D/B ratio means that films in this category are unlikely to be available when needed by a user. The worst case us "stories–holidays and seasons," where 74% of the requests for films have to be denied (D/B ratio = 0.74). On the basis of relative use data (percentage of expected use), the difference between percentage of bookings and percentage of holdings and D/B ratio, Mills is able to make recommendations relating to future acquisitions: some classes need to be strengthened by further purchases, which might be further copies of things already owned ("add prints"), some need to be weeded and some should be strengthened and weeded.

Britten (1990) uses the "80/20" rule as the basis of a study of circulation in an academic library. He found that, while the rule seemed to apply to the complete collection, substantial differences among the LC classes could be observed. For one subclass, 40% of the items are needed to account for 80% of the circulations. At the other extreme is a class in which only 1.5% of the items account for 80% of the use. He advocates that the classes that deviate most from the 80/20 distribution in a positive way (a higher proportion needed to account for 80% of the use) should be "rewarded" in future collection development and budget allocation. Clearly, this type of comparison of the performance of various categories of books is merely another variant of relative use or the turnover rate.

Lee and Lockway (1991) also use percentage of expected use to indicate the most deviant classes in the collection, in this case in an academic library. At one extreme, class HV5001, which accounts for 0.0809% of the collection, gets 0.559^{8}% of the use, a use factor (UF) of 6.92 or a PEU (percentage of expected use) of 692. In contrast, class LH earns a UF of only 0.03 and a PEU of 3.

There are other ways of expressing overuse and underuse of portions of the collection. One is the proportion of items on loan (and, conversely, the proportion that should be on the shelf) at a particular time. A class in which many of the items are in use is a healthy class whereas one from which few items are borrowed is not—little interest exists in this subject in the community, the library is not buying the right books, or the class contains too much that is obsolete. On the other hand, it is not good to have a class in which most books are always absent from the shelves; this would indicate considerable shelf bias and the probability that a user would find particular item on the shelf when needed must be very low. Extremely active classes of this kind need strengthening, at least through the purchase of further copies of the most used items.

The monitoring of collection use by proportions of classes absent from the shelves is not dependent on automation and, in fact, predated automated systems. Nevertheless, such monitoring is much easier when data can be drawn from an automated circulation system. Note the very wide differences between heavily used classes, in which more than 20% of the items are on loan and little used classes, in which less than 5% are in use. In performing analyses of this kind, items that cannot be borrowed (i.e., reference only) should obviously be excluded.

Automated circulation records can also be used to identify items in collection that are receiving little use and, thus, may be candidates for discarding or retirement to storage. Use can be expressed in several different ways, including the length of time that has elapsed since a book was last borrowed. In fact, "last circulation date" can be used to partition the monograph collection by "levels of popularity,".

It is also possible to use the circulation system to "flag" items that are now used so heavily that additional copies should be purchased or some other steps taken to improve their availability. In fact, several commercially–available systems have an alert feature to identify items for which X patrons have placed "holds."

Building of Special Databases

Analyses of circulation patterns of the type discussed in the preceding section are based on data that can be drawn from an existing database– that recording which items are borrowed, when and by whom. But it is also possible to build other databases that can be useful in making decisions relating to collection development and management.

One such database would record in–house use of the collection. In the past, it has been notoriously difficult to get good data on in–library use (Rubin, 1986; Lancaster, 1993a). Today, however, portable data collection devices can be used to scan bar codes or OCR labels on books left on tables or in carrels in the library before they are returned to the shelves. This procedure is likely to underestimate the total volume of inhouse use, perhaps rather considerably, because not all uses will involve carrying items to seats in the library and many items may be returned to shelves by users (Lancaster, 1993a). Nevertheless, it should depict the pattern of inhouse use fairly accurately: if the data show that X items are used five times more than Y items, this probably does reflect the relative use of these two sets, even though both counts may be underestimates.

Lee and Lockway (1991) have discussed the use of data gathered in this way in collection development policies. They refer to it as a "browse–use" factor for the collection. For example, HV 5001 contains 372 items, which is 0.0809% of the total collection and it received 1787 recorded uses in a particular period of time, which is 0.3338% of the total uses recorded. The class is used 4.13 times more than expected (.08% versus .33%), giving a "use factor" (UF) of 4.13 or a "percentage of expected use" (PEU) of 413.

Rapidly escalating costs, coupled with budgets diminishing in purchasing power, have forced many libraries to discontinue subscriptions to some periodicals or other serials. To aid decisions on which serials to discontinue, it may be valuable to build a database of information on the serials that the library now receives. Such a database has been described by Hansen (1986).

The most difficult data to collect, of course, are those on recorded use. If these can not be collected through use of scanning devices, as mentioned earlier, they can be obtained in various ways on a sampling basis, as described by Lancaster (1993a).

Although Hansen records binding cost, she does not calculate a total ownership cost, based on estimates of storage and handling costs as well as subscription and binding costs. The data she does record would allow an estimate to be made of cost per use for each serial based on subscription cost and binding cost, but use related to an estimate of total ownership cost would be more accurate. In any case, the serials with highest cost per use would be prime candidates for deselection in items of budget reductions.

Of course, the construction of a database of this kind and its updating and maintenance, require an investment on the part of the library. Hansen suggests that the investment is justifiable because the database makes readily available the information needed to make deselection decisions and has value in other applications–e.g., to generate printouts of serials relevant to particular academic departments and to provide data useful to binding operations.

Although the database described by Hansen is designed for use in academia, it could obviously be modified for use by other types of libraries. All of the elements other than department–relatedness are equally relevant to other libraries and alternative data could be substituted as appropriate. For example, a subject category could be used in place of department–relatedness in the case of a public library.

Yet another type of database can be built to record interlibrary loan transactions as described, for example, by Wessling (1989) and Chang (1990). Interlibrary loans initiated online, by staff members or library users, can be recorded automatically and others added manually. A database of this kind may be useful in a number of different ways. For example, it could be used to:

1. Identify requests made by particular constituencies (e.g., academic departments).
2. Identify monographs or journals requested more than X times.
3. Identify subject areas in which many requests are made.
4. Provide data that can be compared with other data, such as those relating to circulation and acquisitions patterns.

Data Comparisons

Decisions relating to the development and management of collections will be most firmly based when they take into account more than circulation data alone–hence the value of the specially constructed databases discussed in the previous section. Data on circulation, in–house use, interlibrary loan and current acquisition patterns can all be useful.

For example, one needs to know, for any particular subject area, what the level of current purchasing is and whether use of the class is increasing or decreasing over time.

Class y is very much underused and use continues to decline. This would appear to be a class in which interest is waning and it seems hard to justify the fact that 3.5% of all acquisitions fall in an area that accounts for only 0.2% of current circulation. Similar data for other classes could lead to quite different conclusions. For example, if a class is under-used and on the decline but percentage of current acquisitions is well below percentage of collection, the situation seems to have corrected itself and no further action is called for.

It shows an actual collection evaluation report, for the period July 1, 1989, to June 30, 1990, from a public library in Illinois. For each of the Dewey classes, the following data are presented: percentage of collection, percentage of circulation, turnover rate, percentage of interlibrary borrowings for the past year and percentage of acquisitions for the past year. Note here some classes that seem still to need corrective action. For example, 300 is underused and as a relatively low turnover rate, but interlibrary loans are strong (proportionally more than circulation) and the current acquisition rate is very high. The low circulation and turnover, coupled with the high rate of interlibrary borrowing, suggest that what is being purchased in this class does not correspond well with the current interests of users. If better fit to user interests, acquisitions in this class might actually be reduced. The low turnover rate and discrepancy between collection and circulation percentages further suggest that the class needs some thorough weeding. In contrast, 600 is a heavily overused class; that it now accounts for almost 28% of acquisitions indicates that this fact has been recognized and appropriate corrective action taken. The librarian should look at fine circulation data rather than coarse to avoid jumping to the wrong conclusions. The fact that Dewey class 600 is overused does not necessarily mean that the entire class is overused; it may be that only the cookbooks are overused and all other subdivisions are actually underused. Likewise, overuse of Library of Congress class QA may suggest the need for strengthening of the entire mathematics collection when, in fact, it is only the computer science books that are affecting the results.

Of course, automated circulation systems can yield data that are finer than gross use patterns; use of small subclasses or even individual titles can be examined. One example of this type of analysis can be found in

Britten and Webster (1992), who analysed MARC records for titles heavily used within an academic library in an attempt to identify common characteristics that might predict use of future additions to the collection. Common elements examined were subject heading, author, language and imprint date.

Byrd et al. (1982) have described a method for determining strengths and weaknesses in a collection based on the difference in proportions between the subject breakdown of a library's acquisitions and the subject breakdown of the interlibrary loan requests it generates. The theory is that the classes needing greatest attention are those in which the greatest difference exists between volume of materials borrowed and volume of materials purchased. This discrepancy is expressed as a "collection balance indicator" (CBI), a relative percentage, as follows:

New acquisitions — Titles borrowed

100 × in this class — in this class

Total acquisitions — Total titles borrowed

A positive value on the CBI indicates a subject area relatively strong in terms of current acquisitions while a negative value indicates one relatively weak. This can be illustrated through two simple examples:

$$1.100 \times \frac{100}{400} \; 0 \; \frac{12}{120} \; @ \; 15 \qquad 2.100 \times \frac{40}{400} \; 0 \; \frac{30}{120} \; @ \; 015$$

In the first case, 25% of the acquisitions are made in this subject field but only 10% of the titles borrowed fall in this area. The CBI is a high 15. The second case puts the proportions exactly in reverse–10% of acquisitions and 25% of titles borrowed–and the value is a low –15.

Payne and Willers (1989) have shown how circulation data can be related to acquisitions data to measure success in materials selection (expressed, for example, by the proportion of items purchased in subject X that have circulation within period Y). Success may also be related to source of selection–e.g., faculty versus librarian selection in the case of some academic libraries.

Aguilar (1984) performed a monumental study of the relationship between internal circulation and interlibrary loan requests based on about 86,000 interlibrary loan (ILL) transactions and almost two million circulation records from eighteen Illinois libraries. He found support for his hypothesis that a class that is overused (as defined earlier) in a library will be a class in which the library will borrow many items, whereas underused classes tend not to generate large numbers of ILL requests. This supportthe assumption that it is overused classes ratherthan underused classes that are most in need of strengthening.

As a result of his research, Aguilar (1986) developed a measure "ratio of borrowings to holdings" (RBH), which is simply:

- % of borrowings
- % of holdings.

Values greatly in excess of I would indicate a class in which the borrowing rate is very high relative to the holdings of the library. For example, a class that occupies 8% of the collection but accounts for 15% of borrowings would have an RBH of almost 1.9 (15/8). Aguilar uses the RBH data, together with relative use circulation data, to produce a collection development "model." For overused and underused classes the RBH is looked at. Decisions on the future of the class are made on the basis of relative use and RBH data.

Nutter (1987) recommends that academic libraries should study interrelations among databases representing holdings, circulation, and patron characteristics. Patron files can be coded by department/discipline to allow comparisons of usage and to study what types of materials are used each department. In the case of academic and special libraries, the patron file could actually identify all potential users, allowing the librarian to derive a user/nonuser ratio for the community as a whole and possibly for each department.

Monitoring OPAC Interactions

Another source of information of potential value in collection development is the online catalogue and its actual use by library patrons. Possibly useful information can be obtained from several report generation features existing within commercially available system. For example, the INNOPAC system will identify the names of authors most used within a particular time period and the subject terms introduced by users that do not retrieve any items. While the latter will often be symptomatic of errors in user terminology, or search logic, they may occa-sionally indicate gaps in subject coverage in the collection.

In theory, interactions between library users and the catalogue could be monitored to identify (1) books sought that are not in the collection and (2) books sought and found to be in the collection but not immediately available on the shelves (which could be used to produce an estimate of availability rate). However, this presupposes that users must employ some unambiguous identifier for a book rather than a truncation algorithm that is equivocal.

Present System Capabilities

While all of the analyses discussed so far can based on data obtainable from library catalogues, circulation systems, acquisitions systems or other databases, this will usually require the writing of special programs for extraction and manipulation since the commercially available systems are not likely to offer the capabilities sought as a standard feature. Features that are present in many existing systems include: (1) ability to record circulation by type of patron, (2) ability to identify the most heavily used classes, (3) ability to identify books for which many "holds" are placed and (4) ability to identify books not borrowed within a particular period of time (Hawks, 1988). Unfortunately, while automated systems can be used to generate better data for collection management than librarians have had before, the advantage is more theoretical than actual. Not only do commercially produced systems fail to provide convenient access to the most useful data but many librarians seem unconvinced of the value of the data (Carrigan, 1996).

Materials Availability in an Automated Environment

The factors that affect the availability of books owned by a library have been thoroughly discussed by Buckland (1975). The most important are level of demand (popularity), number of copies and length of loan period. It is obvious that the more popular a particular book the less likely it is to be on the shelf at any particular time. "Popularity" is not a nebulous measure in this case, but a very practical one. As mentioned earlier, it can be expressed in terms of a last circulation date. That is, one could say that 10% of the collection circulated at least once in the last month, 25% circulated at least once in the last six months and so on.

It seems equally obvious that buying additional copies will improve availability. But two copies are not twice as good as one copy–sometimes both are on the shelf, sometimes one, sometimes neither–and the addition of further copies may make only a marginal difference to availability. The effect of adding an additional copy varies with the popularity of the item: if a particular book is never used it will always be available and adding a second copy does not change the situation.

If a book is off the shelf for one half of the year, one can say its availability rate is 0.5. Adding a second copy will improve availability but will not double it (Leimkuhler, 1966). Buckland (1975) presents data to show the effect of varying numbers of duplicate copies on the availability of books at different levels of popularity.

Less obvious, perhaps, are the effects on availability of the length of the loan period. Suppose that every user of a library returns a book on or near the day on which it is due to be returned. There is, in fact, a strong tendency for this to occur, as reported by Newhouse and Alexander (1972), Buckland (1975), and Goehlert (1979). Then, reducing the length of the loan period from four weeks greatly increases the probability that any book will be available on the shelf when looked for by a user. In fact, cutting the length of the period in half has roughly the same effect on availability as buying a second copy.

The librarian can improve the accessibility of books by buying more copies of popular items, reducing the length of the loan period, or both. In fact, if one wished, it would be possible to identify a desired "satisfaction level" (e.g., 0.8–a user will find a desired item to be on the shelf in eight cases out of ten) and take steps to ensure that this level would apply to every book in the library. Suppose one divided the collection into five levels of popularity on the basis of most recent circulation date. For Level 5 the probability of availability could already be 0.99 and would remain there even if the loan period for this category was extended to ten years. For Level 4 the probability of availability might already be 0.8 with a loan period of four weeks and no further action us required. Availability for Level 3 items might be increased to 0.8 by reducing the length of the loan period from four weeks to three weeks. To reach 0.8 availability for Level 2, the length of the loan period may need to be reduced to two weeks. This leaves us with Level 1 items–the rather small number of highly popular items in the library. To ensure a probability of availability of 0.8 one might need, say, five copies of each and a loan period of one week.

Buckland (1975) has published data that show how popularity (level of demand for an item), length of loan period and number of copies affect the probability of availability of books. With a long loan period of ten weeks, the chance that one of the most popular books (class A) will be on the shelf, assuming a single copy, is only .37. This probability can be increased to .66 with two copies and .86 with three. On the other hand, reducing the length of the loan period, without buying further copies, also has a profound effect on the probability of availability. With a one-week loan period, even the most popular items in this hypothetical library have a high probability (.91) of being on the shelf when sought by a user. As Buckland's data show clearly, reducing the loan period or buying further copies are strategies that have most profound effects on the items in greatest demand. The actual probabilities of availability within this model would be determined by the different values accorded to the levels of popularity (e.g., availability values for class A if it were defined as "last circulation date = one month or less" would be different from the values were this class defined as "LCD = two months or less").

Buckland (1975) has reported that a type of "homeostatic" effect may govern book availability. That is, if satisfaction level is pushed up from, say 0.5 to 0.8, use the library may increase substantially because of improved expectations of success among the community. This greatly increased demand, however, increases competition for the library's resources and forces satisfaction level down–perhaps back to 0.5. Automated circulation systems allow one to conceive of a self–regulating library with no fixed loan period. An algorithm incorporated within the system would tell the user how long a particular book could be borrowed at the time of checkout. The calculation would be made on the basis of the circulation history of the book and the number of copies held, the loan period being calculated to ensure that the desired satisfaction level (say 0.8) will be maintained. The system would probably work with a large but finite number of loan periods–in the range of, say, five to ten.

Of course, such a policy might not be popular with users, especially those who find that the several books they borrow on a particular day all have different return dates, but it would definitely make the library more efficient in terms of the probability of materials sought.

Expert System Approaches

Various investigators have attempted to apply expert system techniques to the selection of materials for library collections.

Rade et al. (1987) have described an expert system approach to the selection of journals. While their objectives were somewhat different the decision on whether or not a journal should be included in the MEDLARS database–the criteria built into their system (type of publisher, language, type of article, type of author, publication standards) would be among those relevant to a knowledge base designed to aid a librarian in journal selection decisions.

Meador and Cline (1992) describe a workstation designed to make readily accessible all of the information that a librarian might need in selection decisions–collection development guidelines, holdings and circulation data, financial data and so on. While not an expert system per se, this approach can be considered as a first step toward the development of such a system.

Sowell (1989) describes a rudimentary expert system to aid in monograph selection, but he deals only in a very narrow subject area and the prototype developed was tested with very few cases.

This chapter has dealt with computer–based systems as sources of information or assistance in collection development and management. However, it relates primarily to collections in print–on–paper form.

18

The Use of CD-ROM

Effect on Staff

The obvious appeal of CD-ROM is that it can be used to put bibliographic databases and other reference tools directly into the hands of users, giving them a more sophisticated searching capability than they have with comparable printed tools, and reducing the need for online searches performed for users by members of the library staff.

But CD-ROM technology does not necessarily offer major savings in staff time. Time that was formerly spent in conducting searches for users may now be spent in teaching them how to search the CD-ROM databases for themselves, and in offering assistance to these users when they need it. Where many different CD-ROM databases are made available, a considerable amount of time may be spent by the staff in learning how to use them since each vendor's software will have somewhat different commands and search capabilities. Moreover, while not all members of a reference staff needed to perform remote online searches, they all may need to be able to search CD-ROM in order to help patrons when necessary.

CD-ROM installations also require supervision and maintenance : disks may have to be changed, printers serviced, and so on. These activities need not involve professionals—they may be performed by clerical staff, perhaps by students in certain settings—but they represent a cost to the library nonetheless.

In the majority of libraries, the introduction of CD-ROM databases drastically reduced the number of online searches performed for users by librarians (*delegated or mediated searches*). To take one example, the Education/Psychology/Teaching Materials Center (E/P/TMC) of the Milner Library, Illinois State University (ISU), performed approximately 700 online searches in 1986. The availability of appropriate databases in CD-ROM form in the library brought a decline in online searches (i.e., online to the ERIC or other databases via some telecommunications network) to 200 in 1987 and about 100 in 1988.

Other librarians have also reported a decline in online searching as a result of the introduction of CD-ROM products. For example, Reese (1990), referring to the situation at Vanderbilt University, reports :

> *The amount of online searching we do has been cut dramatically with the introduction of optical products. Librarian-mediated online searching has decreased at least 58 per cent during a two year period. From July 1985-June 1986 there were 493 online searches; from July 1986-June 1987, 203; and from July 1987-June 1988 there were only 85.*

On the other hand, Brahmi (1988), at the Indiana University School of Medicine Library, reports that CD-ROM has caused a dramatic reduction in online end user searching but has had little effect on mediated searching.

Stratton suggests that CD-ROM may eventually create a demand among users for more online access to remote databases, and Huang (1991) reports that this has occurred in libraries that provided little or no online searching prior to the introduction of CD-ROM.

Use of CD-ROM products continues to increase dramatically in many libraries. Geldenhuys (1995), for example, reports a 700% increase in use of the CD-ROM network at the University of Pretoria from 1993 to 1994.

User enthusiasm for CD-ROM seems to have taken some libraries by surprise. For example, Cox (1991) writing of a school of medicine library, found that the MEDLINE database generated so much demand so rapidly that users were having to wait as much as a week to get a scheduled search session; it was obvious that the single workstation available was completely inadequate. Dyer (1990) has reported a wait of as long as two weeks to access MEDLINE in one British academic library.

The migration from mediated online searching to nonmediated searching of CD-ROM databases by library users may also have some undesirable consequences on the professional staff of the library. Some libraries have reported a decline in the morale of staff members who were formerly heavily involved in database searching as they begin to feel their searching skills deteriorating.

Effect on other Library Services

Besides causing a decline in mediated online searching in most libraries, CD-ROM installations can have other effects on the policies and services of the library. Perhaps most obvious is the decline in use of printed tools for which CD-ROM equivalents exist. For example, Massey-Burzio (1990), writing of an academic library, has said that :

> *Our paper index and abstract area is becoming deserted because of the CD-ROM products. Even when all of our workstations are occupied, our library users would rather wait than use the paper indexes. (Page 24)*

This decline in use, coupled with the fact that CD-ROM materials compete for funds with other forms, has led to the cancellation of various printed tools in some libraries.

The adoption of CD-ROM also has implications for the use of library space. Installations close to a reference desk are convenient in terms of database use by staff and the provision of search assistance when needed by users, but this is "prime" space in many libraries; moreover, some library users prefer to work in a less public atmosphere especially if they are unsure of what they are doing. Setting a room or rooms aside for CD-ROM tools offers more privacy but makes supervision more difficult and may reduce the accessibility of the databases to members of the reference staff.

The enthusiastic adoption of CD-ROM technology by library users has also had less obvious impacts. Users are likely to want to borrow more or obtain more photocopies from other libraries, and this will increase the workload of certain members of the staff and overall costs to the library (Siddiqui, 1995). Increases in interlibrary loan has been so great in some libraries that they have had to consider some way of limiting the demand (Fairman, 1991), Also, the use of CD-ROM databases may create greater use of other materials within the library, so more time must be spent on reshelving and the overall maintenance of the collection.

CD-ROM technology has other effects in libraries that are heavily involved in bibliographic instruction since much greater emphasis must now be placed on instruction in the use of electronic resources. In research environments, too, it may create a demand for other types of software, such as software for building and manipulating personal databases (Cox, 1991; Stratton, 1994).

CD-ROM has also had impacts on resource sharing beyond the increase in interlibrary lending. Moody (1990) has discussed several aspects, including union catalogues on CD-ROM and the sharing of databases within a group of libraries. Marks (1994) has described the production of a public-access catalogue on CD-ROM, mentioning some of the problems involved. In general, libraries have simply absorbed the costs of adding CD-ROM databases to their collections, frequently at the expense of other types of materials. However in some situations, particularly in special library environments, it may be possible to find some creative approaches to cost recovery or partial cost recovery. For example, Cox (1991) describes how an academic medical library was able to generate income for the expansion of its CD-ROM service by establishing a fee-based current awareness service.

Fairman (1991) suggests that CD-ROM databases could actually improve the economics of collection management in some libraries, with the library subscribing to only the high use journals and relying on the CD-ROM databases, coupled with interlibrary loan or commercial document delivery services, to provide access to the contents of others.

Cox (1994) has identified other problems associated with the acquisition of CD-ROM databases, besides the cost aspects, including relatively poor characteristics compared with remote access to the same source: less current, slower access time and usually covering a much shorter time span. He, along with Abbott and Smith (1994), also mention as a significant disadvantage the fact that most CD-ROM databases are leased by the library, rather than owned outright, and that the licensing agreements imposed by publishers may be very unfavorable to the library. A very thorough treatment of criteria for the evaluation of CD-ROM databases, covering all aspects, can be found in a book by Jacso (1992).

In a large library system, such as that of a major university, a decision on mode of management of CD-ROM resources may need to be made. While most libraries treat CD-ROM in the same way as other resources—with acquisition, control, and use decisions made by branch or departmental libraries—the possibility of centralized management also exists. O'Donovan (1994) has summarized the pros and cons of each approach.

Effect on Library Users

Most library users, especially student users, much prefer to use a reference source on CD-ROM than an equivalent printed tool. In general, their use of the electronic source is said to give them greater personal satisfaction and to improve their attitudes towards the library. They may also demand more help from the staff than they did in the past, and their overall expectations relating to other library services may be raised. Some users may express annoyance when they discover that their library does not own many of the sources indexed in a particular database.

While CD-ROM offered limited access when first introduced, libraries are increasingly adding CD-ROM resources to their local area networks

(LANs). Besides the technology required for this application, it is necessary to take into account the added load placed on the IAN. Also, the library must maintain a menu gateway for access to multiple resources, each of which has a different user interface. The diversity of resources available from a single workstation poses challenges for the librarian as instructor or intermediary, as well as for the user—who needs to negotiate each system separately.

It is now feasible and economical to offer access well beyond the scope of a local area network. Barbour and Rubinyi (1992), Onsi et al. (1992), and Sylvia (1994) are among the authors who have described dial-in access to CD-ROM databases, and Cutright and Girrard (1991) have put this in the context of support to the distant learner. Technology is now available that will allow several libraries to collaborate in running a server over the Internet using CD-ROM products copied onto large hard drives (Meyer, 1996).

A very substantial body of literature has already accumulated on user acceptance of CD-ROM databases and user satisfaction with the results of searches in these databases. Almost all of this is purely subjective, based on user impressions rather than objective evaluative data. Even the extensive studies of MEDLINE on CD-ROM do not include any true evaluations (Woodsmall et al. 1989). User response to CD-ROM databases has been overwhelmingly enthusiastic. For example, Steffey and Meyer (1989) report that the majority of the comments of their users were of the "Wow! This is fantastic!" type. Nevertheless, some evidence exists to indicate that the initial enthusiasm of same users does decline with increased use of the medium.

It is rather disturbing that so many library users seem completely uncritical in their evaluation of CD-ROM. Many express satisfaction even when they achieve very poor results. For example, Nash and Wilson (1991) found that undergraduate students were generally satisfied with their search results even when very few of the citations retrieved were useful to them.

An extreme example of this misplaced enthusiasm is cited by Dalrymple (1989):

> *As we got further into the study, we became more and more concerned about the reliability of using the idea of satisfaction and what it really meant when somebody said that they were satisfied. Most everybody loved the system. They liked using it. It's fun. They get in and they get something out, but we can tell from our observations that a lot of them are not using*

the system terribly well and perhaps not getting what they think that they're getting. This is a real concerns for us. I had an extreme example of a woman who never got the hang of combining terms. So she would go in with a couple of search terms and she would print out her citations and then she would put in the next term and print out her citations. Then she would walk out with her two printouts, really happy, really satisfied. She loved the system. She was there a couple of times a week.

...Students who would not go within a bargepole's length of a print abstracting service are queuing up to use CD-ROMs.

It is well known that user-friendly online search systems are enthusiastically received. End users are well satisfied because they enjoy being able to find relevant references with simple techniques, with little expenditure of time, perhaps in the convenient location of their own offices. They are in danger, however, from "unquestioned answers." At demonstrations of user-friendly systems, when a simple search has retrieved only a few references, the comment may be heard: "Well, that's all there is in the computer!" End users sometimes do not realize that the computer finds only what they specify, not necessarily what they want.

Alternative Access Modes

Thirty years ago there were few decisions to be made in giving library users access to materials. Publications existed in only one format except for a rather small proportion that could be obtained either as print on paper or as a micro-reproduction of print on paper.

This situation is changing rapidly and some sources of information can now be acquired as print on paper, acquired as CD–ROM, or accessed online. For some sources and for some libraries, online access can be provided either through telecommunications connection to a remote site or by loading the source on the institution's own computer facilities. While such choices apply most obviously to databases representing indexing and abstracting services, choices of this kind now exist for other types of information source, such as encyclopedias and directories and access alternatives are likely to be increasingly common in the future. For example, it is now becoming possible to purchase certain scholarly periodicals in paper or in electronic form or to access them through some network. Indeed, several thousand titles are already accessible in electronic form. Access alternatives of these kinds are the focus of discussion in this chapter.

Decision Criteria

Cost is the most obvious criterion governing the choice of one access alternative over another. Clearly, it is important that no costs be overlooked in such comparisons. For example, the cost of providing access to an indexing/abstracting service in printed form extends beyond the cost of subscription to include cost of the space occupied, cost of checking–in and other handling activities and (possibly) binding costs.

But cost should be balanced against some measure of return on investment. Put differently, if access decisions are to be made on the basis of cost–effectiveness a measure of effectiveness is needed. Unfortunately, a rather extensive and expensive evaluation would be required to compare the effectiveness of two or more access modes. For example, to compare the effectiveness of a search in a printed index with one in an equivalent CD–ROM product, one must evaluate the *results* of these searches (e.g., in terms of overall user satisfaction or, more concretely, the number of useful items retrieved). Similarly, some measure of the amount of useful information found would be needed to compare the effectiveness of a search in a printed encyclopedia with one in an encyclopedia in electronic form.

Since true effectiveness is difficult to assess, one must usually be satisfied with a cruder measure–volume of use. Presumably, the more a source is used, the more likely it is to be valuable to the community even if "value" is not being determined in any precise way. When "use" is accepted as the measure of effectiveness, the cost–effectiveness measure becomes "cost per use."

While cost–effectiveness should be the paramount criterion in choosing among access modes, there will always be secondary factors to be taken into account–for example, implications for user instruction and potential effects on other library services.

Electronic Alternatives

In the academic world, certain electronic databases can now be made available in one of three ways: (a) by acquisition as CD–ROM (with the possibility of networked CD-ROM access), (b) by loading onto the university's own computer network, (c) and by accessing from a remote location as the need arises. These alternatives have been discussed by Meyer (1990, 1993), Halperin and Renfro (1988) and Hanson (1994a,b).

Given that the ultimate criterion governing the choice among alternatives is a cost–effectiveness one of cost per use, it is necessary to look at the cost components on the one hand and the factors affecting volume of use on the other. Meyer (1990, 1993) has discussed the cost aspects in some detail and some of the cost-pricing factors for commercial databases are dealt with by Tyckoson (1989a).

Clearly. "Data access" refers to the cost of obtaining access to the database: of leasing it for use inhouse, of subscribing to it in CD–ROM (or printed) form, or of accessing it via telecommunications when the need arises. Storage cost applies most obviously to the cost of storing a database on the institution's own computers–a major element in the total cost of this mode according to Meyer.

In the case of a data-base present in the library in physical form, the equivalent cost would be the cost of the space occupied–probably trivial for CD–ROM but less so for a large indexing/abstracting service in printed form. But "space costs" apply to more than the database per se. They apply also to the space occupied by equipment–terminals and workstations for CD–ROM or online access to institutional or remote sources.

"Hardware use" refers to the cost to the library of using the institution's computer resources or the cost of owning its own resources–computers, terminals, workstations, networks–amortized over the life expectancy of the equipment. "Software use and maintenance," again, is associated most obviously with a database loaded on the institution's own computers but might also apply to the CD–ROM situation, especially if the library has developed its own interface programs.

"Staff time" applies to all personnel costs that come out of the library's budget: for supervising and maintaining equipment and database use, for instruction of users, for assisting users, for preparation of software, or for purchase of staff time (e.g., programming time) from the parent institution or elsewhere.

Two factors must be kept in mind in relation to the preceding discussion:

1. Only costs to the library have been considered. Costs to the parent institution, not borne by the library, and user costs have not been taken into account.
2. In the case of remote database access via telecommunications, the "data access" costs reflect many of the other components (storage, hardware use, software use, staff time, space costs) listed, as well as others, such as database royalties, that are charged to the library by the vendor.

No attempt has been made to deal in actual monetary values because of the great variations in costs associated with different databases and with different institutions, as well as the fact that these costs may change rapidly. Nevertheless, if we accept x as a unit of cost, the relative values are probably realistic.

The cost of remote access is not volume–dependent or, at least, is affected little by number of searches performed. The table does show some effect of reduced costs associated with high–volume discount. On the other hand, cost of the three alternatives that require a capital investment in database purchase or leasing is very sensitive to volume of searches performed. The cost per search for the locally mounted database option only drops below the remote access search cost when the volume of searches performed per year approaches five thousand.

In the hypothetical example, the cost per search is still lower for the print and CD–ROM alternatives, even at the level of five thousand searches per year. However, this is misleading for it assumes that the print or CD–ROM alternatives will attract as much use as the locally mounted database, which is unlikely.

The locally mounted database option is competitive with the CD–ROM option if it attracts five times more searches per year. It is competitive with the print option if it attracts around twenty times more searches per year. Based on his experience at two universities, Meyer (1996) believes that the comparison is more like several hundred searches in the electronic version versus "a handful" in the printed tool. Since cost per search is so dependent on volume of use, it is necessary to look further at factors affecting the number of searches performed.

Mooers' Law (Mooers, 1960), the principle of least effort (Zipf, 1949) and pain avoidance theory (Poole, 1985) all lead us to conclude that the extent to which any information service is used will be determined primarily by the cost to the user, where cost may be in monetary terms or in less tangible human terms–convenience, effort and general ease of use.

Monetary costs to the user will deter use, except in the case of the more critical information needs and will discriminate against the less affluent.

Given no monetary cost to the user, there are several other factors that will influence the extent to which a database is used. The most obvious is accessibility. Because a network can be established, a database in CD–ROM form will usually be more accessible than one in printed form. Although a CD–ROM network can be designed for dial–in access, it still may be limited in accessibility compared with a network based on an institution's mainframe computer, which may put terminals in every office and allow access from homes, dormitory rooms and other external locations, including Internet access. All other things considered, than, the locally mounted database option is likely to attract a greater volume of use and thus a lower cost per use. The effect of number of stations on annual costs of operating a database searching service is illustrated by Halperin and Renfro (1988).

Note how the CD–ROM installation is much cheaper than the mainframe network for small numbers of access stations and competitive in the 25–35 station range. Beyond that, the mainframe network becomes cheaper. It is important to recognize that this comparison assumes stations dedicated to library use (e.g., making the catalogue and other resources available). The obvious advantage of the locally loaded database situation is that it offers an economical way of extending access well beyond the walls of the library (e.g., through a multipurpose, campus-wide network) and of making resources accessible at times when the library is closed. However, dial–in access to CD–ROM facilities is also becoming more common.

Both search capabilities and "glamour" factors will favor any electronic alternative over print on paper. Not only will the electronic alternative offer improved searching (ability to combine terms, to truncate and so on) but it will frequently offer more access points per record. The locally loaded and remote search alternatives both offer some convenience advantages over CD–ROM: databases will be updated more frequently and retrieval time may be considerably faster.

Display speed will favor the locally mounted database and CD–ROM situations over remote access. Dyer (1990) points out that printed databases still offer certain advantages over other forms, including the fact that single copies or volumes are easily transportable to tables or carrels for use with other materials. On the other hand, for certain types of materials, such as newspapers, use of a CD–ROM version may be much more convenient. Batterbee and Nicholas (1995) point to the fact that newspaper access is the major application of CD–ROM in British public libraries.

The comparison on the basis of ease of use is more difficult. The software available to search the locally mounted databases can be user-friendly or not and some versions of some CD-ROM databases employ tutorials that make them easy to use. Nevertheless, the locally mounted situation offers the obvious advantage that the same software can be used to search multiple databases so users need to learn only one approach.

Moreover, there is an obvious attraction in being able to search many resources, including the library catalogue and a variety of other databases, from a single workstation and using the same or similar approaches. Peterson (1995), however, points out that the separation of OPAC from other databases means that one resource is still usable if the other is down. Moreover, as Meyer (1996) has pointed out, the single interface will confuse some users who will not recognize the distinction between locally owned items and those not owned locally or between databases of books and of journal articles. Databases in printed form may or may not be more difficult to use than an electronic equivalent. The fact remains, however, that most patrons, particularly the younger ones, seem to feel that the printed version is more complicated.

CD–ROM is at an obvious disadvantage in the case searches that must be truly retrospective since it may be necessary to search several disks to go back in time even as little as five years. Moreover, there may not be any possibility of creating a true retrospective search capability because the CD–ROM producer may require the return of an earlier disk for each new one received.

It is clear that the use of information resources will increase as cost to the user declines and as accessibility, search capabilities and ease of use all improve. As volume of use increases, cost per use is reduced. Halperin and Renfro (1988) report that, in one academic library, use of resources in electronic form went from less than 100 hours annually to over 8,000 hours annually in a four–year period, and that costs per hour of use declined from an average of $105 per hour to $10 per hour between 1983 and 1988. These dramatic increases in use and reduction in costs were due to three successive developments: free or subsidized end–user searching of remote databases, the introduction of CD–ROM facilities and the introduction of locally mounted databases.

In general, then, the greater the investment made by the library in making resources more accessible, the greater the convenience to users, the savings in their time and their use of the resources. Meyer (1996) suggests that use and convenience go up by several orders of magnitude when electronic access is used in lieu of print. He believes that user costs must be the paramount consideration in selecting access alternatives. Indeed the subsidization of access may be one of the major justifications for the existence of libraries in a largely electronic world.

Other Factors

There are factors other than those already discussed that can influence access choices and Cibbarelli et al. (1993) for a rather complete list), including:

* Pricing policies of database producer.

  If the database producer charges on the basis of hours of use, or number of records retrieved, local mounting is not an attractive option since costs are not under control.

* Space available.

The electronic alternatives may be especially attractive to those libraries that face critical shortage of space.

* Completeness.

  Machovec et al. point out that the printed version of a tool may sometimes be more complete than the electronic equivalent (e.g., the electronic version of an encyclopedia or journal article may not include all graphics.)

* Resource sharing

  A locally mounted database may allow greater possibilities for resource sharing with other libraries.

* Additional capabilities

  With databases in electronic form, libraries can offer new services to users–e.g., downloading to personal databases and more sophisticated current awareness services. Also, locally loaded databases can be linked with OPACs to show local holdings, although this is not necessarily problem–free (Caswell et al., 1995).

* Effect on other services.

  An discussed in another chapter, use of electronic databases may increase demands on other library services: photocopying facilities, document delivery and, perhaps most significant, user instruction.

Some print versus online CD–ROM issues for school libraries, including issues relating to encyclopedias and magazine indexes, are presented by Dickinson (1994).

Welsh (1989) gives an example of the remote online search versus CD–ROM comparison based on use of the NTIS database–estimated at 162 searches or sixty four hours per year in his library. Welsh estimates the CD–ROM cost per hour to be $35.17 (annual subscription cost to the database, $2250, divided by sixty four) as opposed to per hour cost of $80 for DIALOG/Dialnet access. At the rate of sixty four hours of searching per year, annual savings from CD–ROM acquisition are estimated to be $5120–$2250, or $2870.

As Welsh himself recognizes, this is a rather simplistic cost comparison. Not considered for the online access mode are the costs of printing bibliographic records ($.30 online, $.45 offline), which can be a substantial component in the overall cost of a comprehensive search. On the CD–ROM side, however, some allowance must be made for the cost of paper and other supplies consumed. Mored importantly, some part of the cost of acquisition of the CD–ROM equipment must be allocated to each hour of CD–ROM use. Assume equipment purchase costs (workstation and

CD–ROM drive) of $2195, that the lifetime of this equipment is estimated to be five years, and that it is used for 1600 hours of searching in the five–year period (this estimate is based on five CD–ROM databases, each one used an average of sixty four hours per year).

Then, one must add about $1.40 ($2195/1600) to the cost of each hour of CD–ROM searching for equipment use, plus a little more for paper consumed and for the space occupied in the library by the equipment (which would be more or less comparable for CD–ROM workstation and online terminal). So, the actual cost of an hour of CD–ROM searching may be closer to $37 than the $35 that Welsh estimates, although this is still considerably less than the cost for online searching.

But this analysis is obviously based only on database access costs and ignores the extremely important element of human costs. From the library's own point of view, the CD–ROM database has the obvious advantage that most library users will perform their own searches, whereas online searches in Welsh's library (in a government agency) are performed by professional librarians.

From the agency's viewpoint, however, the situation may be quite different: users searching the CD–ROM database may be paid more, on the average, than the librarians and they will probably spend more time, on a search, than the more experienced librarians (indeed Welsh himself points out that users of CD–ROM tend to spend more time on a search because they know they are not paying for connect time), so the actual cost per search to the agency, taking salaries and overheads into account, could be very much greater for the CD–ROM situation

Of course, this comparison takes into account only the cost side of the cost-effectiveness equation or, at lest, it considers cost per search as the unit of cost–effectiveness rather than cost per useful item retrieved. If the librarians can find many more useful items, through the online facilities, than the library users can from the CD–ROM databases, the cost per useful item retrieved (the true cost–effectiveness measure in this situation) may well be less for the online access alternative.

On the other hand, the most cost-effective alternative, from the agency's point of view, might well be the one in which the librarians perform CD–ROM searches for library users. It is clear that this comparison is quite complicated. The decision on which is the better alternative cannot be made solely on the basis of costs, but must take search results (the effectiveness) into account. Moreover, a different decision would probably be made if total agency costs are considered instead of only the library's costs.

Print Versus Electronic Access

So far in this chapter, major emphasis has been placed on choice among electronic alternatives. It is also necessary to give more direct attention to the electronic versus print situation and to the decision on whether or not to retain the printed version if the electronic source is acquired.

Machovec et al. (1991) identify several factors affecting this latter decision, including:

* Cost differentials.

  If a publisher offers a significant discount for the CD–ROM product when the printed version is also received, discontinuation of print may not be worthwhile.

* Accessibility.

  The printed product may still be needed if there are not enough CD–ROM workstations available to satisfy demand or if CD–ROM access is not available during all the hours that the library is open.

* Space available.

  Discontinuation of the printed version will be especially attractive if the library is critically short of space.

* Continuity

  If a CD–ROM product needs to be dropped for some reason, it may be necessary to return all disks to the publisher (in a leasing arrangement) and backfiles of the printed version may no longer be available. More significantly, print on paper is a technology that lasts (leaving aside the important issues of physical preservation) in that a book printed, say, a century ago is quite usable today. On the other hand, more modern technologies become obsolete rather quickly and electronic products purchased now, perhaps at considerable expense, may not be usable a decade hence.

Huang and McHale (1990) have put forward a "cost–effectiveness" model to aid the decision on when to discontinue a printed source and to rely entirely on online access to that source.

They develop an "online/print threshold" which relates the cost of making the printed source available in the library to the average cost of an online search in that database. The "average yearly cost" of a printed source (yearly subscription rate) is used to derive an "average daily cost," which is the subscription cost divided by the number of days the library is open (estimated at 260 in this corporate library setting). If the average cost of the online search is equal to or less than this daily cost, it is assumed to be desirable that the print source be discontinued. While this is an original approach to the analysis, it is rather simplistic. It is difficult to see why average daily cost is used in place of cost per use of the printed source, other than the fact that some survey must be performed to estimate annual use whereas average daily cost is easily derived (except that cost of ownership exceeds subscription cost).

The "model," in fact, is not a true cost–effectiveness model since search effectiveness is not considered (i.e., it is assumed that searches print or online database are equally effective).

For the time being, access alternatives may not apply to all databases, at least in certain libraries. That is, some libraries may want or need to continue to provide access to a source in several forms. Potter (1989), for example, has referred to the possibility of different "tiers of access":

> *While several libraries have loaded indexes to periodical articles, no library has been able to abandon online searching of commercial databases and each library is continuing to purchase CD–ROM–based indexes. Emily Fayen, writing about Penn, points out that they have found that they actually need MEDLINE in all three forms–online as part of their local system, on CD–ROM, and through commercial services. The local system only contains up to three years of data but is free to readers. The commercial, remote version of MEDLINE meets the need of the serious researcher who needs to cover the entire file and needs the assistance of an experienced searcher. The CD–ROM version is an excellent teaching tool.*
>
> *Penn's experience with three tiers of access suggests a pattern for other libraries. There are some databases, usually the more general ones or the ones that match an institution's strengths, that should be incorporated into the local online system. The wide use these databases receive will justify the expense. Other databases may be used less often but frequently enough to justify their purchase on CD–ROM. Still other databases will be used infrequently and may be so difficult to use that mediated searching of an online commercial database is justified.*
>
> *There is a fourth tier that should be addressed, and that is printed indexes. Some indexes are simply not available in machine readable form. Others cover only the past few years in an online or CD–ROM version. There are also readers who*

> *do not want to go near a computer. So, printed indexes should be with us for some time to come. (Page 104)*

It must also be remembered that the type of resource influences the formats available. For example, certain electronic forms are preferable to print for encyclopedias and training materials because of their multimedia capabilities.

The results of several studies suggest that paper sources have advantages over equivalent electronic sources in some applications and that the electronic sources outperform the paper sources in others, For example, Wu et al. (1995), perhaps not surprisingly, found that students could access an electronic book more rapidly than they could retrieve the physical item from library shelves.

However, once the book was in hand, answers to questions could be found more rapidly in the paper source. Horner and Michaud–Oystryk (1995) compared the performance of librarians in answering reference questions when using paper sources and online databases. In general, "bibliographic" questions (those requiring the location of journal articles on a particular topic) were answered more efficiently online, while factual answers were found more efficiently in the paper tools.

Global Considerations

This is because the true benefit of a library service to its users tends to be very intangible and thus extremely difficult to assess. Nevertheless, volume of use can be considered to be a predictor of benefit, albeit an imprecise one, in the sense that the more a community uses some service the more likely it is to benefit from it. Also, the fact that members of the community use a service, perhaps repeatedly, reflects their perceptions that they are receiving benefits from it.

As mentioned earlier, the discussion in this chapter has looked at the issues–especially the costs–from the library's point of view. Somewhat different conclusions might be arrived at if one took a more global perspective–that of a parent institution or of "society" as a whole. Since the time spent *using* the resources would be the major cost of library service if a monetary value were placed on the time of users, alternatives that minimize this cost are particularly attractive. It is especially important to minimize user time, even if this means greater library expenditures, where the institution is paying for time spent using the library (the corporate setting and perhaps academic and other research settings too) and the cost of the user's time is considerably greater than the cost of the time of the library staff.

Based largely on work performed at the Mann Library, Cornell University (Demas et al., 1995), one can now visualize a library providing various levels of access to electronic resources. Electronic resources in great demand (level A) are made permanently accessible through a campus network, while others (level B) can be accessed remotely via the campus network when needed (e.g., through the Internet).

These are strongly linked to the library because the library may have been responsible for selecting the level A resources from the international network and downloading them to the campus network. It may also have been responsible for building the indexes or providing the pointers that draw attention to the level B resources. Alternatively, the level B resources may be brought personally to the attention of individual users by reference librarians consulted face–to–face, by telephone or through electronic mail. The level C and D resources are not available through the campus network but must be used within the library through a local area network or a single dedicated workstation.

The entire situation of electronic access is changing with great rapidity. Indeed, significant changes have occurred in the short interval between the time we began work on this chapter and the time the text was ready to go to press. For example, various commercially available gateways now offer access to many databases on a flat subscription basis that makes this option cheaper than mounting locally. Also, it is now possible to combine the benefits of local loading with networked multi–location access. For example, several libraries can jointly run a server over the Internet using CD–ROM products copied onto large hard drives. As Meyer (1996) claims, this is somewhat like loading your own database but with "much reduced labor and better potential for economies of scale."

Of course, no access mode can be considered completely permanent. For example, many writers have discussed the likelihood that CD–ROM may be only a transient technology and it is quite possible that new modes for the distribution of resources in electronic form will emerge in the future–although it is now difficult to envision what these might be.

Document Access and Delivery System

The supply to a user of an original item, or a photocopy of it, from the library's own resources or obtained from another library, was the norm in document delivery until fairly recent times. Today, however, the delivery of a publication, or part of it, to a library user can be achieved by a wide variety of methods and sources, and these possibilities are multiplying rapidly. While document delivery does not *per se* imply technology, its inclusion in this book seems fully justified by the fact that electronic methods are being used increasingly to provide access and delivery of materials.

This is based on the journal article situation but it could also apply, with certain modifications, to other publication forms. Even this macrolevel depiction gives some idea of the variety of options available to libraries or their users, and the situation is changing rapidly, with new possibilities emerging on almost a daily basis. Higginbotham and Bowdoin (1993) state that "The variety of services is just short of mind-boggling" and they refer only to the commercial document suppliers. Their book is a thorough survey of this complex areas as of 1993.

The most physical form can be considered as the delivery to a user of an original item from the library's collection or from that of another institution. Only somewhat less "physical" would be the delivery of a photocopy of the item. The most "virtual" document delivery is the provision of access to journals that exist only in network-accessible form. This is most virtual because, while text from such journals could be printed our onto paper, the full features (e.g., hypertext linking and windowing capabilities) cannot be adequately represented in any non-electronic medium, and other features (most obviously motion) cannot be captured at all on paper.

Note that the figure treats delivery as "making available" and does not distinguish between physical delivery of an artifact, or part of it, and the delivery of text or illustration to a terminal, workstation, or other electronic device. In discussing the options, depicted, the more exotic will be dealt with first.

"True" Electronic Journals

A "true" electronic journal is one that has been designed *ab initio* for the electronic medium and that exists solely, or at least primarily, in this medium. If one adopts as rather loose definition of "journal," to include more informal and newsletter-type publications, there are already several hundred of these accessible through the Internet (Mogge, 1996).

Some librarians may be surprised by the number of more scholarly journals that are available primarily in network-accessible form. Clement (1994) lists 25 such journals, in implementation or planning stages, in the sciences alone, and the number is increasing on a regular basis. Woodward (1995a) claims about 100 true electronic journals that are refereed. While some are also made available as paper copy, the majority are only network-accessible, van Brakel (1995) gives a good explanation of why electronic journals are likely to proliferate in the future.

OCLC Inc. has been a pioneer in true electronic publishing of scholarly journals. As of 1996, it offers access to nine such publications (Noble, 1996) and has plans to expand in this area. Many of the other true electronic journals have been established and made network-accessible by various academic departments in major universities.

All of these scholarly journals are similar in that they exist only (or, at least, primarily) in electronic form, can be accessed online, and editors and/or referees impose certain standards on the contents of the database. There are also differences among them.

Some group papers into "issues," in much the same way that a paper journal does, while others merely add new papers to the database as they are accepted. Some accept graphics as well as text, while others do not. Some journals offer contents pages and abstracts, requiring users to request the full text if wanted, while others initially disseminate the full text to users. Several are offered free to users but others are available only on a subscription basis.

Some of the online journals are merely "delivered" to users via a file server or e-mail system while others allow true interaction between user and journal. Of the existing electronic journals, OCLC's *Online Journal of Current Clinical Trials* is one of the most sophisticated, offering elaborate windowing facilities, hypertext linking (including the ability to view an abstract of an item cited in an article), and graphics.

A scholarly journal in electronic form can potentially offer several advantages over one printed on paper, including:

1. More rapid publishing of research results through electronic submission of articles, and network communication among authors, editors and referees, and by the fact that contributions can be added to a database as accepted rather than held to form the next "issue".
2. More efficient dissemination of information through the matching of articles newly accepted into databases with the interest profiles of potential readers.
3. Innovative ways of presenting research, results and other forms of data and information—analog models, motion, sound, hypertext, and hypermedia linkages (including linkages between journals and other electronic resources).
4. Public peer review facilitated through the ability to link reader comments and evaluations to published articles.
5. Lower cost per successful match between article and reader.

6. Speed of publication, and ease of communication, lead to a more interactive journal in which one contribution may spawn rapid responses from other researchers.

Carried further, an electronic journal established within a network can assume a scholarly role that is more comprehensive than the role played by the typical journal in paper form. As Harrison and Stephen (1995) point out, it can become the central component in an electronic center of expertise and a key element in an online intellectual community.

Electronic journals accessible through the networks are now receiving considerable attention from academic libraries. Duranceau et. al. (1996) discuss the approaches taken by one major academic library and Cochenour (1996) describes the consortium approach to archiving and provision of access.

Duranceau et al. (1996) make a distinction between first-and second-generation electronic journals. The first-generation journals are "simpler" in several ways ; ASCII text files, simple file structure, produced by groups of scholars (e.g., the faculty of a single department) rather than established publishers, distributed primarily through electronic mail, and little concerned with copyright issues. In contrast, the second-generation journals are more formal and complex, and present greater challenges for libraries: may be HTMC-based or make use of specially formatted files; may incorporate graphics, multimedia features and/or links to other network resources; likely to comprise much larger files; usually need to be "fetched" from servers by subscribers rather than delivered to them automatically; present much greater diversity in formats, file structures, and other features; and, finally, they are more likely to be produced by traditional publishers having profit motives and copyright concerns.

Electronic journals are still in their infancy. Consequently, they are far from completely free of problems. Harter and Kim (1996), for example, have pointed out that present versions tend to have relatively poor and usability accessibility.

The emergence of network-accessible scholarly journals, many at the initiative of academic faculties, has led many to speculate that the present system of paper-based scholarly publishing, controlled mostly by commercial interests, will eventually be replaced by a new scholarly communication system, network-based and under the control of academia. Clearly, such a development would have a profound effect on libraries in general and academic libraries in particular. The characteristics of such a system, and many of its implications, are discussed in detail in Lancaster (1995) and in Peek and Newby (1996).

Paper Journals Accessible Electronically

A clear distinction must be made between the new scholarly journals, designed for network, access and those that have long existed in paper form but have more recently been made electronically accessible as well. Everett (1993) refers to the several thousand journals that can now be accessed in full text form through various vendors of online service, and points to the advantages of using such databases for article delivery, as follows ;

> *Full-text database as a document delivery system appear to offer several clear advantages—the speed and ready access of the databanks, prices competitive with commercial document delivery services and traditional interlibrary loan, and the payment of copyright royalties, as part of the price, thus eliminating copyright concerns. The most serious drawbacks are the lack of any graphics and the fact that the online version of a periodical may be less complete than the print equivalent, rendering minor articles inaccessible.*

It is clear that full-text databases accessible online cannot meet all of the document delivery needs of a library of any significant size because too few titles are now accessible, and those that are accessible are not necessarily complete in terms of timespan of coverage and inclusiveness (some types of articles, as well as some graphics, may be omitted). Nevertheless full text access is a viable alternative document delivery system for some articles for some libraries, especially, for articles that are needed very quickly. Full text databases have the additional advantage that they are fully searchable online, using index terms, text words, or both. Moreover, text can be delivered to a user's workstation in some libraries, avoiding use of paper copy. Hawley (1992) quotes \$3 to \$3.50 as the average cost of an item taken from a DIALOG full text database.

In fact, full text access is becoming increasingly competitive with periodical ownership in at least some applications. The Articles First component of OCLC's First Search covers around 5000 journals but provides full text access to only the more recent issues. Hawbaker and Wagner (1996) claim that their academic library can offer access to twice as many business journals by moving from ownership to full text access at an additional cost of only 15%.

Another option available to some libraries, but still with very limited coverage, is the ability to acquire journal text and illustration as a database in CD-ROM form. In the oldest example of this approach, ADONIS (Stern and Compier, 1990), several hundred journals are made available as CD-ROMs distributed to libraries or other customers. The customer pays an annual subscription plus royalties for articles printed out. Journals acquired in this way can be made widely accessible (e.g., throughout a campus) by means of a local area network.

Several commercial journal publishers are experimenting with the distribution of journals in electronic form and are using various academic libraries as test sites to gauge acceptability and to identify potential problems.

In the case of projects that make existing journals available on CD-ROM, the text is stored as "bit-mapped" images of the printed journal pages, achieved through optical character recognition. Bit-mapped images require rather large amounts of storage, allow terminal display that is of low quality compared with the display of computer-readable text (e.g., in ASCII format), and cannot be searched or otherwise manipulated by computer (although ancillary databases, such as indexes to and abstracts of the page image, can be). Nevertheless, the bit-mapping approach has the obvious advantage that it allows older materials to be made available in electronic form without the need for rekeying and can also provide some level of access to illustrations. Of course, a particular implementation can incorporate both page images (to give the reader "the feel" of the familiar journal format) and computer-readable text; this is true, for example, in the Red Sage project, which makes use of the Right Pages system devised at AT&T Bell Laboratories the CORE project, and in TULIP.

TULIP (The University Licensing Program) made the text of forty-two Elsevier and Pergamon journals available in both bit-mapped and ASCII full text formats. A participating university could receive these databases, and mount them locally, or could access through the Internet. The objective was to deliver the electronic journals to the desktops of users. This experiment, recently completed, showed that there still exist some technological impediments to the completely digital, network-based library. Moreover, most users still see electronic journals as a supplement to paper journals, rather than a replacement, especially at the present time when a "critical mass" of journals is far from being reached.

Commercial document delivery services, such as UMI, have developed system that combine network access to ASCII text with the ability to access bit-mapped images of journals on CD-ROM (Orchard, 1997) and the JSTOR project, funded by the Andrew W. Mellon Foundation, is also noteworthy as an extensive effort to provide access to retrospective journal issues in the form of bit-mapped images of high quality (DeGennaro, 1997).

When the complete text of print-on-paper journals is made accessible through online networks, the text is in ASCII format and fully searchable.

Nevertheless, such journals are merely examples of print on paper made accessible electronically.

The "true" electronic journals referred to earlier were designed *ab initio* as journals in electronic form and can be given capabilities not present in the electronic manifestations or printed journals. For example, the text can be encoded with SGML tags to improve its functionality (e.g., in the implementation of such features as windowing, hypertext, and the integration of text with graphics).

At present, it is clear that libraries cannot fully dispense with paper journals in favor of electronic alternatives— the coverage is not yet extensive enough and other barriers to the replacement of print on paper may exist (e.g., a publisher may supply a full electronic version only to libraries that already subscribe to a paper version). Nevertheless library managers must continue to monitor developments in this entire area. Moreover, use of databases of full text available online may already be a viable option for obtaining rapid access to articles from journals to which a library does not subscribe.

Interlibrary Loan

Technological advances have brought about significant improvements in document delivery through conventional resource sharing among libraries. Online union catalogues greatly facilitate item location, and network messaging systems make the transmission of a request from one library to another a virtually instantaneous process. In some library consortia, some users can bypass the local library, at least for monographic materials, using the network to make their requests directly to another library and having the item delivered to their campus offices (in the case of academic consortia) or local library.

The supply and return of the item can still be very slow when regular mail service is used, but some consortia improve this situation through use of vehicles sand drivers dedicated to interlibrary delivery. Urgently needed items can be moved by express mail or, depending on their length and type, by fax transmission. Of course, fax can be also used for the transmission of a request.

The transmission of a journal article by fax will usually incur long distance telephone charges but may still be cost-effective when compared with the making of a photocopy, addressing envelopes, packaging, and other activities associated with the physical movement of items. The obvious disadvantage of fax is that it produces copy of an inferior quality, especially for illustrations, and involves the use of thermal paper in most institutions.

The resources of the Internet now give libraries an alternative to fax for the rapid transmission of text and illustrations. The Ariel system, developed by the Research Libraries Group, offers many advantages over fax. The supplying library uses an Ariel workstation, comprising at PC and a scanner, to create a bit-mapped image of an item, compress it, and transmit it over the internet to a receiving workstation consisting of a PC and laser printer.

High-resolution scanning, digital transmission, and use of a high-resolution laser printer result in quality of copy that is much superior to fax. Other advantages are the fact that scanning can be done directly from bound volumes and that transmission costs are absorbed through the Internet and not charged directly to the library. The main disadvantage at the present time is that an Ariel workstation can only transmit to another Ariel workstation so the capabilities are limited by equipment availability within libraries. However, the workstation incorporates commercially available equipment, the PC involved can also be used for other purposes if necessary, and cost of the Ariel software is modest.

Jackson (1993a) has described other experiments that have been conducted in the area of network transmission, including the interfacing of Internet capabilities with regular fax machines. While these particular experiments are no longer active, it seems entirely probable that, in the future, the library community will routinely use network resources to exchange items, both those already in electronic form and those scanned from paper copy for subsequent trans-mission. Tuck and Moulton (1995) discuss the advantages of using electronic mail protocols for the transmission of scanned page images, a method being used experimentally by the British Library Document Supply Centre.

Commercial Suppliers

Commercials document delivery services, which emerged in the late 1960s as a logical extension of online searching services, have experienced tremendous growth and are now a significant alternative to conventional library resource sharing. The major suppliers in the United States offer delivery from several thousand journals (in the ten to fifteen thousand range in 1995) and the British Library Document Supply Centre has access to more than 200,000 journal titles. Many suppliers will accept orders in a variety of modes—online, telephone, mail or fax—and delivery can be by fax, mail, express mail, or (in some cases) Internet.

Libraries, particularly academic and special libraries, have adopted these services because they can be faster than interlibrary delivery and, if all costs are considered, are economically competitive with it. Consequently, some libraries see the commercial services as offering an alternative to ownership of expensive journals that are less frequently in demand. Another advantage of the commercial services is that they automatically take care of copyright requirements. Kohl (1995) claims impressive gains in one academic library: for an annual cost of $20,000 (to provide free article delivery to faculty and graduate students), journal subscriptions were reduced by $180,000 a year and the 350 cancelled titles were replaced by ready access to 10,000 titles formerly unavailable.

The ability to use commercial suppliers, in addition to interlibrary resource sharing, has greatly encouraged the use of table of contents (TOC) services to allow access to the contents of a much wider range of journals and also, possibly, to permit the cancellation of subscriptions for some less used titles.

Databases of journal contents pages can now be accessed online, acquired on CD-ROM, or obtained in a form suitable for loading on local computer facilities. TOC services also permit personalized current awareness since some will automatically transmit the contents pages for each issue of journal titles selected by a user to that user's e-mail address. The commercial TOC services also provide document delivery and, in some cases, allow online access to complete text. TOC databases can be searched on keywords in titles, possibly supplemented by use of index terms.

A number of evaluations of the performance of commercial suppliers have been undertaken, and some have compared the commercial suppliers with interlibrary delivery. Unfortunately, these studies, many of which have been summarized by Higginbotham and Bowdoin (1993), Truesdell (1994), and Mitchell and Walters (1995), have produced conflicting results. While some claim that the commercial services are efficient and economical, others report no advantages over interlibrary loan in fill rate or delivery time, and that costs are greater.

However, Cain (1995) reports data from an Association of Research Libraries/Research Libraries Group study (Roche, 1993) that indicates that ILL now costs $29.55 on the average (borrower and lender costs) and that commercial services are certainly competitive with this. Getz (1991-2) has prepared an analysis of costs of ownership of a journal versus cost of use of a delivery service, but some of the newer delivery options are not included in his analysis.

In one of the more recent studies, Mancini (1996) evaluated four commercial suppliers. Based on a sample of 175 request, she reports a fill rate of 135/175, about 76%, but this varied from a low of 35% for one supplier to a high of 96% for another. Average arrival times of articles using fax was in the 2-3 day range, while average arrival time for items mailed (two suppliers only) was in the 5-6 day range, still a considerable improvement on interlibrary lending, which she reports at around 14 days on the average.

Total cost per article for fax delivery was in the $14-20 range; for mail delivery it was in the $10-20 range. She concludes that, while commercial suppliers cannot completely ILL (most obviously because of the continuing need for access to older materials), “they can enhance the productivity and flexibility of current services and increase user access to many necessary titles.”

A survey performed by the Association of Research Libraries (Jackson and Croneis, 1994) indicates that the great majority of the research libraries surveyed (78/90) do use commercial suppliers and that delivery speed and copyright/royalty handling are the reasons most often cited for use of these services.

Jackson (1993b) and Mitchell and Walters (1995) have produced useful lists of criteria for evaluating document delivery services. Data on turnaround time and fill rate would be obtained by collecting relevant statistics based on actual use of these services over a significant period of time or, alternatively’ through use of a test in which the same set of orders is submitted to various vendors, although some data might be extracted from studies performed in other libraries.

In comparing vendors, it is important to seek the data that are most meaningful. For example, average (mean) turnaround time can be very misleading. Much more valuable would be data on the number of requests filled in x days, in x + 1, x + 2, and so on.

Just as network-based union catalogues and circulation systems permit library users to generate their own interlibrary loan requests, and databases accessible online or as CD-ROM allow them to perform their own subject searches, so document delivery and TOC services put document ordering into the hands of the individual library user. Clearly, this raises the significant issue of how such orders are paid for.

Integration of Document Delivery Services

1. Commercial services used only after interlibrary resources have failed.
2. Commercial services are the first source a library goes to for any item not available locally.
3. Library patrons use commercial services directly.

4. Some patrons (e.g., faculty with generous research grants) use commercial services directly; others must go to the library to request service (interlibrary or commercial).
5. Patrons access full text in electronic form, either online or via CD-ROM.

Institutional Databases

The Future of Access and Delivery

The trends discernible today strongly suggest that more and more journals (and, indeed, other types of publications) will become available in electronic form and that, increasingly, these will be accessed directly by the public without the intervention of the library. In the short-term, this will mean electronic access to existing sources.

There are strong forces pushing in this direction, most notably the massive Digital Library Initiative funded by the National Science Foundation and other agencies, the establishment of the National Digital Library Federation (Lamolinara, 1996), and the fact that some libraries have reached their own agreement with publishers to acquire sources in electronic rather than paper form.

ELINOR and successor projects at De Montfort University already make many thousands of pages from textbooks, journals, and other sources accessible through an online, full text retrieval system. Other libraries have implemented electronic access to materials previously made available in conventional printed form, including "reserve" materials needed in support of university coursework, and some publishers are making it possible for faculty to build their own customized teaching materials from digital text drawn from books, journals, and other sources. In the Digital Library Initiative, many major publishers, including professional societies and commercial enterprises, are making textbooks, journals, and popular magazines available to research libraries in digital form to allow studies of use factors and problems of implementation. The JSTOR project, funded by the Mellon Foundation, is working with publishers to get the full text of back issues of leading journals into digital form (Degennaro, 1997).

Commercial document delivery services are now putting great emphasis on providing network access to the full text of journals, and other materials, through Web interfaces designed for direct access by end users (Orchard, 1977).

In the longer term, it seems very likely that print-on-paper publications will very largely be replaced by completely new electronic forms, publications that cannot exist as paper by virtue of their characteristics—incorporating motion, sound, and hypertext/hypermedia features, and allowing the user to interact or participate with the publication. Very likely this will eliminate distinctions now made among monographs, journals, and certain other publication forms (Arnold, 1995). For a realistic vision of the electronic publications of the future one must go beyond the literature of library science and read such authors as Lanham (1994) and Negroponte (1995) as well as writers in the area of virtual reality—Rheingold (1991), Helsel and Roth (1991) Pimentel and Teixeria (1995), and especially Krueger (1983). Barden (1995) emphasizes how important it is today for libraries to develop capabilities for multimedia document delivery.

General Trends in User Services

As mentioned throughout this book technology has had major effects on the services that libraries provide and on the way these services are used. These effects can be categorized as (1) modification of traditional services, (2) introduction of new services, (3) disintermediation of services, and (4) perhaps most significant, the extension of services of remote users. This grouping seems a useful one even though the categories are not mutually exclusive.

Modification of Traditional Services

The modification of traditional library services, hopefully their improvement, has been illustrated in many of the other chapters. Perhaps the most obvious example is the gradual substitution of electronic access for more conventional tools—the OPAC for the card catalogue and electronic databases for much use of printed indexes and other reference tools. Such developments are generally considered to have improved the quality of services although, as implied elsewhere in the book, some libraries may be inclined to exaggerate the improvement. At the very least, surveys of library users tend to show that the great majority prefer the new tools to the old. Furthermore, the new tools have expanded the horizons of library users—e.g., by replacing the catalogue of a single library by one covering the holdings of many—and have made possible significant improvements elsewhere—e.g., online union catalogues, coupled with fax, have greatly increased the probability that an urgently needed item can be delivered expeditiously to a user.

New Services

Computer and telecommunications technologies have allowed libraries to develop services that would have been almost impossible to offer earlier. Some of these have developed logically as extensions of traditional services or tools. Most obvious the expansion of the catalogue from a single-library finding tool to one that may now be a doorway to a universe of information resources :

1. The holdings of other libraries
2. Databases providing access to millions of journal articles
3. Databases constructed by the library itself (e.g., of community resources, of local history, of carpooling information)
4. Via the Internet, the holdings of even more libraries and an almost limitless variety of formal and informal sources of information.

Tyckoson (1989b) gives a dramatic illustration of the important of the expansion/enhancement of the catalogue, especially by its inclusion of references to the journal literature, when he points out that the "traditional' catalogue provides access to only about two percent of the collection in a typical academic library.

The enhancement of the catalogue is likely to continue in a number of directions in the future. For example, the PALINET consortium in the Philadelphia area is experimenting with the augmentation of the catalogue through the inclusion of tables of contents of monographic publications PALINET announces, 1995).

The ability to access databases in electronic form has allowed libraries to offer a number of nontraditional services to their users. Hanson (1994a), for example, provides a useful discussion on aiding users to build their own electronic resources by downloading from CD-ROM or other databases. In this context, he believes that the library can play an importance role in (1) alerting users to software that can be applied to build and manipulate their own databases of downloaded records, (2) making such software available, perhaps through some form of central site license, (3) training of users, and (4) offering assistance or troubleshooting where necessary. Hanson (1995) presents a useful survey of bibliographic software that library users can apply to their own databases.

A related development is the improvement of library-provided current awareness services. Libraries have long offered various current awareness facilities or services to their users. The most obvious, and least sophisticated, is simply the placing of current issues of journals on a special and prominent display. Another obvious example is the preparation of booklists representing items recently added to the collection. The circulation of current issues of journals on a routing list was very common in special libraries in the 1950s and 1960s, and continues in some today, while a few special libraries have prepared and distributed their own bulletins of abstracts. Major improvements in photocopying technologies, leading to greatly reduced costs, led many special libraries to distribute multiple copies of journal contents pages instead of routing the journals themselves. As discussed in previous Chapter, table-of-contents (TOC) services have become increasingly common in libraries of all types and many such services are offered online by publishers and other vendors. Mountifield (1995) gives a useful survey of these.

In the late 1950s, Hans Peter Luhn of IBM first discussed the possibility of a more sophisticated level of current awareness in which computers are used to match subject terms associated with newly published items against subject terms in "interest profiles" of users. He later referred to this as "selective dissemination of information" (SDI). SDI services became popular in the 1960s because they were very cheap compared with the cost of using computers to search databases retrospectively on demand. Based on databases made commercially available by major publishers, and occasionally on in-house databases, SDI services were offered by many special libraries, and, later, by dissemination centers selling such services on a fee basis.

Services of this type, involving the searching of magnetic tape and the distribution of printed lists of retrieved references, were rendered somewhat obsolete by the emergence of online systems that allow a library user (or a librarian on his/her behalf) to access a database periodically to achieve a continuing current awareness service.

The increasing availability and diversity of CD-ROM databases in libraries has made it even easier for a library user to keep somewhat up-to-date in an area of interest through a search of one or more sources on a regular basis as they are updated. The intelligent user, presumably, would develop an effective search strategy (interest profile) and retain it for continued use.

Nevertheless, some believe that a better level of service would result if librarians involved themselves in the process. For example, Hanson (1994a) describes a librarian-mediated "electronic current awareness service" offered at the University of Portsmouth. Subject specialist librarians help users to develop their interest profiles and to select the CD-ROM databases that will be searched regularly on their behalf. The actual searches are run by clerical personnel on the library staff and the retrieved references are supplied to users in an electronic form that allows their input into personal databases.

Cox and Hanson (1992) have discussed similar current awareness services, in special and academic libraries, based on CD-ROM, floppy disk, online databases, and library catalogues. Again, output is delivered to users in electronic form. In one of the services, offered by a hospital library, an annual fee is charged. The authors believe that the "image of the library can undoubtedly be enhanced by the introduction of an electronic current awareness service" and they report that such a service can be expected to increase demand for document delivery and may even affect journal subscriptions (indicating titles that should be added to the collection but also, possibly, some that could be discontinued).

Herala et al. (1995) describe the use of software that can process SDI profiles on CD-ROM databases automatically (most software packages supplied with CD-ROMs do not support automatic processing of saved search strategies). They emphasize the value of CD-ROM in providing SDI services in the less developed and less affluent countries.

Modern technologies also allow libraries to offer current awareness services of a completely different type. For example, Webb (1995) refers to a video news service of Kapiolani Community College at the University of Hawaii :

> *It is delivered by a large-screen television that broadcasts continuous cable news in a special alcove adjacent to the library's current periodicals and reference areas. This arrangement permits students to follow a topic of interest from its most current stages, through recent treatments in periodical format, and then to perform further research into historical and other background aspects of the topic by using the library's reference, general, and special collections.*

It is quite possible that libraries, especially those in industry, might use technology to offer completely new services to their communities. In particular, commercially-available databases could be applied to several activities beyond the more conventional bibliographic searching and current awareness.

For example, Lancaster and Loescher (1994) have discussed how databases might be applied in corporate intelligence and in various forms of technological or social forecasting, as well as in historical analyses (tracing the movement of "ideas" through the published literature).

Disintermediation

As mentioned several times elsewhere, new technologies now allow library users to undertake for themselves various activities previously provided for them by members of the library staff. Examples include charging items for later pickup or delivery, the searching of union catalogues, the initiation of interlibrary borrowing and ordering from commercial suppliers, and the unmediated searching of remote or CD-ROM databases.

One obvious effect of such disintermediation is that it should free some time for librarians and support staff to spend on other activities, perhaps in providing some of the new services alluded to earlier.

Disintermediation can also have less obvious effects. For example, Ison (1995) has pointed out that it can have a rather profound effect in changing interlibrary lending patterns, perhaps making the whole service more equitable :

> *A somewhat surprising outgrowth of patron-initiated interlibrary loan is the shifting of the lending away from the larger libraries to a reliance on smaller, more rural, libraries. According to statistics, rural libraries were better able to rely on each other and, in several instances, smaller libraries loaned more than they borrowed from the largest libraries in the consortium.*

Not unexpectedly, she also reports dramatic increases (fivefold) in overall interlending.

On the other hand, Farber (1995) has pointed out that disintermediation may have undesirable consequences because it makes it increasingly difficult for librarians to instruct users at the moment of need (the "teachable moment") :

> *An undergraduate's request for many interlibrary loans, for example, can provide a perfect teachable moment: explaining to the student at the moment of need which items are appropriate and which are not—and why. Several institutions have automated that process, and others are in the process of doing the same. In this case, such automation precludes the possibility of a potentially valuable educational experience. That is why the move toward "disintermediation"—removing the librarian from a procedure that was once performed by individuals and substituting an automated procedure—should be examined carefully to ensure the gain in efficiency is worth the loss of educational benefits.*

The aspect of disintermediation that is causing most problems for libraries is that related to document delivery. Haricombe and Lusher (1995) recognize three phases in this activity :

1. The user asks the library to acquire a particular item from another library or commercial vendor.
2. The user interacts with a librarian to select a source for an item and the user than places the order directly.

3. The user handles the entire process, bypassing the library.

Clearly, the third phase (and, to some extent, the second) creates problems if the library continues to bear the cost of providing access and delivery to users. If some users have the ability to charge items to a library account, some obvious dangers emerge—including the possibility that costs will be incurred for items readily available locally, that many items purchased will turn out not to be useful (the librarian may have prevented some of this), and that the library staff loses control of its own budgeting. Issues such as these have been raised by a number of writers, including Jackson (1992), Leach and Tribble (1993) and Higginbotham and Bowdoin (1993). Jackson implies that these are problems that libraries must face squarely because users who have network access to a myriad of information sources, perhaps from their offices or homes, will expect to be able to order documents directly as references to them are located. She suggests the need for some routine that would automatically check outgoing document orders against local holdings. The automatic blocking of orders for things held locally is now possible with at least one vendor interface (Sellers and Beam, 1995).

Jackson and Croneis (1994) point out that traditional interlibrary resource sharing is expensive and that "patron ordering may be more cost-effective and more staff-efficient...in the long run." In their survey of ARL libraries, they determined that 49 (out of 89) do allow direct patron ordering but none now absorbs the costs. Of the 40 that do not allow patron ordering, eleven claim to be exploring it. Since the ARL survey, at least one library has experimented with subsidized unmediated document delivery using a single vendor (Sellers and Beam, 1995).

In actual fact, while a definite move toward disintermediation can be observed in the services referred to earlier, with certain other activities the reverse situation (i.e., mediation where it did not exist before) has occurred, at least to some extent. One example of this has to do with referral of users to other libraries or institutions. In the pat, the user of a research or special library may have been informed that another institution might be an appropriate source of information but contact with that institution was frequently left to the user. Today, the referring librarian may use electronic mail to contact the target institution on behalf of the user and may even use Internet resources to search that institution's catalogues. Kovacs et al. (1994) have discussed the role of librarians in using Internet resources in the provision of reference service.

While Ewing and Hauptman (1995) cast doubt on the need for reference librarians in an electronic environment, others have taken the opposing position :

> *Contrary to the arguments put forth by Ewing and Hauptman, reference librarians and the services they provide are needed more now than at any other time in the past due to the increasingly [sic] popularity and complexity of such resources as the Internet in the automated reference environment. (Kong, 1995).*

Service to Remote Users

The disintermediation trend, discussed in the previous section, leads logically to a more profound matter that libraries now must contend with—the fact that electronic networks allow people to use certain of the library's resources, and to obtain services traditionally provided by the library, without visiting the library or consulting a member of the library staff. Service to "remote users," then, has emerged as a major issue facing libraries, particularly academic and special libraries.

Not surprisingly, remote access to at least some of the library's resources is becoming increasingly common, as demonstrated in the results of surveys undertaken by the Association of Research Libraries in 1986 and in 1993. In 1986, some 57 libraries (48% of those responding) provided remote access; by 1993, the coverage had increased to 67% (Haynes, 1993).

The 1993 survey showed that access to the online catalogue was the remote service offered most often (71 of the 75 libraries responding), followed by reference service—typically through electronic mail (46 libraries), circulation services (40 libraries), and inter-library loan (38 libraries).

In addition, 59 libraries (82% of those responding) claim to offer "technical assistance" to remote users, including helping users with computer-related and bibliographic-related questions. Only twelve of the libraries claimed to have a formal policy on service to remote users and these appear to be of only a very general nature (e.g., remote users should have the same capabilities and level of service as in-library users).

Remote users of library services are difficult to identify and may include many individuals who have not been regular visitors to the library. Such users may encounter problems that would be more easily solved if they *were* physically present in the library and had ready access to staff members.

Kalin (1991) mentions the need to provide various support services to such users. She discusses various forms of support, including help with the technology itself and with the more intellectual aspects such as search strategy, as well as such longer-term support as the instruction of users and the development of improved tools (interfaces or gateways). As Kalin points out, the big problem is the fact that remote users, while they may have less immediate access to assistance from library staff, may also have higher expectations regarding quality and speed of service.

At the present time, a remote user may be able to perform the following activities that would previously require a visit to the library:

(a) search the library's catalogue,

(b) search the catalogues of other libraries,

(c) search other databases,

(d) charge out an item owned by the library for subsequent pickup or delivery,

(e) charge out a book from another library for subsequent pickup or delivery,

(f) initiate an order for a photocopy from another library or a commercial supplier,

(g) communicate with members of the library staff for reference service or other assistance,

(h) have the results of searches or current awareness services delivered electronically, perhaps in a form suitable for incorporation into personal databases, and

(i) in some cases, have the full text of required items delivered to a personal workstation.

It is clear that this last capability represents the ultimate in remote use since search, retrieval, and delivery need not involve the library at all. In the case of academic and public libraries, of course, it will still be a long time before most of the items that users need will exist *in toto* in electronic form.

In the case of certain special libraries, however, the completely or nearly-completely virtual collection may already exist. This might be true, for instance, in an industrial setting in which the library is concerned primarily with the company's internal information resources. Norbie (1994), for example, describes a library of this type: "The library sits on employees' desktops throughout 14 western states. It does not matter where the librarian located." In this environment, she sees the following as important roles for the "electronic librarian" :

* The focus is on identifying which employees are not yet customers and turning them into users and gathering statistics on users by divisions within the company to determine where the library needs to be marketed;

* The librarian function focuses on making partnerships and designing user-friendly interfaces; users do their own research or reference work;
* Space planing has become screen planning;
* Instead of helpful, smiling people, friendly customer service is now the friendliness of computer menu screens;
* The pieces of data that become metrics for the success of the service are different. Circulation statistics become statistics on how frequently document groups are accessed by users and how users are realizing a savings of time and increasing productivity; and
* New measurement models for the cost of information must be developed, because users now perform research themselves.

Some of the problems involved in remote reference service have been discussed by Abels and Liebscher (1944). While it may be convenient for a user to transmit some form of reference request by electronic mail, and to receive certain results electronically, asynchronous communication does not permit the traditional "reference interview." Nevertheless, because writing out a request is likely to help many people in clarifying their own needs, a question submitted electronically may often be relatively precise. Ablels and Liebscher suggest the need to develop electronic "templates" to guide users into formulating more precise questions. Horwitz (1989) points out that remote reference service removes geographic and certain physical barriers (e.g., service to some handicapped groups) to information access.

A debate held at the annual meeting of the Medical Library Association in 1995 posed some questions to library administrators that reflect real concerns regarding the problems of remote reference service :

* Is electronic access to reference the most effective way to answer reference questions? Isn't a reference interview important? Does effectiveness of electronic reference depend on the type of library (i.e., hospital versus a academic)?
* How do you communicate with users you never see; how do you know what they need? (Nagle, 1996)

Remote use of library resources is likely to increase and, in fact, significant increases have already been reported. For example, Lewontin (1991), referring to use of business-related databases made available by an academic library, reports that use of these resources was greater within the library in August 1988 but that remote use exceeded in-library use one month later; by 1990, remote access exceeded in-library access "overwhelmingly". Bristow (1992), in a larger academic library, reports approximately 330 reference questions answered through electronic mail for 51 different users in a three month period. Users were enthusiastic about the service and some suggested that the library 'train everyone to use e-mail and abandon the phone."

Heller (1992) also claims significant increases in library use as remote access to resources became more feasible :

> *At Norwich University, delivering services beyond the physical confines of the library has had the result of increased performance in every category by which the library measures its success. Marked growth in these statistical yardsticks comes at a time when the student population has significantly decreased, further underscoring the importance of greater access to the delivery of service.*

He claims that remote access can bring the library more directly into the teaching process because faculty members now often use office terminals to refer to library resources during conferences with students.

Remote use has the obvious advantage that it can make some, at least, of the library's services accessible twenty four hours a day. Bellamy et al. (1991) point out that it can also save money—e.g., avoiding the need for individual academic departments to acquire database searching capabilities. Remote use will also have impact on other library services, perhaps reducing the demand for interlibrary and commercial document delivery.

Davis (1988) discuss the training needs of remote users and describes a number of approaches within a university environment, including an electronic instructional module that can be used in classroom and other settings.

Bobay et al. (1990) mention some other effects on the library: the instruction of users changes rather dramatically (designing interfaces and offering electronic mail assistance rather than face-to-face instruction); collection development policies may need to be re-examined if the remote user community includes groups that were not previous users of the library; and resource sharing among libraries grows in importance as increased use puts greater demands on document delivery services.

DiMattia (1993) has discussed the importance of maintaining the quality of remote services—by ensuring system reliability, upgrading capabilities where necessary, and offering various forms of help to users. Speaking from the viewpoint of the public library, he implies that reaching the "information poor" should be one of the priorities in developing remote access to library services. Sloan (1991) emphasizes the need for good communication with remote users and suggests that some form of newsletter would be valuable.

Clearly, remote library use also implies that members of the library staff need somewhat different skills than they did previously, such as the ability to offer various levels of technical support (deKock, 1993) and to have the facility to communicate with users in an asynchronous electronic mode rather than through direct face-to-face interaction or even telephone contact. Weller (1985), however, reports that the interpretation of the requests of remote users is not as difficult as one might expect.

Sloan (1991) suggests that remote users of OPACs may be significantly different from those who visit the library: more sophisticated users of computers, more likely to use online help facilities, and more likely to be searching for known items that to be performing subject searches. He also points out that they can be at a serious disadvantage as information seekers because they do not have the full resources of the library readily available. One result of this is that they are more likely to request the delivery of items that turn out to be of no use to them, suggesting the need for the enhancement of catalogue records by inclusion of annotations or contents pages. Sloan claims that remote users may need interfaces that are different from those designed primarily for in-library users, but he gives no details on what these differences might be.

User Reactions to Library Technology

Anecdotal evidence from librarians suggest that the majority of library users fully approve of the increasing application of technology to library operations. A survey of 238 libraries of all types, undertaken by Hauptman and Anderson (1994) in 1990, found that 50% of respondents agreed that "patrons appreciate technology" and a further 28% strongly agreed with this. A mere 1% strongly disagreed. On the other hand, only 33% could agree that technology is fully utilized by patrons and only 6% cold strongly agree with this. Nevertheless, the responding librarians are almost unanimous in the opinion that further technology would increase library service: 48% agree and 37% strongly agree. Direct surveys of patrons to determine their reactions to the increasing automation of services, or the effect of technology on their use of libraries, seem virtually nonexistent in the professional literature.

Characteristics of the Available Computer System

The capabilities and limitations of computer system available to the library must be known prior to deigning the computer-based library system. In the case of the described acquisitions system the equipment available to the library was in International Business Machine System 360/50 computer installation consisting of the following devices listed with their IBM type number and related capabilities.

1. First there was a 2050 central processing unit (CPU) with type 1052 typewriter and console that could handle compilation and execution of programmes together. CPU core storage is 131,172 bytes (characters)., Two 16-digit decimals may be multiplied together in 37.25 microsecond. This speed of data handling is illustrated by the fact that 18 three-line bibliographic records (call number, author, and title) plus a page heading may be formatted for printing in less than 1 second including an edit (Verification) of the call number and allowance for spaces between entries.
2. There were two 1403 line printers for printed output. Each printer is rated at 600 lines per minute with 132 characters per line using a printing chain with the Standard Character Set of 48 graphics (26 upper case alpha, 10 numeric, and 12 assorted special characters). Using the Full Character Set (Text Printing) chain, which includes upper and lower case letters, numerals, and many more special characters than the Standard Set, printing speed is reduced by more than 50 per cent to about 250 lines per minute.
3. A 2540 card reader punch was available for reading punched-card input and punching output data. This machine reads 1000 cards per minute and punches 300 cards per minute.
4. There were four 2311 disk drives that house "compilers" and the various monitor systems." Compilers are programmes that translate instructions in specific programmes into the language that the machine can use. Monitor systems coordinate and direct the computer system's capabilities for maximum effectiveness in processing user programmes. There are 7.25 million characters of random (direct) access storage available from each disk drive and it may be read at 56,000 characters per second. Direct access is essential to such operations as sorting or putting a file in some desired order. For example, 3000 variable-length records can be alphabetized in less than 3 minutes including the time it takes for the input and output magnetic tapes to be rewound.
5. Five 2400 model 1 magnetic tape drives for general input/output (I/O) operations were available. There are 23 million characters of sequential storage available per tape drive deliverable at 30,000 characters per second. The tapes are useful or files that will be used but not rearranged in processing.

6. A 2671 paper-tape reader was provided. With the feed and take-up spools, paper tape is read at 1000 characters (about three book orders) per second. The spooling accessory allows tapes to be read in proper data sequence without respect to how the paper tape is wound.
7. A 2361 bulk core storage provided over one million bytes of core storage supplementing the storage capacity available in the central processing unit.
8. A 2841 control unit for the disk 2311 drives and a 2821 control unit for the 1403 printers and the 2540 reader were available to synchronize the I/O devices with the CPU so that the programme processing would continue during the I/O operations. Being mechanical, these operations are considerably slower than the electronic operations of the CPU.
9. Peripheral utility type equipment was also available including the 129 keypunch, the burster for breaking apart paper printout, the decollator for pulling out carbon paper and separating multiple copies of a printout, the punched-card duplicating machine, and the punched-card sorter.

19

Electronic Access to Global Information

In addition with its library network programme, CALIBNET has added to itself under to information centre approach, a new dimension that of a purveyor of global information, a phenomenon that now pervades international information market.

With online access to Internet and in-house CD-ROM resources, CALIBNET can explore a wide spectrum of the knowledge base and cooperate and professional enterprises, and meet the information requirements of researchers, academics and other scholars, professional and any other practitioners engaged in a wide gamut of subject interest.

CALIBNET Services/Activities

(i) *On-demand Information Services*: CALIBNET has several attractive information packages:

- *Confile Service:* CALIBNET's Confile service reaches at one's desk contents of any journal of one's choice out of over 20,000 high-impact journals. Libraries can now prune their journal subscription list or even forego subscribing to new ones, when budgetary constraints so demand, and still get expressed to their contents from ConFile. ConFile helps libraries in economizing on journal subscription and reducing the drain on precious foreign exchange resources.
- *Caliborder:* On demand, caliborder offers the requisite back-up service by way of delivery of full text of any article and even patents.
- *ConAlert:* Through ConAlert service CALIBNET gives current and tailored bibliographic information. One can leave with

CALIBNET just keywords defining his subject interest and get at regular intervals, the current information related to his interest at his desk.

- *RetroFile:* This service offers latest status and trend of research on any specific topic.

  ConFile, ConAlert and RetroFile, in combination, offers the latest information and advances in the entire spectrum of the subject interest.

(ii) *CALIBLINK:* A special feature of CALIBNET is the Caliblink, a email connectivity (from its ERNET hub) installed and working fine at four institutions.

(iii) *Institutional Resources Development Services:* Some of the key institutional resources development services offered are:

  (a) Retrospective conversion of existing card catalogue in libraries into computerized local databases via electronic mode by down loading from international databases;

  (b) Consultative services on LIS automation

  (c) Manpower development for operating and manning automated LIS environment through a wide range of graded training programmes, and customized courses for individuals or group at client's site.

(iv) *SANJUKTA & PARAPAR Software.*

Sanjukta

A multi-user storage and retrieval software has been developed in-house to support CALIBNET's Centralised Database and to provide online access from remote locations. SANJUKTA has been designed and implemented by A Mukhopadhyay, Technical Consultant, CALIBNET and his associates based on MOD+, a software he developed earlier to support management of small/medium-size libraries.The software has been developed, using 4 GL Code and designed to provide the user with options and flexibility in generating records, organizing and searching information viewing the search outputs, and interchanging data files with external databases with least manual interference.

Parapar

A conversion software package, PARAPAR has been developed in CALIBNET to support interchange of bibliographic data between USMARC, UNIMARC and CCF Files and also from non-standard formats to standard ones. Its primary objective is to convert data files, received from the participating libraries in variant formats, into a ISO-2709 compliant implementation through which the files are merged into the centralized Database of CALIBNET.

Guidelines for Implementation of UNIMARC: It has been brought out by CALIBNET to provide the library professionals in India with a working tool for developing their databases in a mutually exchangeable format. The document has been prepared in 1994, based on UNIMARC Manual (1987), by A Mukhopadhyay, Technical Consultant, under a project sponsored by the National Information System for Science and Technology (NISSAT), Department of Scientific and Industrial Research, Government of India. The guidelines have made an attempt to take care of the special requirements of the Indian libraries. They are expected to serve the Indian libraries in upgrading their databases to the international standard.

Immediate Focus

(i) *Indian Resources Database:* Development of Indian Resources Database on historical value covering manuscripts and rare books, and personal collections, has already been initiated with porting on the CDB and index to serials published by Asiatic Society during the last two countries.

(ii) *CALIBNET on INTERNET:* The design of CALIBNET web page is complete and is available on the Net. The web page(http://www.calibnet.org/) facilitates access to bibliographic information resources available through hosting of CALIBNET's centralized database. The CALIBNET web site provides:

a. Active link to access:
   - Indian Library and Network Resources.
   - Overseas Library Resources on India, including rare documents–printed and manuscripts.
   - Worldwide Library Catalogues.
   - National Libraries of the world.
   - Newspapers and journals.
   - Electronic Reference tools.
   - Factual Information sources.
   - Book Trade Databases.

b. Varied CALIBNET programmes for:
   - On-demand Information services.
   - Electronic-mail connections.
   - Consultative services for Library Automation.

- Manpower Development.
- R&D in IT Application.

INFLIBNET

INFLIBNET is an autonomous Inter-University Centre of the University Grants Commission (UGC) of India. It is a major National Programme initiated by the UGC in 1991 with its Head Quarters at Gujarat University Campus, Ahmedabad. Initially started as a project under the IUCAA, it became an independent Inter-University Centre in 1996. INFLIBNET is involved in creating infrastructure, modernizing university libraries for sharing information among academic, information centres and R & D Institutions in India and connecting them through a nation-wide high speed data network using the state-of-art technologies.

INFLIBNET is set out to be a major player in promoting scholarly communication among academicians and researchers in India. Major Activities include computerization and automation of libraries and information centres to support modern information service, creation and augmentation of databases to support academic and research work, establishment of a cooperative communication network for linking libraries, information centres and academicians to make optimum use of the resources available at the national level, up-skilling of existing library staff through regular training programmes, seminars, workshops and conventions.

Objectives

Objectives of INFLIBNET are:

- To promote and establish communication facilities to improve capability in information transfer and access, that provide support to scholarship, learning, research and academic pursuit through cooperation and involvement of agencies concerned;
- To establish Information And Library Network "INFLIBNET" – a computer communication network for linking libraries and information centres in universities, deemed to be universities, colleges, UGC information centres, institutions of national importance and R&D institutions, etc. avoiding duplication of efforts.

Functions

In order to fulfil the broad objectives, INFLIBNET will :

- Promote and implement computerization of operations and services in the libraries and information centres of the country, following a uniform standard.

- Evolve standards and uniform guidelines in techniques, methods, procedures,computer hardware and software, services and promote their adoption in actual practice by all libraries, in order to facilitate pooling, sharing and exchange of information towards optimal use of resources and facilities
- Evolve a national network interconnecting various libraries and information centres in the country and to improve capability in information handling and service
- Provide reliable access to document collection of libraries by creating on-line union catalogue of serials, theses/dissertations, books, monographs and non-book materials (manuscripts, audio-visuals, computer data, multimedia, etc.) in various libraries in India.
- Provide access to bibliographic information sources with citations, abstracts etc. through indigenously created databases of the Sectoral Information Centres of NISSAT, UGC Information Centres, City Networks and such others and by establishing gateways for on-line accessing of national and international databases held by national and international information networks and centres respectively
- Develop new methods and techniques for archival of valuable information available as manuscripts and information documents in different Indian Languages, optimize information resource utilization through shared cataloguing, inter-library loan service, catalogue production, collection development and thus avoiding duplication in acquisition to the extent possible
- Encourage cooperation among libraries, documentation centres and information centres in the country, so that the resources can be pooled for the benefit of helping the weaker resource centres by stronger ones.
- Enable the users dispersed all over the country, irrespective of location and distance, to have access to information regarding serials, theses/dissertations, books, monographs and non-book materials by locating the sources wherefrom available and to obtain it through the facilities of INFLIBNET and union catalogue of documents.
- Create databases of projects, institutions, specialists, etc. for providing on-line information service
- Train and develop human resources in the field of computerized library operations and networking to establish, manage and sustain INFLIBNET.

- Facilitate academic communication amongst scientists, engineers, social scientists, academics, faculties, researchers and students through electronic mail, file transfer, computer/audio/video conferencing, etc.
- Undertake system design and studies in the field of communications, computer networking, information handling and data management.
- Establish appropriate control and monitoring system for the communication network and organize maintenance.
- Collaborate with institutions, libraries, information centres and other organizations in India and abroad in the field relevant to the objectives of the Centre.
- Create and promote R&D and other facilities and technical positions for realizing the objectives of the Centre.
- Generate revenue by providing consultancies and information services.

Major Activities

1. Library Automation
2. Database Development: INFLIBNET is involved in creation of union databases of Books, Theses, Serials, Experts and Projects. These databases are available for online Access.
3. Software development
4. Information Services and Networking
   - i) Bibliographic Information Services:
     - Online Database Access & Search
     - Sewak
     - CD ROM
     - COPSAT
     - OCLC's First Search
   - ii) Document Delivery Services
   - iii) University Information System
   - iv) Networking of University Libraries
5. Human Resources Development
6. Other Activities:

Library Automation

The automation of university libraries is a pre-requisite for networking and resource sharing. INFLIBNET Centre, through UGC, has been providing the required support to universities in phases. Till 1999-2000, 123 universities have been given initial grant of Rs. 6.5 lakh each to develop infrastructure for automation.

By the end of 9th plan period, rest of the universities will also be included. After installation of the systems, further financial support is provided for the first five years to take care of recurring expenditure. These Libraries on receipt of initial grant sign a Memorandum of Understanding with INFLIBNET.

An integrated software for the automation of in-house functions called 'SOUL' has been developed. It has been well received by the University Libraries. SOUL has been installed at 27 libraries. Many more libraries have shown desire to procure and install SOUL.

Database Development

Development of Union databases is one of the major activities of INFLIBNET. Eight databases have been developed and are continuously growing. They pertain to Books, Theses, Serial holdings, Current serials, Experts, Research projects, Secondary serials/CD-ROMs and DDC serials. These are grouped under following two categories.

Bibliographic Databases	**Non-bibliographic Databases**
Serials Holdings	Research Projects
Current Serials	Experts
Secondary Serials Catalogue	University Information System
Theses	
Books	

The bibliographic databases represent the holdings of university libraries, for which the data is contributed by participating libraries. These databases provide an access to large pool of information available besides, serving as tool for resource sharing. Non bibliographic databases are created to promote the communication among the scholars.

Software Development

- *Library Management Software:* For the automation of in-house functions of participating university libraries, INFLIBNET Centre has developed a user-friendly state of the art GUI based software named ' SOUL' software for University Libraries. This is based on

Client/Server Architecture. It uses an robust RDBMS as back end tool. This works on Windows and Windows NT environment with a number of new features.

- *Utility Software:* Following utility software developed at the Centre are available to the universities on request.
- To search the data from union databases (OPAC).
- Catalogue card generation.
- Duplicate checking of records.
- Customised software for Books, Theses, Serials.
- Data Conversion from Dbase, FoxPro and text file to ISO-2709 format.

SOUL: Software for University Libraries

University libraries are complex entities, having large collections and serving a huge clientele. To carry out various operations in a library effectively, there is a need for automation. Computer and communication technologies have brought revolutionary changes in the information acquisition, processing, storage, retrieval and dissemination. Keeping in view the latest trends in Information Technology (IT), INFLIBNET Centre has developed a Windows based Library Management Software "SOUL", which provides total solution for Library Automation.

SOUL is designed using Client-Server Architecture which imparts extra strength to storage capacity, multiple access to single database, various levels of security, back up and storage facilities etc. This software has been designed after a comprehensive study of different library related functions practiced in university libraries. It has MS-SQL Server 6.5 RDBMS as the back end. This user-friendly software is quite easy to work with. The software comprises following modules:

- Acquisition
- Catalogue
- Circulation
- OPAC
- Serial Control
- Administration.

The in-built network feature of the software will allow multiple libraries of the same university to function together as well as access to the distributed databases installed at various university libraries and union catalogue mounted at INFLIBNET using VSAT network.

Information Services and Networking

Bibliographic Information Services

a) Online Database Access & Search

INFLIBNET is involved in creation of union databases of Books, Theses, Serials, Experts and Projects. These databases are available for online Access.

- Books
- Theses
- Serials
- Experts
- Projects.

Online Access to the Union Databases

All the databases have been mounted on different servers at INFLIBNET. Librarians and scholar community can access these databases. There is no restriction for access.

Keeping in view the current trends in information technology and web based access to information, INFLIBNET has developed web interface for online access to all the union databases in 1998 itself, thereby providing access over the INTERNET.

Searching Databases

To search the databases hosted by INFLIBNET, one has to have one's computer connected to the Internet with access to WWW and GUI based browser running on it *viz.* Netscape Communicator or Internet Explorer. With this, log on to the the INFLIBNET site at URL: http://www.inflibnet.ac.in.On reaching the home page on the site, one needs to follow the below given steps:

- First, choose the database. To carry out the search, select the desired database from the front page
- Read carefully the description and example given on the first page of each database.
- Select the access point to retrieve the data.
- Type in correctly search term(s) or phrase in given search box.
- After you complete typing, press return key or click the mouse button on search.
- Then results of the query are displayed with brief detail at first level.

- To see further details click on fields appearing in blue colour in the respective records.

b) *Off-line/E-mail Access to INFLIBNET Databases :* INFLIBNET Centre has mounted a variety of bibliographic databases on the Internet. Persons having Internet connectivity can access these databases on-line by logging on to INFLIBNET's web site at URL http://www.inflibnet.ac.in. On the other hand, persons having only e-mail facility could till now only send their queries through e-mail to INFLIBNET, which were manually processed at the Centre and replies were sent back through e-mail. This was a time consuming exercise. Now, INFLIBNET Centre has developed a software tool called SEWAK, which automatically processes queries received through e-mail and sends back replies. This mode of search scores over the on-line search in view of:

***Reduced Internet Access Time*:** A user simply shoots a query and relaxes. He/she need not spend large amount of Internet time on searching through the databases to get the results. SEWAK does the searching on behalf of the user, saving his/her time and money.

***Multiple Queries*:** A user can send multiple queries at a time through e-mail. SEWAK conducts the needful searches and sends back results to the user. This is not possible in on-line searches.

***Multiple Users*:** A number of users in a particular location having only one e-mail address can send their respective queries and receive individual results.

Thus SEWAK truly serves the users, saving their precious time and money.

CD-ROM Database : INFLIBNET Centre has been subscribing to quite a few Bibliographic Databases in CD-ROM/Floppies covering different subjects.

These have been subscribed with a view to provide Bibliographic Information Service on the topics of interest to the faculty members and researchers working in the universities and colleges. List of such databases currently available with INFLIBNET is given below.

To make an effective use of these databases, it has been decided to promote this service to the faculty members and researchers at the national level. To begin with, this service is provided free of cost. Interested users may send in their requests in a prescribed format through the Librarian. The search output will be provided in a floppy or through Email wherever possible.

List of Databases subscribed at INFLIBNET:

- Current Content on Diskette:Social and behavioural Sciences
- Dissertation Abstracts International: Humanities & Social Sciences
- EconLit: Economic Literature
- EMBASE Drugs & Pharmacology CD
- ERIC: Education and Research Centre
- IICD: Inside Information
- Inside Science
- Inside Social Science
- ISSN Compact: The ISSN register on CD-ROM
- LISA: Library and Information Science Abstract
- NUCSSI: National Union Catalogue of Scientific Serials in India
- Philosopher's Index
- PsycLit: Psychological Literature
- SSCI: Social Science Citation Index
- Sociofile: Sociological Abstracts
- Ulrich's On Disc: International Periodicals Directory.

Following CD-ROM based databases are also available at INFLIBNET, which are being frequently used for database creation work.

- BNB: British National Bibliography, Current file, 1986 to 1999
- OCLC: Recent Books 1999
- OCLC: Old Books 1999
- OCLC: Serials 1999
- OCLC: Authority file 1999
- CDMARC: Subject Heading 1996
- CDMARC: Names 1996
- CDMARC: Holdings 1996.

These can also be used for providing the required information to the Universities.

COPSAT Service (Contents of Periodicals in Science and Technology) : The Contents of Periodicals in Science and Technology is a service provided by INFLIBNET in collaboration with National Centre for Science Information (NCSI), Indian Institute of Science, Bangalore. It is basically a Current Awareness Service provided every month covering more than 4000 top ranking journals in the area of life sciences, physical sciences, chemical and earth sciences, engineering, computing technology, agricultural and environmental sciences. Besides contents, most of the journals covered by this service also contain author abstracts.

This service allows one to select upto 40 (depending upon the output medium opted) titles from wide range of 4000 journals and subscribe as one set at an affordable price. One can subscribe to more than one set and it is open for both individuals and institutions for academic and research purposes.

OCLC's First Search: The On-line Computer Library Centre Inc. is a not-for-profit largest leading network and bibliographic utility for libraries in the world, linking more than 26,000 libraries from 64 countries. The OCLC offers number of services to its member users over the network. The prominent and highly used ones are union catalogues, ILL and First Search Service. In the recent past, OCLC has introduced number of new services over the Internet, making available services cheaper, faster and widely available.

FirstSearch is an economically priced on-line bibliographic service that offers a comprehensive collection of over 85 databases and includes links to the WWW. It offers online full text, document delivery, library holdings and Inter-Library-Loan services. There is no charge for database connect time, record displays, record printing or record delivery by email. The databases covered are the ones that are highly used and important ones from the academic and research point of view. These 85 databases represent all major areas.

The INFLIBNET which aims to supplement the existing information services in the country in a cost-effective manner, has recently started helping universities by subscribing to OCLC's FirstSearch Service. This service enables INFLIBNET to provide the FirstSearch Service to all its funded universities, to begin with in an off-line mode. The user of library will have to send the request for literature search along with keywords etc. to the INFLIBNET. INFLIBNET will access the databases, conduct the search and download the records and send it to the requested libraries. Only requests routed through the libraries will be accepted. Charges are borne by INFLIBNET to begin with. It may please be noted that, only bibliographical information will be provided under this service and will be restricted to the databases covered through this service. This service is launched on an experimental basis by the INFLIBNET.

Document Delivery Service: Due to ever increasing subscription cost of learned journals, decreasing value of the Indian rupees against major foreign currencies and the stagnant library budgets, INFLIBNET has launched the Document Delivery Service to make optimum use of the existing collection of some of our resourceful libraries in support of academic and research work in the universities in the country.

The Document Delivery Service is a new service initiated by INFLIBNET in collaboration with the following six university libraries which are well known for their strong collection base and commitment to provide timely service.

- Banaras Hindu University, Varanasi
- University of Hyderabad, Hyderabad
- Indian Institute of Science, Bangalore
- Jawaharlal Nehru University, New Delhi
- Panjab University, Chandigarh
- Tata Institute of Social Science, Mumbai.

Under this service, the above mentioned six university libraries will serve as Document Delivery Centres and deliver, on demand, the copies of papers from learned journals, conference proceedings and other materials available in their collection at nominal cost. The role of INFLIBNET here is mainly to act as a catalyst in promoting this service to the academic and research community in India.

University Information System: INFLIBNET has created home pages for a number of Universities, giving entire information about each university with focus on academic and research activities. These are Developed by INFLIBNET CENTRE based on the data sent by the respective Universities :

Networking of University Libraries: Currently libraries funded under the programme are advised to subscribe to one of the following networks, depending on the availability in the respective locations:

- ERNET
- VSNL
- NICNET
- Other ISPs.

Wide Area Network : It is planned to setup a Wide Area Network "UGCNET" linking more than 170 universities and other academic institutes in the country.

Local Area Network : INFLIBNET Centre has suggested all the funded universities to set up LANs using HUB/SWITCH and CAT V cables within their libraries for successful installation of SOUL software. Since SOUL is based on client/server architecture, It is essential that the server and all other nodes be connected by LAN.

INFLIBNET Centre desires that each university should establish a LAN in it's campus linking all the departments including library. This LAN in turn will be connected to the WAN.

Human Resources Development

Following training courses are conducted to enhance the skills of University Library staff for implementation of INFLIBNET Programme:

- *One month Training Programme:* This is mainly meant for operational staff of libraries. They are given exhaustive training on application of computers to library and information services. Eighteen such programmes were held covering most of the universities, and around 350 persons have been trained.
- *On-site Training:* Staff from INFLIBNET Centre visited 31 universities, and conducted training for the library staff members for a week initiating automation process.
- *ILMS Training:* Ten Librarians from different universities spent a week at INFLIBNET to solve their problems in using ILMS.
- *SOUL Training:*Soul was installed at 15 University Libraries and onsite training of one week to the library staff was provided at each site.
- *CALIBER:* It is an annual convention held every year in collaboration with a university in different region on a theme related to library automation. Seven such conventions have been held so far.
- *Workshops:* Six workshops for senior level staff viz, University Librarians and Deputy Librarians were conducted.

Other Activities

Publications: INFLIBNET centre has been bringing out the following publications on regular basis.

- CALIBER Proceedings
- Union Catalogue of Secondary Serials(including Bibliographic database on CD-ROMs)
- Guidelines for Data Capturing: A User manual
- Newsletters (A Quarterly Publication of Information and Library Network Centre, UGC).

CALIBER Proceedings

Topics covered in these proceedings are contemporary, covering major areas of librarianship *viz.* Library Automation, Library Networking, Database Management, Impact of Information Technology to library and Information Centres, Changing role of Library professionals and future role of libraries in INTERNET environment. These volumes will be valuable resource for library professionals who would like to keep up to date with recent development in the field

Union Catalogue of Secondary Serials

This union catalogue of Secondary Serials is the first publication in the series of publications been brought out by INFLIBNET Centre. This covers 337 unique titles which includes 99 CD-ROM based Secondary Serials titles. This data has been contributed by 106 universities, covering for the period of 1998. The catalogue provides list of titles along with minimum bibliographic information and library codes. The same is being updated for 1999

Guidelines for Data Capturing (A User Manual)

To maintain consistency and quality in databases prepared by the libraries and INFLIBNET, INFLIBNET Centre had constituted a taskforce consistency experts in this area. This task force has brought out a 100 pages documents entitled GUIDELINES FOR DATA CAPTURING: A USER MANUAL. This document is prepared based on Common Communication Format (CCF), 1992 edition and same has been given to participating libraries for adoption. The task force also studied other standards required for this activity and accordingly recommended that the following

- Anglo American Catalogue Rules. Edition 2nd revised
- Library of Congress Subject Headings may also be used.

Disussion Forum: INFLIBNET Centre proposes to start a Discussion Forum on the network for various subjects. The first Disussion Forum already started is regarding the SOUL Software developed by INFLIBNET Centre and installed at a number of Universities. The users of SOUL or anyone else interested in SOUL can make use of this Forum to seek clarifications on SOUL.

Installation of SOUL at 27 Universities by INFLIBNET: Library Management software SOUL, developed by INFLIBNET Centre, has been installed at 27 University Libraries. Teams of INFLIBNET visited these universities for installation of SOUL and for providing online training.

Launching of Electronic Document Delivery Service by INFLIBNET: INFLIBNET has taken a new initiative by launching an innovative service called Electronic Document Delivery Service. This service was launched in the month of July 2000, simultaneously by following six university libraries, which are identified to serve as Document Delivery Centres.

- Banaras Hindu University, Varanasi
- University of Hyderabad, Hyderabad
- Indian Institute of Science, Bangalore
- Javaharlal Nehru University, New Delhi
- Panjab University, Chandigarh
- Tata Institute of Social Science, Mumbai.

Under this service the above Document Delivery Centres will provide copies of research papers appearing in learned journals, conference proceedings etc. from their available collection to academic and research community at an affordable cost. This service is preferably going to be delivered using Internet. The required infrastructure *viz.* Computer connected to Internet, scanner, printer, fax, etc. are being set up at each Centre. The end users and libraries using e-mails can request for the research papers. The service is primarily targeted at the academic and research communities in the country who currently have very limited access to the information available in very few select libraries. All these libraries have been provided with a minimum grant to support the infrastructure facilities. With this service, it would be possible to optimally use available resources in the country.

Retro-Conversion of Five Major Libraries by INFLIBNET: The Retrospective conversion of five major library catalogues has been launched under the INFLIBNET Programme from June 2000. This is a new project initiated by INFLIBNET to minimize the effort & cost involved in retrospective conversion work of its member libraries. Under this project, following five libraries, who have the largest and unique collection, have started creating a qualitative database. This work of Retro-Conversion is expected to be completed in two years. The data will be provided to all other universities on CD-ROMs for directly downloading the records. This will avoid need for entry and reduce overall cost and improve quality of the data.

1. Banaras Hindu University, Varanasi
2. Indian Institute of Science, Bangalore
3. Jawaharlal Nehru University, New Delhi
4. University of Madras, Chennnai
5. University of Mumbai, Mumbai.

All these five libraries have been given extra funding to take up this mammoth task of creating records of their holdings as per the standards recommenced by INFLIBNET. This funding is basically restricted to creation of records in electronic form only. The infrastructure cost will be borne by the respective libraries.

The bibliographic records contributed by five libraries will be hosted on INFLIBNET Servers for online access. INFLIBNET proposes to use this data for retrospective conversion and shared cataloguing of all its member libraries and large number of college libraries thereby minimizing duplication of effort and cost involved.

Organizing Seminars, Workshops, Conferences, etc.: INFLIBNET has also been engaged, from time to time, in organizing seminars, symposia, workshops and conferences for the benefit of Library staff and Information Professionals. A 10 days intensive workshop on "Bibliographic Standards and Formats for Retro-Conversion: Tools and Techniques" was organized at INFLIBNET from May 15, 2000.

Membership

- Primary
- Secondary.

Primary membership: The University Libraries entitled to receive from UGC will become primary members immediatly on receipt of the initial grant under the INFLIBNET programme.

At present, there are 13 Central Universities. The UGC is assisting 19 deemed universities at present, out of the 38 universities for plan grants. The UGC is providing development grants to 108 State Universities. Currently, 142 universities and other institutes have been covered under the INFLIBNET programme.

Associate membership: The libraries who are not entitled to receive the grants from the UGC but are public funded academic and research organizations, Govt. departments, Non-profit making organizations can have the associate membership of INFLIBNET by signing an MOU and by paying the requisite fees.

MALIBNET

MALIBNET has been conceived to overcome the problem of resource crunch in the libraries and to provide information at a low cost to the users in and around Chennai. As a universal phenomenon, libraries in the region are facing two major problems:

- Knowledge explosion and the consequent information explosion and
- Price escalation of library documents.

These problems have forced the information specialists to cut down the number of journals they procured to manage the situation within the available resources. In order to find a solution to these pressing problems, the concept of automation and cooperation are proved much effective.

The need for interconnecting libraries and information centres in Chennai was visualized by Indian National Scientific Documentation Centre (INSDOC) in 1991. INSDOC undertook a feasibility study, which was completed in March 1992. MALIBNET was registered as a society in Chennai in February 1993. The nucleus of MALIBNET, the Network Service Centre (NSC) for MALIBNET is located at INSDOC Regional Centre, CSIR, CSIR, Madras Complex, Tharamani, Chennai.Presently, nearly 50 libraries in Madras are contributing actively to the creation of various databases on MALIBNET. With the help of communication links and sophisticated information technology, the resources of the member libraries are shared and made available to the users.

Aims and Objectives

The main aim of MALIBNET is to facilitate resource sharing and information dissemination by establishing network of libraries, and thus helps fostering growth in the field of Information science and Technology. Following are the main objectives of MALIBNET:

- To encourage cooperation among libraries, documentation centres and information centres in Chennai so that the resources can be pooled for the benefit of helping the weaker resource centres by the stronger ones.
- To evolve a network, interconnecting various libraries and information centres to improve capability in information handling and services.
- To provide reliable access to document collection of libraries by creating a union catalogue of library holdings and housing it in a centralized host system of the network.
- To provide better access to bibliographic information through access to national and international databases.
- To optimize information resource utilization through shared cataloguing, and inter library loan services and avoiding duplication in acquisition to the extent possible.
- To centrally acquire information, specially the contents and abstracts from all the journals and then disseminate information as and when required, thus avoiding duplication in journal acquisition and reducing the expenditure of individual libraries.

- To organize conferences, lectures, workshops and seminars.
- To undertake scientific research in the field of library & documentation.

Activities/Services

MALIBNET provides the following services

I. Services: General
   - Access to list of current serials subscribed in 50 libraries
   - Full journal holdings of these libraries
   - Access to specialized database giving article index with abstracts
   - Door delivery system for document copies
   - Access to International databases through INSDOC
   - Contents, Abstracts & Photocopies from about 1200 important journals under CAPS service
   - Contents information of journals supplied as per user's choice
   - Each subscription covering 20 journals
   - Contents data suppiled in hard copy form, through E-mail or in diskette with retrieval software
   - 12 despatches under one subscription
   - Standing order based/Demand based Abstract service from journals
   - Full text of journal articles from member libraries supplied within 48 hours
   - Creation of specialised databases at user's request
   - Library automation
   - Training courses
   - Consultancy in networking and computerization

II. Services available free of cost to members
   - *Electronic Mail (E-mail)*
   - Free exchange through E-mail among all member libraries and Network Service Centre
   - *MALIB Card*
   - Enables card holder to consult member libraries
   - Provides free access to MALIBNET resource centres
   - *Online Access*
   - Free online access to all the MALIBNET databases

- *Free CAPS service*
- Free dispatch of contents information of journals through E-mail

III. Databases Information services

MALIBNET has following databases;

- Directory Database of Current Serials:
- Contents Database:
- Specialized database for Automotive Industries:
- NUCSSI(National Union Catalogues of Scientific Serials in India):
- Medicinal and Aromatic Plants Abstracts (MAPA):
- Patents Database:
- Polymer Science Database:

Databases' Updates

- Directory Database of Current Serials includes 2720 unique titles from 46 libraries.
- Contents Database has information from 371 journals and 45746 records for the current year.
- Automotive Industry Database has information from 16 journals and 12567 records.
- Current Journal Holdings Data collected from 30 libraries.

MALIBNET Freeware

MALIBNET's worldwide database information services can be utilized by users around the world by placing their orders through the cost effective mechanism of E-mail. In order to place their orders, users may request for MALIBNET freeware software customized to run on Dos, Windows & Unix platforms. For this purpose, they have to send an email to MALIBNET.

Users will receive two emails from MALIBNET. One is a 'readme' mail and the other is the freeware software in encoded form. The 'readme' email provides all the necessary instructions required to decode and get an executable version of the freeware software. Freeware software can be executed on the system (DOS/Windows/UNIX) at the user end to avail MALIBNET services. The Freeware software contains:

- Information on MALIBNET
- Member Institutions of MALIBNET
- Services Offered on MALIBNET
- Malibnet Registration Form

- Fee Structure For Members & Non Members
- Order Registration Forms.

Content Search Service

This allows a search on the contents database existing at MALIBNET. It contains nearly 500 online journals. The journal list is provided to the user in the Freeware software. This database is searchable through journal title, year, volume & issue.

Results are sent back to the user through E-mail. Requests for availing these services can be made by filling up the data entry forms for these services provided in the MALIBNET freeware software supplied to the user. Users can start availing MALIBNET services after they become registered users of the MALIBNET. On registration, each user is given an unique code number & password.

Literature Search Service

This is a keyword based search service on four MALIBNET databases namely Contents, Autoabst, Polymer Science & Patents. Users can specify the keywords to include and keywords to exclude as well as specify the period to be covered in the search. Users can also specify the maximum number of references needed. Contents database holds article index of approximately 500 journals.

Autoabst (a Specialized Database for Automotive Industries) is very useful for research professionals and industrialists. This database covers valuable national and international journals and currently has 10,000 records.

The Patents database covers around 40,000 records and the keyword based search can give details like the inventor, country code, patent number, international classification code etc. The Polymer Science Database is a database on polymer science and related scientific areas.

Document Procurement Service

MALIBNET provides full text of articles from S & T journals. To avail this service, users are expected to provide the details of journals, year, volume, & issue along with page numbers.

The charges for this service is very nominal. Requests for availing these services can be made by filling up the data entry forms for these services provided in the MALIBNET freeware software supplied to the user. Users can start availing MALIBNET services after they become registered users of the MALIBNET. On registration, each user is given an unique code number & password.

International Databases

Apart from querying its own databases, MALIBNET also extends search on international databases through Dialogue, DATASTAR and STN International to its users. It provides current and constantly updated information.

These databases include bibliographic, commercial, statistical, full text, patents and variety of other databases.

Information on Consumers, Export/Import data, Exporter/Importer list, Product information, Market Information can be supplied. Users will have to specify the keywords to search, unwanted aspects in the search, their affordable cost for the search etc. through the data entry forms in the MALIBNET Freeware. The charges depend on the actual cost incurred in searching the International databases through Dialogue, Datastar or STN International.

Internet Services

MALIBNET also provides search on Internet for users requesting information found at various sites on the net. This service provides Directory list, Patents Abstract Search, Literature/Bibliographic search, Library Catalogues, File transfer, Data and Software Archives, Information about Companies, Organizations and Associations, etc.

The users specify the keywords to include and exclude, their affordable cost and short descriptions on the nature of search. The cost incurred is calculated in terms of the time spent in accessing the required information on the Internet. MALIBNET also provides attractive discounts for its users on this search regularly.

Requests for availing these services can be made by filling up the data entry forms for these services provided in the MALIBNET freeware software supplied to the user. Users can start availing MALIBNET services after they become registered users of the MALIBNET. On registration, each user is given an unique code number & password.

Publications;

- *MALIBNET News Letter:* A half yearly newsletter of Madras Library Network

Publications released by MALIBNET:

- *Directory of Current Serials in Engineering Sciences Institutions in Madras – 1998*
- *Directory of Current Serials in Basic Sciences Institutions in Madras – 1998*

- *Directory of Current Serials in Medical Sciences Institutions in Madras – 1998*
- *Directory of Current Serials in Social Sciences Institutions in Madras – 1998*

The above publications are free for members and priced at Rs. 50/- each for non-members. These are available in hardcopy form and on floppy diskettes with retrieval software.

- *Electronic Information Products:*

Available on floppy diskette with retrieval software;

— Directory of Current Serials – All disciplines

— Contents of Journals (selected from list) – Engineering and Physical Sciences

— Journal Holdings of Madras Libraries (selected from list) – 60 Libraries.

Organising Seminars/Meeting/Events;

- *Seminars :* MALIBNET also organizes seminars and meetings time to time for the benefit of Library and Information professionals.
- A meet organized at University of Madras on *"Resource Enhancement Through Networking"*, exclusively for Principals of City Colleges in March, 1998
- A seminar organized at Stella Maris College on *"Improving The Academic Environment Using Information Technology"* in April,1998. Experts spoke about the importance of resource sharing and the functioning of MALIBNET at length and gave a glimpse of network society of the future. An interactive session with live demonstration of online databases was conducted.
- *Training Courses Scheduled :* The following training courses are being held by MALIBNET for the Library and Information staff and interested users:
- Library Automation and Networking
- Windows and Internet
- Computer Networking, Unix & E-mail
- Internet.

MALIBNET can also organize specialized training programmes at customers' institutions.

Membership

Membership is open to Universities, Colleges, R&D Institutions, Industries and Individuals.

Membership Category	Initial Contribution (Rs.)	Annual subscription (Rs.)
Patron	500,000	Nil
Institutional (Academic	200,000	10,000
Institutional (Industry)	300,000	15,000
Associate Institutional	10,000	5,000
User Category	Nil	5,000

Presently there are 17 major educational/research institutions which have joined as member institutions of MALIBNET.

From the study of above Library Networks, we see that attempt has been made to expand more and more services by the respective library networks to give maximum benefits to their members in terms of bibliographic as well as factual information. These networks are also engaged at various university libraries and institutions for automating their house keeping activities.

In future, these as well as new established library networks, *viz.* ADINET, PUNENET, BONET, MYLIBNET, etc. are expected to play an important role in interlinking and resource sharing among various universities, R&D institutions, public libraries, academic libraries and other information centres in the country.

The Role of Preservation and the Library of the Future

What is the role of preservation in the library of the future? Will digital technology overcome all of our preservation problems or will we still need to actively manage the accessibility of information? What do we need to do to prepare for the future?

Let me begin by saying that I do not know the answers to these questions. In a time of rapid change it is hard to predict what the library of the future will look like, let alone what preservation issues and solutions it will enjoy.

However, we can make some educated guesses. As a preservation manager, making educated guesses about the future is part of what I am paid to do in order that we can prepare for it in a sensible manner. Therefore I have frequent cause to think about these questions as I try to prepare my colleagues and my institution-and most emphatically myself-for what we will need to be doing in five, ten or twenty years' time.

From this you will gather that this paper is intended to be a small exercise in future guessing, to see if we can pick up some clues as to how we can prepare for the preservation responsibilities that lie ahead of us.

The Existing Role of Preservation in Libraries

I define preservation, at least in a library context, as the processes of keeping collections and the information they contain available for use for as long as they are needed. Such a definition begs many questions, of course, such as: available for what kind of use? And: needed by whom? However, I believe this is a good enough working definition to take with us on this exercise.

Preservation has played an important role in libraries. Because of the "things" that libraries have collected, preservation has developed with a strong focus on preserving physical material: understanding why materials deteriorate and what we can do about it.

The Threats Preservation is Used to Dealing With

Our collections are made up of materials that are naturally subject to deterioration, caused or influenced by many things, including:

- the materials themselves-acidic papers, poor quality binding materials, unstable media such as cellulose nitrate and cellulose acetate photographic films, PVC-based audio tapes
- the environmental conditions we store them in-the heat, moisture, light, pollutants they are exposed to
- mould, insects, mice, and other pests that live on them or in them
- the abuses, or just plain uses, of users and staff
- sudden disasters such as floods, water leaks, fire, building collapse, vandalism, acts of terrorism, war.

We all know that preservation is about protecting our collections from such threats, or salvaging and repairing them to compensate for their impact.

Of course, our view of preservation, and our sense of priorities, are both influenced by our working context including the kind of collections for which we are responsible, and the kind of threats that are most pressing. For example, in Canberra, where the National Library of Australia is situated, the climate is generally dry and often cool; the air is clean; we have few insect pests that worry us; we are most unlikely to suffer major floods or earthquakes.

We have good buildings with reasonable air conditioning systems and reliable electricity supplies. We generally have access to well-trained and well-paid staff. Our traditional preservation priorities tend to focus on dealing with brittle papers, repairing library materials damaged in being used, ensuring the building systems work on the few days of high humidity we experience, and preventing disasters like water leaks and fires. I know that my preservation priorities would be different if I worked in a different environment, such as one with mould, insects and other pests as constant threats, with high levels of humidity and heat and polluted air, with unreliable building systems or energy supplies, with very few trained staff and inadequate resources to stop damage happening or to repair items when damage occurs.

Whatever our experience and our situation, however, we can recognise that the business of preservation has been to deal with threats of damage or loss.

Preservation Responses

One would have to say that at the theoretical level at least, the preservation profession has developed good responses to many of these threats. For reasons of limited resources, libraries are often unable to apply them, but we generally know what to do.

We have a range of good strategies for preventing damage. We know that reducing temperature and humidity levels will slow down deterioration, and that we need to filter out air pollutants and control exposure to light and UV. We know how to store, package, and handle collections, and how to train staff and users to do what they can to protect library materials and minimise the impact of use. We are aware that we need pest control programmes and disaster plans. We have even developed national and international campaigns to eliminate the use of unstable materials such as highly acidic papers in publishing and cellulose acetate film in record photography. We have developed good microfilming techniques and standards that allow us to make reliable and long-lasting copies of unstable material or items in high demand.

When our preventive measures fail, the conservators have developed some very effective treatment strategies that can respond to most kinds of damage for most kinds of materials. We have access to a wide repertoire of approaches that draw on long-standing traditions of maintaining and repairing collections developed over many centuries in many parts of the world.

We also make use of a great deal of scientific knowledge and technical development that has become available over the past 30 to 40 years as professional conservators and conservation scientists have looked for better ways of protecting and stabilising and repairing documentary materials.

Alongside the practice of preservation, we have developed mature approaches to managing our preservation programmes. We are used to identifying needs, setting priorities, planning and managing projects, bidding for resources, developing skills, allocating responsibilities, evaluating progress, adjusting plans, learning from mistakes and celebrating successes.

Given the right resources, preservation has become one of the mature, functioning areas of libraries, able to draw on a great deal of shared knowledge and some standard ways of approaching problems. There is a sense that we know what needs to be done: we just need the resources and support to get on and do it.

Changes in the Preservation Context

However, libraries are changing in quite profound ways. The information they have access to is changing, how they do business is changing, and the demands and expectations of their users are changing. Many of the assumptions upon which library preservation has been based seem to have been shaken.

I want to focus on two quite obvious and related changes: the impact of digital technology, and where collaboration might lead. There are many other changes happening in our library and information world as well, but these two areas seem to have particularly interesting and challenging implications for the preservation role, and for the questions of whether we will continue to need such a function, and what it might have to attend to.

Digital Technology

The introduction of digital technology is old news: libraries have been dealing with it as a collection issue for at least 20 years. Many of the changes wrought by it are obvious and widely discussed. We are seeing vast amounts of information of varying value published in digital formats, and many libraries are investing heavily in creating digital versions of analogue collection material.

I want to consider the preservation implications of digital technology in libraries, both in terms of managing digital information coming into our collections, and in terms of using digital imaging techniques as a preservation tool that might help us to manage our existing analogue collections.

Collaboration

Greatly enhanced prospects for collaboration between libraries is just one of the doors opened by digital technology. This is going to be driven by the demands of users for access to information wherever it originates, but it will also be driven by libraries themselves, as they look for opportunities to reduce their costs while improving the services they can provide. Collaboration will also be driven by a survival instinct, as libraries find themselves competing with other providers in an information market place. By working together, libraries will be able to leverage off each other to offer extremely powerful services, based on great expertise in finding, defining, managing and delivering information that people want. On the surface, this may not appear to have much to do with preservation, but I believe it will have a profound impact on what we do and how we do it.

While I am going to discuss them separately, I believe we will feel the impact of these changes working together over the next decade or so.

Preservation and Digital Information

On the surface, digital technology appears to offer few preservation problems. Bits and bytes are easy to copy, so there should be no problems in developing an unending chain of copies into the future, and having copies all over the world in case of disaster. However, we already know that the reality is not so simple and that there are very significant technical and management problems. The two main factors leading to inaccessibility of digital information: changing technology platforms and media instability, are relentless, with the potential to render digital information useless. This becomes a critical preservation problem for libraries, because libraries unable to give access to information have no future.

In the past we have understandably, but wrongly, tended to see preservation as what happens after everything else has been sorted out, towards the end of the natural life-cycle of documents, books, photographs and so on. With digital information we cannot afford to build preservation programmes on such an assumption: the inaccessibility factors operate on such a short time span that the problem becomes pressing as well as critical.

This means that preservation functions will have to be much more focused on digital collections than they have been so far. Libraries that have a custodial function will need to bring preservation perspectives to bear on the ways they manage digital information from the beginning.

Preservation Responses

What will we need to do to preserve access to digital information?

One thing we know we have to do is to bring digital information into a safe place where we can manage it and have time to make good decisions about its long-term preservation. The world of changing websites, unstable floppy disks and individual computer systems is not a place where any particular digital resource is secure for very long.

Margaret Phillips, my colleague from the National Library of Australia, will cover much of the territory to do with these highly necessary, preservation-enabling archiving steps for online publications in her paper tomorrow, 'Managing Chaos in the Cyberworld'.

Long-term preservation of digital information across generations of technological change is a daunting challenge. At this stage we still do not know for certain how we will achieve it. There is much research going on at a conceptual level, and some practical experiments underway. There is also a lively debate between proponents of different approaches. As well as an interest in developing standards (which should ease but not solve the preservation problem), and new formats that might not be affected by either technological change or the forces of media deterioration (which seem to be noble but doomed hopes), most attention is being given to two approaches: migration (in which files are copied to new operating systems and converted so they can be accessed in each new technical environment), and emulation (in which files are maintained in their original formats and accessed using emulation software that recreates their original operating environment). At the National Library of Australia we believe we will have to use both approaches, as some resources will migrate to new standards without problems while others will require special software to access them from their original format.

Internationally, there is not much interest in maintaining museums of technology, although we know that we will have to keep some hardware and software in order to maintain accessibility while we are adopting other approaches. For good reasons there is also little faith placed in data recovery as a preservation strategy, although we are using it to good effect on individual items where it is crucial to recover something of the data, even if there is some loss of formatting and other functionality.

The National Library of Australia is very interested in these debates at a conceptual level, and in trying to participate in and contribute to them. But as well as progressing the theoretical debate, we are also committed to making progress with practical things that will be useful for now as well as for the future. We need to take this action so that we don't lose the chance to save what we can now, and so we can influence the discussion in directions that might address our needs. Even when solutions emerge, we will need to decide what is applicable to our situation. To do this we need to be well-informed and aware of what our needs really are, in order to recognise what will work for us and what is actually the solution to someone else's problem.

Those practical things include:

- building the technical infrastructure and procedures for archiving
- establishing mechanisms for recording the metadata we will need so we can manage preservation
- developing persistent naming conventions for digital resources so they remain visible and findable
- moving digital resources from less stable carriers like floppy disks to more stable carriers like CD (knowing that we will have to move from CD within a few years as well)
- identifying formats that we should be able to migrate easily and formats that will cause problems
- setting up registers of existing emulation software that we may need to use
- identifying when we need to take action so that we don't lose access to the digital resources in our collections.

We believe these should all assist us in building pathways from current archiving to long-term preservation.

As we search for these pathways we can see some positive trends emerging that should give us encouragement:

- there is a growing awareness that digital preservation is a critical issue, calling for measures that go beyond immediate archiving
- there are a number of very good projects underway attempting to develop workable approaches and best-practice archiving models. One internationally prominent example is the Reference Model for an Open Archival Information System (OAIS) being developed by the Consultative Committee for Space Data Systems as a new ISO standard. The OAIS provides terminology, conceptual data models, and functional models for open archives that can interoperate. It defines the nature of "information packages" in terms of both their content and what is needed to understand, access and manage the content. The model also tries to describe the processes required for archiving to be successful. This approach is very helpful, and a number of archiving projects are attempting to follow it closely. There are other projects underway, including the National Library of Australia's PANDORA project, that take account of OAIS principles but have charted a more independent course. It is not yet clear whether the OAIS Reference Model will be more usefully viewed as a street directory to be followed exactly, or as a checklist of requirements to be achieved.

- Many digital archiving issues are coming under some kind of control. The position is very promising with software to harvest information from the Internet efficiently and accurately; there are good tools developing for describing digital resources; and storage systems that move data around, perform back-ups and error-checking, and serve files when requested in accordance with a raft of access criteria
- We have seen progress on standards for formats, producing great improvements in interoperability
- There is a real interest in developing tools for emulation of various formats and in making them available
- There is a substantial international effort in researching many aspects of these problems, largely collaborative in nature by institutions and individuals committed to sharing information. The National Library of Australia maintains a special internationally supported subject gateway called PADI (Preserving Access to Digital Information) as an important part of this information sharing.

Despite these positive trends there are also some negative influences tending to push workable answers further away:

- Libraries are moving to service short-term information-access goals. They have to do this to survive. There is a danger of long-term maintenance issues being put aside, (although in some cases this will be entirely appropriate)
- The volume of digital material is growing geometrically, beyond the capacity of our tools, expertise, management structures, and even just numbers of available people to deal with them
- Unsurprisingly (because it is exactly what we have expected), new formats are entering the market and therefore our collecting landscape, that we do not even know how to collect, let alone manage for long-term access
- Intellectual property rights issues are becoming increasingly complex. For preservation purposes these may be relatively straightforward, but we know that preservation will involve copying in some form or other, so even preservation encounters some fundamental ownership rights. As digital publications become more and more a virtual product of layers of software and data from various sources, getting permission for even the most simple preservation copying processes may become an impediment
- We are also going to find it increasingly difficult to carve up our preservation responsibilities along clear lines. In what may turn

out to seem a very 20 century way of looking at the world, we hope to negotiate archiving and preservation responsibilities along the lines of political boundaries. In Australia we look to each of the State libraries to take responsibility for the publishing output of their State; internationally, we say we will take responsibility for the Australian things. And yet Web-based information makes those concepts increasingly difficult to apply: how do we decide the responsibility for sites and publications that are made up of bits and pieces residing on other sites all over the world?

- The research effort that I have already referred to as a very positive trend, has made progress, but often its most obvious output is to show up the difficulties with other people's proposed long-term strategies. To date, there is little sense that the problems of long-term preservation are being reduced by the research.

These trends lead me think that the preservation problems applying to digital information will not be easily solved, but will remain a very significant challenge to libraries for a long time to come. With great optimism, an Australian colleague recently said that the injection of some millions of dollars and dedicated research might make it possible to develop software tools that would solve the preservation problem automatically: a system that would accept digital information resources in one format and automatically convert them to different formats, again and again, without loss. Such tools are some way in the future; even if and when they do appear, they will have to operate in a context of human-driven decisions about what needs to be preserved. It also seems likely that technology will change significantly enough over time to make such tools themselves obsolete.

What are we to do with Our Analogue Collections?

Digital technology is probably not going to reduce the size of our analogue collections in the foreseeable future. While the number of publications existing only in digital form will continue to grow, it also looks likely that libraries, or at least some libraries, will continue to collect growing collections of papers, books, journals, photographs, maps, paintings, films, videos, and all the other non-digital things that go into our collections. Even if these collections did not grow at all, we have our existing large collections of these very physical materials to manage.

We have not found any viable large-scale panaceas for the underlying problem of deterioration: the best we can do is to retard its progress and ameliorate its effects. I need to go back to my earlier description of preservation as a mature, functioning part of libraries. This somewhat complacent comment hides a truth that our analogue collections and our management of them will remain problematical for a long time to come.

As with digital preservation, there are some trends, generally positive, that are worth noting:

- Over the past 30 years various mass deacidification processes for paper collections have looked promising, and a number are in experimental or production use in various countries. Development has often has been constrained by the resources required to do the job safely and well. Overall, mass deacidification has had a reasonably unhappy history, and there are still no processes that have won universal support and acceptance. Because of the substantial investments required, it seems likely that mass deacidification will remain a peripheral possibility for many libraries in our region for some time to come, but it also seems likely to play an important role for our collections in the future, if the resources can be found to pay for it. On the other hand, mass deacidification is no magic bullet-it will not reverse damage that has already happened, and it will require repeated application to intrinsically unstable materials like newsprint
- Perhaps the most promising factor in the long-term preservation of our paper-based collections is the switch to alkaline papermaking that has happened in many countries-for reasons completely unassociated with preservation! As environmental concerns have driven paper manufacturers to change their bleaching and effluent control practices, it has become more economical to change from acidic to alkaline processes. Again, we do not expect this change to solve all our preservation problems but it may mean the worst brittle paper problems are limited to material published between the middle of the 19 and the end of the 20 centuries, and to material such as newspapers. Of course, this is a large enough task, but it looks more achievable than dealing with an unending intake of material on increasingly unstable papers.
- In recent decades there has been a growing acceptance of reformatting as an appropriate preservation tool. It is worth considering the likely contribution of these techniques to preservation in the foreseeable future.

Microfilming and Digital Imaging

I have already mentioned the positive role of preservation microfilming. Given the expected long life of the materials, microfilming is often referred to as a proven preservation technique.

In recent years we have seen improvements in standards, and the widespread filming of materials such as newspapers that have an uncertain future in their original format. With high standards, microfilming can produce copies that divert the pressure of use from fragile originals; if sufficiently well made, those copies can also eventually replace unstable originals that become unusable.

However, it is easier to talk about preservation standards for microfilming than it is to achieve them. I have seen many microfilming projects that failed to deliver preservation goals, for a variety of reasons, including:

- damage caused to the originals in filming
- pages missed in the filming
- illegible film images that could not be used
- the use of unstable base materials like cellulose acetate that become brittle
- the use of camera masters for reference or printing: when they were scratched there was nothing suitable for generating new service copies
- blemishes developing in film because it was not processed or stored properly
- inadvertent filming of material for which there was already suitable microfilm in existence.

In other words, the apparently 'easy preservation option' of the past 30 years demands substantial inputs, significant planning, and a lot of control if it is to achieve its preservation potential.

Apart from those not-insignificant considerations, the main concern that has emerged with microfilming as a preservation strategy in recent years is the reluctance of users to use microfilm. In a service-oriented, client-driven world, this is a powerful difficulty.

The alternative that has encouraged users to speak up and declare their dissatisfaction with microfilm is, of course, digital imaging. From an access point of view, digitisation is streets ahead-and we all know it. Many of us have clung to the idea that we can have the best of all worlds by using microfilm to create a reliable preservation copy that can be safely put away, and digitising to create an acceptable access copy we can make available to users. This was the basic principle behind our largest digital imaging project to date, the Australian Cooperative Digitisation Project 1840-1845, conducted over the past 5 years by the National Library of Australia, the State Library of New South Wales, and the University of

Sydney Libraries. After digitising something like 60,000 microfilm images of mid-19 century Australian serials, we are still uncertain about the viability of this approach.

Microfilming gave us a reliable preservation copy, but it added very substantially to the costs of the project. We also know we will seek to maintain the digital files permanently, so it seems reasonable to ask whether we really need the microfilm copy. We will not know the answer to such a question for some time, at least until we have managed to develop and test the infrastructure and procedures for managing digital files long-term. At least until then we will probably be pleased to have the microfilm.

Does digital imaging itself offer us any preservation answers for the future of our physical, analogue collections? This is a complex question. We need to look for an answer in the preservation pluses and minuses that digitisation can produce.

Digitisation can offer some preservation benefits, but as with microfilming, it is entirely possible for digitisation to happen in ways that give us absolutely no preservation benefits.

There are two main ways in which digital imaging seems to offer potential preservation benefits: in providing preservation replacement copies for unstable originals, and in providing access surrogates that relieve the pressure of access from valuable or fragile originals. In both cases, the benefit depends on achieving suitable image quality (which must be good enough to satisfy most demands for use, now and into the future), and on understanding and acting upon the responsibility to maintain the digital files in an accessible state long-term. These two conditions both require informed, conscious decisions that are reflected in well-controlled specifications, quality control management, and considerable investment of resources.

Digitisation's ability to reduce use pressures on fragile originals is also uncertain. We need always to ask not just whether it can have that effect, but whether or not it *will*. The answer requires some understanding of user behaviour: Internet availability sometimes leads to increased pressure for access to the original.

At the same time, digitisation may present some threats that need to be minimised, such as exposure of vulnerable and valuable originals to high levels of light, heat, and handling; unsympathetic preparation, and unsuitable scanning equipment.

Rather than solving all the preservation problems of our analogue collections, digital imaging appears to offer some benefits but only if we manage it properly to achieve them, and some potential negatives requiring management. Preservation does not come automatically with the digitisation territory, and its net effect is usually to add to the preservation burden when one takes into account the long-term maintenance of both analogue originals and digital copies.

We are convinced that without being firmly managed the technology tends to run ahead of the objectives that should be driving its use. To achieve the positive preservation potential it seems to have, while avoiding the preservation pitfalls, digital imaging must be based on, and surrounded by, very clear and robust policies, procedures, and understandings. As these are put into place, we can expect to see digital imaging playing an increasingly useful-but probably never complete-role in preservation. Digital technology will be a powerful tool but by no means the only one, and by no means a self-driven, self-managed one. Library managers and preservation managers will need to be clever to choose when digitisation is appropriate and cost-effective, and clever to manage it well.

Regardless of its preservation benefits or otherwise, there will undoubtedly be increasing use of digital imaging to enhance access to our collections. It seems likely that there will be a major role for preservation in helping to manage digitisation programmes as part of multi-disciplinary teams required to achieve a range of institutional objectives.

The purpose of this rather lengthy digression on microfilming and digitisation has been to illustrate the view that while there are some encouraging tools, there are no once-and-for-all solutions to the preservation demands of our analogue collections. It looks very much like libraries will have to continue to struggle with their analogue collections and the influences that tend to make them unusable, while also meeting the challenges of preserving digital information in a range of formats. Rather than doing away with the preservation role, this looks like a future with a growing set of preservation needs.

20

Oriented Strategies for Digital Libraries

Introduction

Libraries are information and knowledge service providers. Without service, libraries are indistinguishable from museums. Montanelli and Stenstrom (1999) stated that, "Although technology is a powerful tool, it is people—librarians and staff—who build user–centred libraries." It is the quality of the people who work inside the library that makes the difference between an excellent library (*e.g.* a five–star rated library) and a poor or an average library (*e.g.* a two–star rated library).

According to Sirkin (1993): "The bottom line is that all of the major causes of customer dissatisfaction are strongly linked to human performance. Therefore an organization's staff has the greatest impact on the satisfaction of its customers."

We need to set the focus on the quality and attributes of librarians. The issues that must be decided are what quality attributes are we looking for? How can we maximize the people aspect in this digital era? What are excellent customer service techniques to use for a digital library?

Digital Library Defined

Digital libraries marry the missions, techniques and cultures of physical libraries with the capabilities and cultures of computing and telecommunication, according to Marchionini. Chowdhury and Chowdhury reported that the Digital Library Federation (DLF) defines digital libraries as follows:

Digital libraries are organizations that provide the resources, including the *specialized staff* [emphasis added], to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities.

The word specialized staff was emphasized here. It shows that the success of digital library projects depends on the quality of the specialized staff (the people aspect). The difficulties of assessing the people aspect of digital libraries arise from the complexity of the process involved in building and maintaining a digital library.

Literature Review

Tan and Foo outlined three problems in assessing service quality. The first problem was the intangibility of service, which cannot be displayed, physically demonstrated or illustrated. The second problem was that service performance depends very much on the level of library users' demand. The third problem was the high degree of people involvement, both from librarians and users, in delivering a quality digital library service. Kebede identified shortage of staff, both in quantity and quality, to be one of the main problems for libraries in developing countries.

Gorman found the seven deadly sins of library service that can prevent a library from becoming user–centred to be apathy, brush–off, coldness, condescension, robotic, rulebook, and runaround library staffs. Apathy happens when the library staff lack the interest or enthusiasm or concern to serve customers. Brush–off happens when the library staff refuse to listen to the customers.

Coldness happens when the library staff is neither friendly nor enthusiastic in serving their customers. Condescension happens when the library staff feel superior and look down on the customers. Robotic service happens when the library staff behave without thinking, and lack imagination and creativity. Rulebook service happens when the library staff is dependent on the library rules and less concerned with satisfying customer needs. Runaround happens when the library staff treats users badly by not giving them the help or information the user needs or by deceiving the users.

As Atkins and Stenstrom put it: "The success of the library in meeting user demand for collections rarely depends on organizational structure. The knowledge and skill of the selector rather than organizational structure is key to the development of high–quality user–oriented collections." Tan and Foo showed that reliability was ranked as the most important service dimension, followed by responsiveness, assurance, tangibles and empathy. Fifty percent of the respondents commented on the lack of prompt service, helpful and knowledgeable library staff.

Calvert (1994) analysed the perceptions on New Zealand public library effectiveness. It was found that all librarians, local political councillors and users who participated in this survey agreed that one indicator, namely the helpfulness and courtesy of library staff, determines public library effectiveness. In the same way, sixty–one performance dimensions of public library effectiveness presented by Van House and Childers showed the importance of having educated, responsive, customer–oriented, adequate, helpful, quality and high–morale library staff.

Ahmad Bakeri identified 13 key IT competencies needed for information professionals in Malaysia: IT basics, word processing, electronic mail, Internet and intranet, graphics, presentation and publishing, spreadsheet, project management, design, development, and administration of databases, system maintenance, design and development of application in web, system analysis and programming. All were found to be important, except system maintenance. It is crucial for each librarian to possess strong technical expertise.

Poll used the percentage of staff devoted to IT services as one of the performance indicators for library's electronic services. Poll calculated the number of full time staff members involved in planning, maintaining, providing and developing IT and Web–based services. The calculation also included staff in reference and training. Shahar Banun and Norhayati projected that new criteria for librarians in Malaysian public libraries would be to be webmasters and Internet information managers who are capable of searching, scanning, analysing and compiling selected information according to the library users' needs and capable of creating a special Web directory, hosting it, maintaining it and monitoring it in a way that benefits the library users. The authors further added that the librarians should have strong proficiency in English in order to assist library users in information searching on the Internet.

Fisher studied the impact of information technology on librarians' work tasks. The findings revealed that expertise in computer application ranked as the fifth most cited item in 298 job ads, followed by online searching skills. Knowledge and skills in Web technology were found to be the eighth most important job characteristic. Research by Robinson and Jacobson also supported this idea. The trends focused on a workforce skilled in information technology (IT). Information knowledge management; and database creation and management skills were ranked as most important, followed by Web development, intranet development, extranet development, information storage and information retrieval skills.

Jerabek outlined detailed job descriptions specifically for librarians handling interlibrary loan/document delivery. They were expected to have an operating knowledge of modern information management and technologies. They were expected to implement fully automated library system. They must have experience with computer hardware and software.

Librarians must meet or satisfy customer needs and provide extra services (*i.e.* value–added services) to customers. Hernon and Altman emphasized the following four aspects of service quality in a library: excellence, value, conformance to specifications, and meeting and exceeding the expectations of library users. Meeting the needs of library users is the first step towards providing excellent library services. Devadason and Lingam introduced an information needs identifier (INI) for identifying the information needs of various types of library users. The major steps in the process of identifying information needs were: study of a subject of interest to the organization/client, study of the organization and its environment, study of the immediate environment of the clients, study of the clients, a formal interview, identification and recording of information needs, and analysis and refinement of the identified information needs.

Devette showed how the Cetus Corporation in Emeryville, California was determined to satisfy seventy–five percent of its users' information requests within the subscription budget of $100, 000. This company spent three years collecting the first page of all photocopied materials. This extra copy was placed in a box next to the photocopier. Then the details were keyed into database software which kept track of the usage statistics.

Today's cutting–edge technology paves the way for providing excellent library services to billions of prospective library patrons worldwide without needing to have a huge multi–billion dollar library building and without requiring patrons to physically walk into those buildings. Tilke proposed four possibilities: subscription services on the Internet, library web page, web–based library catalogue, intranet and e-mail.

According to Bryson, there were nine R's in strategies to achieve a customer focus in a library: retention, requirements, refined segmentation, reach, response, relationship, receptiveness, regular consultation, and review. Added value, such as additional advice on the best pages to access and tips on better searching strategies, can help to retain customers. Since different patrons have different information requirements, the best practice is to use tailor–made services to meet their requirements: for example, personalizing the reply e–mail.

Analytical Comments

It is noteworthy that the Digital Library Federation emphasized the importance of having specialized staff for digital library projects. Firstly, the qualifications of the staff are a combination of library skills and information technology skills (or more precisely, digitization of information skills). And secondly, the staff should possess excellent customer service skills (*i.e.* the "people" aspect hidden or latent in the personality of the librarians) to be communicated to the patrons via the Web. We suggest that the IT skills and human skills of a librarian are distinguishable. A librarian may possess plenty of IT skills, but lack human–oriented customer service skills. On the other hand, the reverse might be true as well. The ideal situation would be to have librarians who might be rated "excellent" on both aspects and dimensions.

Such specialized staff differs from those in the traditional physical library setting because in a digital library setting they are also required to have expertise in the digitization process, which includes computer skills and telecommunication skills. At the same time, they must understand what makes information retrieval via the Internet faster and more precise with less connection/connectivity problems. They should be able to predict and provide a quick response to any technical difficulties that may result in the loss of valuable information. They should be able to keep track of the traffic, number of hits, number of web page visits, number of information downloads and feedback by customers. They also should be able to produce daily, weekly and monthly reports of these statistics within minutes, if not seconds.

Information needs vary according to the customer's level of education. It is more difficult to predict information needs in this digital era. It is not easy for librarians to meet and exceed customer expectations with regard to information retrieval. The main problem, as stated by Tan and Foo above, is the intangibility of service. Different people may have different perceptions, expectations and preferences. However, when it comes to library services, they might have one thing in common: the library should be able to provide the information that the patrons need. It does not matter whether the information need is met via the Internet or via the physical library collection or via interlibrary loan. The patrons must get the information they are looking for at minimum cost (to them) and within the shortest possible time.

The existence of a digital library can merely be considered a value–added library service if the digital library content is too basic (*i.e.* too simple or too little); and hence the patrons still need to go to the library physically to meet their information needs. In contrast, a digital library service can become the main library service to the public if all the information is made available and accessible via the Web with extensive hyperlinks to important and pertinent/relevant sites. Customers, regardless of their geographical boundaries, then can access the library's collection by a few simple clicks of a mouse. The second problem mentioned by Tan and Foo regarding providing better digital library service was the level of library user demand. We would consider that the demand for a digital library depends on the availability of a telephone connection, the type of Internet connection and the availability of computers. The monies spent on developing and maintaining a digital library cannot be justified if the benefits cater only to selected urban communities. Librarians and libraries will not be able to enjoy the "economies of scale" benefits (the economics principle/concept which states that firms are able to enjoy lower unit cost through mass production and over the long term) through such a small user community.

The motivation to provide excellent digital library service largely depends on the degree of librarian and user involvement. The digital library project must have strong support from all levels of library management. Substantial budgetary resources must be put aside for developing and maintaining a digital library project. Adequate training must be conducted/carried out to ensure the smooth running of the project. There must be extensive marketing so that the public can be quickly aware of and feel the presence of the digital library. Users can play their role by providing continuous feedback and suggestions, and can indirectly promote the digital library website as well.

Recommendations and Suggestions

The more the staff understands customer preferences, the more a refined segmentation can be achieved. Try to offer different information access and delivery mechanisms, such as networked CD–ROMs, video-conferencing and downloading via the Web, etc. to the customers. Though the digital library may function perfectly, some customers may still prefer to go physically to the library. Therefore, keep the options open for them that will allow them to do so. Ensure that the library catalogue is readily and easily accessible via the Web (not just via the Intranet). Provide more and more value–added services, such as the renewal of borrowed materials, reservation of books, etc., automatically delivering overdue/fine notices, delivering a list of newly added materials (books, print/electronic journals, databases etc.) directly to patrons' emails and conventional postal addresses.

The new material should also be listed under the popular "What's new?" link. Deliver the right message to the right customer at the right time in the most courteous and professional manner. Build strong customer relationships by knowing their details and preferences. Librarians and staff must be receptive to feedback and suggestions from customers. Use newsgroups and online forums to discuss and consult customers. Librarians should also continuously review and improve the digital library system. Last, but not least, remember that digital library technology is there to assist human librarians, not to totally replace them or render them useless. The centre of attention should still remain the same: the client and not the technology.

Qualified library staff coupled with excellent customer service will boost the overall customer satisfaction and confidence in using the digital library. It will make a core contribution towards a higher level of digital library usage among the communities.

Harold Lancour and West African Librarianship

Harold Lancour's monumental report on "Libraries in British West Africa" has had far-reaching consequences. Much has changed in the region in the subsequent thirty years: the colonies he visited have become independent, and their populations have grown enormously. For example Nigeria has grown from 34 million to over 100 million persons. Considerable economic growth has also come to pass, and the library movement has made significant advances. However, some of the problems identified by Lancour still exist. Despite good supplies of natural resources, prosperity has not reached West Africa; societal polarizations remain intractable; various degrees of political turmoil are found throughout the region, with the possible exception of Gambia.

West Africans, Lancour observed, shared with Americans a high value placed upon education. But in terms of libraries, if the 1950's African was fascinated by them, the 1990 counterpart would appear to be largely indifferent to them. And the fascination with European/American culture, which he found to be typical among Africans of the 1950's, is rare today. Yet, all things considered, the tale of West African librarianship since 1958 is largely a success story. Lancour could hardly have imagined that by 1982 there would be 24 university libraries in Nigeria, 29 polytechnic libraries, 28 college of education libraries, 19 public library systems, and 61 special libraries. Holdings are in some cases substantial: public libraries range from 57, 000 to 500, 000 volumes; universities range from 25, 000 to 700, 000 volumes. A directory of libraries in Ghana, published in 1974, comprised 62 pages; it included seven public library systems, 12 academic libraries, and 32 special libraries. In the Gambia there is a national library and an academic library; in Sierra Leone there are three public libraries, 11 academic libraries and 18 special libraries. But it is in library education-the focus of the Lancour report-that progress has been most remarkable.

In the belief that the advancement of libraries depends upon professional leadership, Lancour recommended the creation of a postgraduate programme in librarianship. He pointed to the University College at Ibadan as a suitable home for that programme. And in 1960 that College (now a University) began a training course to prepare candidates for the (British) Library Association registration examinations. This evolved into the Institute of Librarianship in 1963, offering an independent diploma. Not without considerable opposition within Nigeria, this curriculum became a postgraduate Master's programme offered by the Department of Library, Information and Archival Studies. Graduates of Ibadan have played decisive roles in the Nigerian library movement. The requirement of advanced university education for librarians is no longer in dispute.

With that said, it must also be acknowledged that in the face of recent economic hardships library growth has halted, and indeed there is difficulty in sustaining existing libraries in the region. Economic policies, set up in response to the foreign debt problem, have devastated currencies, impoverished most of the educated middle class, and reduced the ordinary populace to a level of near destitution. For many elements of the population, survival needs rank first. In the libraries, there has been a struggle to pay staff in the past few years, and book funds have virtually disappeared.

It may be that the mission of public libraries in such circumstances needs to be reconsidered. I have examined elsewhere the need for African libraries to articulate their purposes, and other writers have written of the need for library service to address the needs of large rural and non-literate segments of African societies. However, it should not be supposed that Africa should ignore the technological advances available to libraries in order to throw all resources into service to the rural population. Africa needs information technology for development; library automation should facilitate access to knowledge that may bring national economies out of their backward, primary-producer stage into healthy modern forms. Both rural and urban populations have a stake in the success of that transformation. The underlying theme of the Lancour report, that librarians should have the most advanced education so that their libraries can keep pace with those in any part of the world, is to be cherished now, in times of recession, as much as it was in periods of growth.

Rural Libraries in Cuba: Experiences in Camaguey

In his *"Recuerdos de mi viaje a Puerto Principe"* [Memoir of my trip to Puerto Principe], published in the Havana journal *La siempreviva*, between 1838 and 1839, Antonio Bachiller y Morales wrote: "I saw a large city, civilized and magnificent in the middle of an island, bordered by arid lands; I saw the second city of my homeland as a mystery in the history of the people." It is interesting to once again read through the memories recorded by the "father of Cuban bibliography, " because, without a doubt, the well–known scholar was trying to bring to life an image of the city and the surrounding land, which he described in minute detail, from the first moment of his arrival, highlighting not only the physical aspects of the area, but also its unique vocabulary and architecture. Historians and specialists on Camaguey agree that Bachiller's descriptions of the interiors of the houses of Puerto Principle are among the best ever written.

Many travellers from distant places passed through the old city of Camaguey years ago on their journeys, and they, too, recorded their impressions, describing the special make–up of a region so different from others on the Island.

Legend has it that the city of Camaguey, whose official name was Puerto Principle, was founded in 1514, although historical sources available today give us a slightly later date, somewhere between the end of June and the beginning of July of the year 1515. For various reasons, in 1516 the city was relocated towards Caonao, on the banks of the river of the same name, and in 1528, it was moved further inland, between the Tinima and Hatibonico Rivers, where it finally remained, definitively established as Villa de Santa Maria del Puerto del Principe, a name which was shortened over time to Puerto Principe. Camaguey, its official name since 1903, is a colonial city that conserves much of the charm of its past, and has gone down in history as a legendary city, birthplace of patriots, and producer of beautiful women.

Within a short time, cattle ranching had become the principal source of wealth in the region. By the beginning of the nineteenth century, with the increase in the production of cattle, and a developing sugar refining industry, Puerto Principe was enjoying a high level of economic growth and prosperity.

By the seventeenth century, Puerto Principe was known as a city with its own unique culture and style. Around 1608, *Espejo de paciencia*, the first work of Cuban literature, was written here. It has been attributed to Silvestre de Balboa Troya y Quesada, a native of the Canary Islands who lived in the city.

The *latifundio* system–in cattle–ranching at first, then in sugar refining–endowed Puerto Principe with a certain cultural profile and a special way of life, typified by a close attachment to the land, and to art and culture in general. These conditions facilitated the creation of special cultural characteristics, such as the use of traditional elements in the city's architecture, and the preservation of Spanish customs, especially those of

Andalucia. The city's celebration of the festival of St. John, which dates from the end of the eighteenth century, marks the end of cattle sales for the year, and has continued to be a part of our traditions today, albeit with profound changes.

Cubans active in intellectual and literary endeavours of the nineteenth century included:

- Francisquito Aguero Velazco, considered to be the first martyr for Cuban independence (1826)
- Gaspar Betancourt Cisneros sponsored railroad construction, and fought for the economic modernization of the area, as well as for improvement in public education
- Ignacio Agra Monte y Lorna, Salvador Cisneros, Bernie Boza, and Eduardo Agramonte, among others, illustrious Camagueyanos outstanding in their fight for independence during the Ten Years' War (1868–1878)
- Gertrudis Gomez de Avellaneda, one of Iberoamerica's most important lyrical voices, whose homeland is reflected in works such as the legend *El aura blanca* and her novel *Sab*.

During the neo–colonial period, certain people and groups attempted to achieve some progress for the region. Among these, the scientific research of Carlos J. Finlay, and the work of Luis Casas Romero as bandleader, composer, and radio pioneer should be mentioned. In the field of fine arts, there was Fidelio Ponce de Leon, symbol of the pictorial avant–garde of Cuba.

The literary culture of the nation has been nourished by Camagueyanos such as Nicolas Guillen, Emilio Ballagas, Felipe Pichardo Moya, and Mariano Brull. During the 1950s, the figure of Rolando T. Escardo created a literary environment which fostered the development of authors like Raul Gonzalez de Cascorro, Luis Suardiaz, and others whose work has enriched Cuban literature.

The triumph of the Cuban Revolution allowed a great enrichment of the nation's culture: the literacy campaign, the preparation of and attention to the amateur sports movement, the consolidation of the system of artistic training—all of these programmes helped to begin to erase the differences between urban and rural areas, and to make cultural activities available to all citizens.

In order to provide this description of Camaguey summarizing the most important historic and social facts about the city from its founding to the present day, I consulted the Cultural Programme of the Biblioteca

Provincial. The province of Camaguey occupies an area of 16, 000 square kilometres, and is home to a population of 781, 815 inhabitants, of whom 595, 393 live in cities, and 196, 422 in rural areas. Following the political and administrative re–districting of the country in 1974, the province of Camaguey was divided into 12 municipalities; the principal cities are Nuevitas, Florida, y Guaimaro. The economy of the region centres around cattle ranching, the generation of electrical power, and sugar production.

Today, the city of Camaguey occupies 70, 500 square kilometres, the largest urban area in the country, after Havana. Its population of nearly 300, 000 is exceeded only by that of Havana and Santiago de Cuba. Historically, as the city kept moving, its area and boundaries kept changing; the present configuration of Camaguey's city boundaries was established only in the middle of the last century. The *tinajon*, a large earthenware jar used for collecting rainwater, is the symbol of Camaguey, an image so deeply rooted in the history and culture of the area that the city is often referred to by its symbol rather than by its geographical name. For this reason, Camaguey is known throughout all of Cuba as the "city of water jars."

The Camaguey area boasts a vigorous education system, with students assigned to particular school centres throughout the province offering varying levels of instruction ranging from elementary grades to high school.

A Brief History of Public Libraries in Camaguey

The province of Camaguey has been known for having libraries since the nineteenth century. The first public library was inaugurated in 1831, under the sponsorship of the *Sociedad Economica de Amigos del Pais*. Other libraries were established during this century as well, although they served the patrons of private schools or educational and recreational societies, rather than the public.

Also worthy of mention is the public library founded at the beginning of the twentieth century by the *Circulo de Trabajadores*, and operated by the workers themselves. They were able to count on support from the government, sporadic though it was, which enabled them to continue providing services up until 1959. Libraries of the upper and middle classes had a better chance of survival, since they served a much smaller circle of patrons.

The March 1950 issue of the *Boletin de la Asociacion Cubana de Bibliotecarios* notes the existence in Camaguey of 18 public and 36 private libraries. With rare exceptions, these libraries performed poorly, and lacked the dynamic character of our modern libraries. In 1959, educational and cultural opportunities opened up for the Cuban people, opportunities accessible to all without regard to sex or race. Along with other basic programmes, the Cuban government successfully oversaw the *Campana de Alfabetizacion*–the campaign for literacy–and in 1961 created the National Library Network, an action which assured the development of libraries in Cuba.

Although a public library was opened in Camaguey in January of 1960, it lacked a sophisticated organization, and there were no qualified professional staff members to maintain its operations. As a result, a short time later, its collections were merged with the holdings of the *Biblioteca Publica "Isabel Esperanza Betancourt"*, located in the Ignacio Agramonte Provincial Museum. These institutions were subjects of risky popular debates, which called for official endorsement of both the library and the museum in order to assure their continued operations at a high level. The Isabel Esperanza Betancourt Library remained in a formative stage until the Cuban Revolution, and opened shortly thereafter, in 1960.

But it was with the opening on June 1, 1963 of the Julio Antonio Mella Library, the very first library established in our province by the National Library Network, that our goal was finally realized of having a truly modern cultural centre to meet the needs which had emerged in a moment of enormous cultural growth.

The Juan Antonio Mella Library has a well–structured and functioning organization, with trained professional staff members who serve the library users at the highest levels, making it an effective institution for raising the cultural level of the community. Beginning in 1963, municipal or town libraries were also established. Camaguey's public library system consists of thirty–one libraries: one provincial, twelve municipal and eighteen branch libraries, with thirteen of the branches located in sugar refineries, and five in communities.

The public library system in Camaguey in rural areas and cattle–ranching communities.

The growth of public libraries in the province can be divided into four basic stages:

1963–1969. During this stage, three libraries were created, including the Biblioteca Provincial, on June 1, 1963; and two others in the towns of Nuevitas and Florida. The *Bibliobus*, or travelling library, was also started that same year.

1970–1977. The province's own socioeconomic and educational development during this period promoted the creation of municipal libraries in Esmeralda and Cespedes, and two branch libraries in Santa Cruz del Sur and Florida. In addition, agreements between the Ministry of Culture and the government office of sugar production fostered the creation of libraries in sugar mills, refineries, and communities near these industries.

1980–1989. This was the period of greatest growth, bringing the number of libraries to twenty, consisting of eight in provincial capital cities, nine branch libraries in areas of sugar production, and three in cattle–ranching districts. For the most part, the libraries located in sugar producing areas were defined as small towns, because of the small number of residents–under 10, 000–and the limited radius of service. Libraries in cattle raising areas were considered strictly rural, with fewer than 2500 residents.

1990–1997. The close of the twentieth century saw the creation of four new libraries: two in cattle areas, two in sugar refining areas.

At the present time, the number of registered library borrowers exceeds 10, 475 in the thirty branch libraries. Some of these libraries are located in remote areas such as Minas, Santa Cruz del Sur and Sierra de Cubitas. However, the library staff, in conjunction with those promoting cultural activities, work together to carry out the mission of a modern–day public library, which is to contribute to the development of the people of a community, and to their sense of identity; as well as to serve as a bridge between accumulated stores of culture and free and open access by the community to information, knowledge, and entertainment.

With the creation of the public library system in our province came an ongoing interest in promoting reading to children and teenagers, and along the way improving the cultural and educational formation of the community in order to forge the ethical characteristics of our nationality.

Figures in the following table summarize the results of these activities to promote reading:

		No. of activities with children	Nos. of participants	No. of activities with teenagers	Nos. of participants
Biblioteca Provincial Provincial Library		1494	12039	400	4417
Bibliotecas municipales	Nuevitas	247	6120	62	1820
	Esmeralda	80	436	43	190
	Florida	190	2637	102	6740
	Guáimaro	113	2691	48	1172
	Céspedes	171	3068	55	1257
Municipal libraries	Sibanicú	393	5979	204	3575
	Jimaguayú	175	2770	78	876
	Najasa	166	2977	36	548
	Minas	193	4428	164	4232
	Sta.Cruz del Sur	255	1619	24	510
	Vertientes	40	1678	8	298
	Sierra de Cubitas	111	7220	75	983
	TOTAL	2134	41623	899	22201

We cannot leave this panorama of the library system without mentioning the attention paid to handicapped people: nine municipal libraries have special areas for the blind and visually handicapped. In addition, libraries provide activities in old age homes, maternity homes, hospitals, and family clinics.

Library service to farm cooperatives, sugar cane factories, and work centres located in rural zones is made possible through the creation of mini–libraries and home–libraries.

By 1999, there had been a sizeable increase in this type of service which offers effective ways to bring books to people who, for various reasons, are not able to use the library, usually because it is too far from their homes. In the first quarter of this year, the number of rural mini–libraries rose to sixty–seven, and rural home–libraries to twenty–six, together offering a total of 879 activities to promote reading.

The *Sistema de Informacion de la Education* of Camaguey province, with which the libraries maintain close and productive working relationships, offers travelling collections which provide service to 317 schools in rural areas without libraries. This service is operated by librarians who transport their collections to these schools, organize activities to promote reading, and insure that local teachers have the resources they need to educate the children. Books and other documents—bibliographical and audiovisual—are deposited in the schools, which become operating libraries. Borrowing is done on a weekly basis. The public libraries support this effort by participating in inter–library loan projects, or through the Library Extension Department, which organizes mini–collections to be used on loan for consultation by teachers and students.

The application of new technology to library operations has placed in the hands of librarians valuable tools which increase information and knowledge. The web page of the provincial library includes a complete directory of the thirty municipal and branch libraries; and at the same time, the libraries are listed on the web pages of the municipal offices of culture, which are periodically updated. The web pages have been received with great enthusiasm by people interested in knowing important events and services of Camaguey's public library system. The local organization of the Cuban Association of Librarians offers summer courses in July and August for library staff, aimed at improving their cultural and professional training. Some of the courses which have been offered include: initiatives to promote reading; public relations and communication; and an origami workshop. This year, a "hands–on" course is being prepared, which will include technical assignments, and a special programme on organizing and administering community projects.

Also worth mentioning are the consulting services–part of an overall community health initiative—offered to the staff of the library network by a specialist in the Children's Division of the Provincial Library on the appropriate application of early childhood bibliotherapy to school—age children who experience behaviour problems as a result of poor parenting. The municipal and branch libraries in Esmeralda have seen satisfactory results in children with respiratory problems using reading and stories as part of their therapy. These results have been presented at scientific and community conferences, as have the efforts of the Children's Division of the Provincial Library, which were noted at the Convention of UNESCO Associated Libraries in Cienfuegos in 1996.

Here Comes the Library!

Our best and most rewarding experience in rural areas has been with the bookmobile, the *Bibliobus*. Those of us who have had the opportunity to work with the *Bibliobus* regard those memories with great respect and admiration. Today, for technical and economic reasons, the *Bibliobus*is used mainly for reaching neighbourhoods on the outskirts of the city of Camaguey; whereas the efforts of municipal and branch libraries, which have been working together for more than thirty years to promote reading, have been focused on the most remote areas of the province of Camaguey.

The Julio Antonio Mella Library's *Bibliobus* began operating in 1963. From the beginning, it offered services to specially selected rural areas on a bi-weekly basis, and the response was so favourable that its route was expanded. When conditions permitted, the *Bibliobus* carried with it photographic exhibits furnished by the provincial office of the *Instituto Cubano de Amistad con los Pueblos*, or documentary films provided by the *Empresa de Cine*, which were shown in schools, grange halls, and small towns. Book borrowing was direct: patrons registered in the *Bibliobus* and were able to take out the books they requested. Children were accompanied either by a teacher or a parent. The bus made 40 official stops along the route, an indication of the extent of the support it offered to the school library system as well. The *Bibliobus* that provided service to the eastern part of the province of Camaguey eventually had more than 3000 members, both children and adults, and made 112 stops on a route which covered more than 60 zones.

By 1971, the mini–libraries had begun to operate. The *Bibliobus* provided service to all those who happened to be situated along its route: it accepted patrons' requests at the stops along the way, and delivered the materials to them on the return trip, two weeks later. In contrast, the collections of the mini–libraries were carefully chosen so that all types of materials were easily and immediately accessible to patrons, and, furthermore, were able to satisfy the specific needs of that patron group.

Clearly, the *Bibliobus* provided services to a very wide public. Its route covered the most remote areas, where people had never before had direct, immediate, tangible access to culture. The arrival of the *Bibliobus* was a great event in the lives of these people. As soon as they caught a glimpse of it, they began to shout, "Here comes the Library! Here comes the Library!" They would line up, and enter the bus in small groups, where they would receive the books they had requested. The excitement which the arrival of the bus brought to life in these distant places was the subject of an article which appeared in *Bohemia*, one of the most important journals published in Cuba.

The study "Dynamics of reading in rural areas of our province, " written by two staff members of the Provincial Library at the end of the 1990s, summarized the work of the *Bibliobus* and its relationship with its registered users, taking into account socio–demographic factors (sex, age, occupation, and level of education) along with the number of visits and number of books borrowed. The hypothesis presented by the authors was that "in rural areas of the province of Camaguey, the greatest number of adult readers would be housewives." In order to examine this hypothesis, 287 registered users, chosen from 10 different rural locales, were interviewed, and other data was assembled based on information from readers' cards, and the type of books borrowed.

The results described in the study regarding the use of the *Bibliobus* and its collections prepared the way for other projects in rural zones administered by the public libraries, which we will mention in a moment. The conclusions of the study showed that *Bibliobus* users included adults between the ages of nineteen and twenty–five, and children between the ages of ten and twelve. Of those who had some years of schooling, most fell into two groups: those in the economically inactive sector, who had completed sixth grade; and those in the economically active sector, who had a basic high school education. Most users were housewives, students, or workers in the cattle industry. Students and housewives accounted for the greatest number of subjects consulted. The most popular subject areas requested were foreign literature, national and social politics, Jose Marti, history, and Latin American and Caribbean literature.

Community Intervention Projects

Community intervention projects, which illustrate the interest in improving the cultural level of people living in rural areas, and in developing good reading habits in children at a very early age, include two studies undertaken by members of the provincial branch of ASCUBI. The National Programme for Reading that is being carried out in Cuba establishes general objectives, one of which is to consciously and creatively include both the community and the family in the activities of the programme. The "Reading for a Better World" project, which has been run by the Municipal Library of Jimaguayu in the Los Dolores neighbourhood since 2001, is the result of a careful study of reading programmes, and is based on the idea that the individual and his community should appropriate the material and spiritual resources of his environment, in order to satisfy his own necessities, interests, and expectations.

The barrio of Los Dolores, a rural area of 896 residents, where the chief economic activity is raising livestock, lies about two kilometres from the town of Jimaguayu. There are no other economic or recreational enterprises anywhere in the area. Because there are no sources of entertainment for the community, the Municipal Library "Gertrudis Gomez de Avellaneda" decided to launch a programme to promote reading among very young children in their spare time, which would be led by a staff member of the library.

To make the "Reading for a Better World" project meaningful, it was necessary to consider different research methods and techniques, so that the people's perception of the quality of the services offered could be evaluated at the end of the project. The project ended up developing joint activities with cultural and health institutions aimed at capturing the interest of three–year–olds: reading activities, traditional games involving literature, and book presentations, etc. This year, the International Festival of the Book, aimed at municipalities, also benefited rural populations.

The National Programme for Reading also showed the high quality of its programming and the possibility of successfully creating a reading audience, by focusing first on young children and teenagers. A staff member of the Municipal Library set up a casa–biblioteca or "home library" in her own house for greater access by readers, with a collection primarily made up of books for children and young people to be used there until such time as another place for reading could be built.

Another community intervention project that focused on housewives had its antecedents in a study of its patrons conducted by the Biblioteca Provincial in 2000, the results of which showed that this social group was poorly represented among those who used the library and its collections. It was decided to investigate two pre–selected and stratified groups in order to learn about their informational, cultural, and thematic interests: first, housewives residing in the historic city centre; and second, housewives who lived in a rural zone on the outskirts of the city, in this case La Belen, a target area in the Programme for Social Prevention that the Library has been developing since 1991.

The results of the survey were important because they revealed not only the interest of the women in learning skills such as decorating, cooking, hairdressing, and handicrafts, and their desire to understand more about family relationships in particular, and human relationships in general, but also the reading preferences of housewives under 65 years old.

With all of this in mind, the programme directors made a careful selection of assignments or activities which would satisfy the expectations and interests of this group of readers. Because of the distance of La Belen from the Provincial Library, a communication strategy was devised to attract this particular patron group, beginning with activities coordinated with a reading initiative. At the present time, the project is in its experimental stage.

Even though we have emphasized the experiences of rural libraries in the province of Camaguey, it is appropriate and important to point out that the National Network of Public Libraries also provides similar experiences for readers in difficult–to–reach areas in the eastern and central parts of the country, as part of the Turquino–Manati Plan. Libraries in Guantanamo, Santiago de Cuba, Granma, Sancti Spiritus, and Villa Clara–all provinces containing mountainous areas–have organized a special programme for the people of the highlands through the creation of municipal libraries, branches, mini–libraries, and centres. In the city of Trinidad in the province of Sancti Spiritus, the bookmobile offers its services in mountainous areas, and in Matanzas special attention is given to the rural locales of Cienaga de Zapata. In other libraries around the country, special programmes are being carried out in logging zones, coffee plantations, and mines.

Although there is more to say on the subject, the short time allotted for the presentation has forced us to summarize both basic and new aspects of rural libraries in Camaguey province. This report, a synopsis of public library development in Camaguey up to the founding of the Biblioteca Provincial, has been preceded by an introduction describing the region from a socio–historical point of view, a necessary preamble to the main topic of discussion. I am grateful to the organizing committee of this event and to the chairmen of these prestigious library organizations for extending an invitation to me, since it has given me the opportunity to exchange experiences and to represent my province at this international conference.

The Pioneers: Asa Don Dickinson

Asa Don Dickinson, an American librarian, served in the University of the Punjab for a year during 1915-1916. He was the third foreign librarian in British India, preceded by John MacFarlane, who served as the librarian of the Imperial Library, Calcutta, from 1903 to 1906; and William A. Borden, who was employed by the Baroda state in 1911. Dickinson's sojourn, however, was in several ways unlike that of his predecessors. Anis Khurshid views this difference as follows:

Some of the developments emanating from British rule were significantly different from the practice then existing in Great Britain itself. For example, the commission of Asa Don Dickinson in 1915 specifically required him to organize a library training class at Punjab University in Lahore. Such training did not exist at all in any British university at that time. The Calcutta University Commission Report (1917-19) stressed the need for the appointing of a trained librarian with the status and rank of a professor at Calcutta University; this practice was uncommon in British universities where preference was given to those with academic qualifications. All writings published in India and Pakistan repeat these facts without explaining why such events did take place. We shall try to look into these events only in relation to Dickinson. Was the British Indian Government involved in the "commission of Asa Don Dickinson" in any way? This is the key question.

The British tradition of placing the library under the charge of a scholar was very much in force at the University of the Punjab. Dr. A. C. Woolner, who was the principal of the University Oriental College (1903-1936), was also working as the honourary university librarian since 1903. His status in the University can be judged from the fact that he later on became the vice-chancellor of the University (1928-1939). It was quite natural that Woolner was managing the library in the traditional British fashion. A change, however, took place in 1910, which laid the foundation of modern librarianship in Indo-Pakistan.

In 1910, Professor James C. R. Ewing, principal of Forman Christian College, Lahore (1888-1918), was appointed as the vice-chancellor of the University of the Punjab (1910-1917). Ewing, an American national, had been educated in the U.S. His appointment was the beginning of the penetration of American influence in the academic aspects of the University of the Punjab. During 1913, Ewing submitted certain proposals to the Syndicate of the University for the improvement of the functioning of the University. One of his suggestions was to recruit "A trained librarian to thoroughly arrange the library and to train a class of young men for such work." The vice-chancellor's suggestions were approved by the Syndicate.

It seems that Ewing prevailed over Woolner and got the position of a temporary university librarian advertised in the United States. The following paragraphs appear in the May 1915 proceedings of the Syndicate.

Library Aid to Developing Countries in Times of Globalization

Globalization is emerging as a major issue in the world today, affecting both "have" and "have-not" countries in many significant ways. In the library world, interactions between libraries in developing countries and organizations assisting libraries are not new: provision of information, resources, and expertise has been ongoing for much of the second half of the last century. Some of the issues raised by renewed concerns about globalization, however, stimulate inquiry into the efforts of developed countries assisting libraries in developing nations. Despite questions being raised in the literature of other disciplines about the impacts of globalization, it appears that very little research has appeared in the library literature that examines the impact of this phenomenon on the practice of library aid.

The concept of "globalization" carries considerable political baggage: whether one views the term positively or negatively depends on one's social and economic view of the world. For Held and McGrew, globalization is a "re-articulation of international space, in which the notions of sovereignty and democracy are being prised away from the traditional rootedness in the national community and the territorially bounded nation-state." North American information-related companies view this "re-articulation" as an opportunity to expand their customer base into developing countries with technology-driven products, and most articles on globalization reflect this commercially-oriented, North American focus. Peter Evans, in "Trends, Pressures, and Realities in the Library Systems Marketplace, " speaks of the need for LIS companies to develop a different "corporate, cultural, and design philosophy" so they can compete and survive in countries with different languages and cultures.

David Dorman, in "Taking Library Services around the World, " reports on library service companies such as OCLC, Blackwell, and EBSCO, whose globalization strategies are designed to increase their share of the international customer marketplace and place their products in developing countries. Some librarians note that globalization can be a "very positive force for cultural and social and economic development…provid[ing] the opportunity for a much greater understanding and interaction among the various peoples of the world." But this view, also expressed by Dorman, relates primarily to the opportunities and advantages realized by North

American libraries whose access to information becomes more global as national barriers fall.

David Korten, former faculty member at the Harvard Business School, expresses a more pessimistic view of globalization. He gives evidence of increasing social and environmental disintegration in developing countries, and documents the negative human and environmental consequences of the successful efforts of international corporations to reconstruct values and institutions in developing countries to serve the company's own narrow ends. According to Korten, the convergence of ideological, political, and technological forces behind this process of economic globalization shifts power away from the local governments who should be responsible for the public good (including funding for libraries) and shifts that power toward a handful of corporations and financial institutions driven by the quest for short-term financial gain. A negative view of globalization is also voiced by Alan Scott, who notes that increasing cross-national flows of information tend to make "nations, nationality, and national boundaries less important to people's lives, " resulting in a loss of local identity, control, and responsibility.

This review of literature pertaining to library aid and globalization was prompted by the authors' vacation visits to libraries in various countries, conversations with librarians in developing countries about the "double-edged sword" of donations, and by the authors' admiration for those librarians who continue to deliver very important services in developing countries despite limited resources. The review will focus on two questions: what are the major needs of libraries in the developing countries? And, what are some of the ways those needs are – or are not – being met? Despite anecdotal evidence gathered by the authors during visits to developing countries that globalization has affected the type of library aid now needed, no research could be found that linked these two phenomena. It is the contention of the authors, however, that lessons learned from the existing research about more traditional "book" aid remain very relevant to library aid relationships affected by globalization, and that these lessons should be used as the basis for further research that incorporates this new phenomenon of internationalization.

The phrases "Third World" and "developing countries" are essentially Western in origin and use; they are used to describe less affluent countries in Latin America, the Caribbean, the Middle East, Africa, Asia, and the Pacific. These descriptions are considered to be ethnocentric by most outside the Western world who do not characterize themselves in this way, nor divide the world into two camps – developed and developing. However, in the context of the literature to be discussed, these terms will be used as they are in the literature. "The phrases 'Third World' and 'developing countries' are essentially Western in origin and use; they are used to describe less affluent countries in Latin America, the Caribbean, the Middle East, Africa, Asia, and the Pacific."

Because a wide diversity of political, economic, cultural, historical, and geographic factors affect libraries in different countries, it is impossible for a single document, or even a suite of documents describing specific needs, to serve as a detailed blueprint for all. As a result, the literature chosen for Part One of this review was selected for its ability to provide general overviews of library needs in developing countries. Essays and books are included that provide a philosophical overview of issues and attitudes for both "givers" and "receivers, " an understanding of which is essential in developing successful programmes. Although published in 1966, Lester Asheim's classic, Librarianship in Developing Countries, remains an excellent explanation of the philosophical underpinnings of culture and libraries, knowledge of which is central to developing successful aid programmes. Asheim's book will form the starting point for Part One of the review.

In Part Two, the focus is on articles that describe an array of different programmes that have assisted Third World countries with library development. There are many different past and present aid programmes to libraries all over the world; it is impossible to review all of them. Therefore, we have selected articles that represent both positive and negative examples of different types of projects, while also highlighting a variety of donor and recipient countries.

One further point regarding literature selected: not surprisingly, much of the literature written in recent years about both the needs of libraries in developing countries and the projects in place concerns technology. While not discounting the importance of technology in this field, we have chosen to focus our attention upon more traditional areas of need, such as collection development and preservation, literacy, indigenous book publishing, and staff training initiatives. Despite the attention being diverted to automating and connecting libraries in both developed and developing countries, traditional areas of need still exist and, perhaps, are in danger of being overshadowed. As Lucinda Zoe explains in her thesis on women's information centres in developing countries:

> *While library scientists and information specialists praise the abilities of the new technologies developed for information management – computerized online catalogues, commercial online database services, CD-ROMs, laser printers, FAX*

machines, and electronic networking to name a few – the small information centres in the developing nations of Asia, Africa, and Latin America struggle with fugitive materials that do into fit neatly into traditional classification schemes. … Furthermore, however impressive the new information technologies and communication systems appear, use is difficult, if not impossible in areas where the infrastructure is not solid: the telephone system is unreliable or erratic; power supplies are often interrupted or non-existent for days, if not weeks; equipment, maintenance costs and access to continued materials (disks, paper, ribbons, etc.) are beyond the financial resources of organizations; and privacy, confidentiality, and protection of information is difficult…

Library Needs in Developing Countries

Asheim Still Relevant

Lester Asheim wrote his brief but compelling book, quoted from below, after he spent five years (1961-1966) visiting libraries in Africa, Latin America and Asia as Director of the American Library Association International Relations Office. The quotation provides his basic premise for appropriately serving the cause of librarianship around the world. Although written nearly four decades ago, many of Asheim's observations about library operations in North America and developing countries still hold true, but his opinions must, of course, be taken in the context of the times – the early 1960s. You may remember that I began with a reference to Culture Shock, which I said occurred whenever the system of logic in which we believe is challenged by a logical system to which we do not yet possess the key. It is not the other system that must be corrected, but the absence of the key. There are usually reasons for what people do, even if they are not our reasons. Before we condemn out of hand a pattern of behaviour which happens not to fit our preconceptions, we should try to find out what the reasons were that led to it. We may still not accept the reasons as valid for us, but we may discover a different context of validity for evaluating the behaviour pattern and its use by others.

Lester Asheim, Librarianship in Developing Countries

Closed shelves, lack of extensive reference or circulating services, differing or absence of classification schemes, limited children's service and, above all, an emphasis on the primacy of the book over the reader are characteristics of Third World libraries as observed by Asheim. These characteristics are still prevalent today.

In his book, Asheim looks for the "key" he mentions above. He describes how economics, education, societal structure, attitudes towards authority, the impact of colonization and its (supposed) overthrow, the predominance of the English language worldwide, religious beliefs, attitude towards work, low prestige assigned to librarianship, and even climate have affected the development of libraries in these countries, and have resulted in libraries which, to Western standards, may appear to be below the mark. Asheim urges us, however, to avoid making that evaluation because:

> *... the difference between two concepts of a service, an objective, or a procedure can be measured by the gap that exists between what each faction sees as the essentials. The essentials are determined by the goals each side wishes to attain, whether overtly stated or not. And the goals reflect the system of values each party holds, determined by its history, its tradition, its culture. We are as much victims of our heredity and environment as they are of theirs...*

Despite the "chasm" between cultures Asheim describes, he believes librarians can establish bridges. According to Asheim, the first question to answer is the hardest: "Does anyone really want the help we offer?" To provide background for one's decision, Asheim then discusses many of the negative ways that Americans and Europeans have used libraries as propaganda agencies for political reasons (for example, donating books reflecting an anti-communism ideology) that in some cases led to the retardation of local development, an opinion shared by others: "[In the past,] … the establishment, growth and decline of donation programmes were more closely related to changing American foreign policy objectives than to the success or failure of… [the programmes themselves]." Despite possible negative elements, Asheim concludes that six characteristics of American librarianship are worthy of export:

1. the conception of the library as an organization of books,
2. the evolution of a library profession,
3. the attitude of service,
4. the function of the library as an education institution,
5. the role of the library in the advancement of intellectual freedom, and
6. the conception of organized information as a public resource and responsibility.

Simply put, aid programmes that support one or more of these functions and have the support and cooperation of local authorities are desirable. Attitude is everything, according to Asheim: "…we must begin to see ourselves as an equal partner in an exchange rather than as a condescending Lady Bountiful. We must... develop an Ear of America as well as a Voice. We must listen as well as tell, learn as well as teach, receive as well as give." To further this interactive rather than autocratic viewpoint, Asheim favours programmes that acknowledge the need "…to adapt rather than to adopt the methods and procedures that we happen to favour for our own purposes." Finally, quoting "an old India hand" [Ranganathan], Asheim encourages those wishing to advance librarianship in developing countries – "a daunting task" – to substitute the word "problem" with "opportunity."

"Despite the 'chasm' between cultures Asheim describes, he believes librarians can establish bridges."

Donor Objectives

A thorough search for reports or theses reporting research results focused specifically on library aid revealed little scholarship in this area. The research of Jesus Lau, however, provides excellent information necessary for understanding the economic and political complexity of well-intentioned but sometimes ill-advised donor objectives. His assessment of the relationship between information growth and social development in 31 countries from 1960 to 1977 revealed that the information gap between developing and highly developed countries is widening faster than the social gap (life expectancy, food consumption). His results also suggested that increased information development as shown through library indicators is associated with positive change in social development.

D.E.K. Wijasuriya, International Federation of Library Associations (IFLA) Representative for Asia and Oceania in the 1990s, echoes Asheim's and Lau's recommendations in a framework for development adopted by IFLA and described in "The Advancement of Librarianship (ALP): IFLA's Core Programme Orientation to the Third World." Much of this document concentrates on facts about developing countries, terms of reference, and time tables, but the author also outlines general objectives and programme areas:

> *The main objectives of the ALP Core Programme are to contribute, within the framework of IFLA's programme structure, to the progressive improvement of library and information services within the developing countries so as to enable them to contribute significantly to national development. At the same time, programme objectives shall place special emphasis on the creation of conditions likely to contribute towards national initiatives and a systematic progression towards self-sufficiency.*

Wijasuriya acknowledges that the advancement of librarianship (ALP) "can be conceived in the most infinite terms, " but maintains that for practical purposes, the primary goals in 1990 were:

1. the establishment and development of public library systems with particular attention to the needs of rural and urban marginal areas,
2. greater identification of libraries with literacy programmes, and
3. greater attention to education and training.

According to Irene Norlund, Scandinavian aid agencies (SIDA, NORAD and DANIDA) have specified support of culture through library/archival aid as a primary objective since the early 1980s. In "Culture and Institution-building, " Norlund outlines both the problems and benefits of aid programmes designed to support cultural heritage. Major obstacles include the reticence of aid organizations to support such programmes, combined with the ambiguous attitude to cultural aid funds held by governments in some recipient countries, who may favour programmes that show a direct economic benefit. She promotes providing assistance to 1) set up new archives and libraries, 2) collect and organize documents, and 3) train librarians to maintain access to historical materials as the key components in preserving of indigenous cultures. "Support to culture will also lead to the building up of enriched and renewed institutions and by that means increased capacity, " observes Norlund.

The fragile nature of important cultural and religious documents in developing countries makes more compelling the need for collection and preservation. Many are held in private collections and religious temples or monasteries, where maintenance is not secure. "There is limited time to save these irreplaceable heritages, which are a key both to enlarging knowledge and self-confidence and to building institutions which can link up to the world at large, " concludes Norlund.

Carolina L. Afan, Library Director-Cultural Centre of the Philippines, agrees with Norlund's point of view about the importance of preservation, but from the perspective of an aid recipient, not a donor. She sees a need for support beyond written forms of communication: "The librarian and other cultural workers should have the skills and knowledge in documenting prints, tapes, photographs, films, videos and others." Expertise in preservation regarding these different media is necessary as audiotape, video, film, etc. are more "natural" media for oral cultures to record their stories, history, etc., rather than in the Western tradition of print. Afan speaks strongly and persuasively in favour of repatriating rare historical and cultural materials that are in European and American archives since "colonizers had their share in looting and taking away the resources of their former colonies." In the same vein, she cautions her colleagues:

> *[Developing] countries should guard against the intellectual and cultural exploitation being done by some foreigners who in the guise of doing research are actually taking advantage of our natural and human resources for their own use and interest. Cultural agreements, donor contracts and exchanges should be carefully studied and analysed before going into them. Any agreement should benefit both countries and must not be a one-sided affair.*

Other librarians and educators have voiced the same concern – that aid to libraries not be a form of "neocolonialism…to perpetuate cultural and economic dependency" on donor countries. Mary Niles-Maack believes that donors' goals must be examined closely: initiatives based on the aim of spreading Western culture have caused "intellectual consequences" for developing countries, as a dependence on foreign books prevents the promotion of local publishing initiatives. As well, donor objectives may be tied to larger global alliances – for political and strategic reasons the donor country may want to strengthen ties with the recipient country. Afan concludes her report by noting that the central government of the Philippines has embarked on a decentralization process for both cultural centres and libraries, which she describes as "the democratization of access to libraries and other learning centres, insuring the provinces and regions that their cultural treasures will be left to them to be utilized, conserved and appreciated."

Rosario Gassol de Horowitz also writes about donor objectives from "a Third World perspective" (the sub-title of her book *Librarianship*). Like Asheim, she observes that library development has taken place from "the Anglo-Saxon tradition" and has been "propagated, consciously or unconsciously, by Western librarians travelling abroad on consultant missions and through library literature, much of which has been produced in the United States." Paraphrasing Ivan Illich, she states that "the nations of the West are packaging their services to contain their views of the world." Rather than rejecting the contributions of the West, Horowitz (in terms she herself identifies as more closely related to liberation than development), calls instead for innovative leadership from librarians in developed countries and an enhanced communication process to assist those countries in breaking free from their inherited mantle of dependency and oppression. "The new orientations confirm the calls for a new type of professional and for a bold and non-traditional library service which cuts across the compartmentalization imposed by tradition and organizations, to meet the circumstances and conditions in which people find themselves." She urges that isolated library workers in developing countries seek support through strengthened ties with other workers throughout the country—as well as the continent—by creating active and cohesive professional associations.

Language Challenges

Language issues are problematic for many developing countries—as well as for donor agencies. In *The Bookseller* (11 April 1997), Caroline Horn notes that South Africa and Ethiopia each have eleven language groups, and she identifies language as a prominent concern for library/literacy projects in these countries and others. Her article also supports the fact, often mentioned in the literature, that libraries are foreign to the way of life for many traditional, oral societies in Africa. As a consequence, governments may be unaware of the purpose and benefits of libraries and reluctant to support them financially.

The issue of language and library development also surfaces in Asian countries where oral traditions have predominated. From a Malaysian perspective, Diljit Singh notes that the "...reading habit is still not fully ingrained in the Malaysian public." He attributes this partially to the fact that Malaysians (East and West) speak many different dialects, creating difficulties for library clients seeking service and materials in their local language. This problem highlights the need for support of local publishing initiatives so people can have access to literacy programmes and to relevant materials in local libraries and bookstores-in their own language.

Need for a Cooperative Approach

With its long history of apartheid, South Africa serves as an interesting example of "have" and "have-not" communities within one country. *The Use of Libraries for the Development of South Africa; Final Report on an Investigation for the South African Institute of Librarianship and Information Science* proposes a plan for development consistent with the views expressed by Asheim. The report states: "Librarians should familiarize themselves with the psychology and the sociology of the underdeveloped. In particular they should not expect persons bred in the culture of the subordinate to act according to the cultural and psychological patterns of the dominant."

The report is also reminiscent of Asheim's observations regarding assumptions about the "apathy of the underdeveloped, " a phenomenon that Zaaiman describes as a psychological state induced by subordination and a dependence on "the dominant group" as well as the overwhelming battery of problems that disadvantaged individuals face. Skepticism on the part of recipients and frustration and discouragement on the part of librarians from donor countries can result. This report says that a cooperative approach to development is absolutely necessary to counteract creation of a cycle of apathy and donor disappointment:

> *Developing communities should always be fully involved in the planning, development and execution of development projects that concern them... Community involvement means exploring the people's basic needs with them, and designing and developing methods with them to fulfil those needs. It should be remembered that the underdeveloped cannot relate to a concept such as "libraries" of which they have had no experience... Key groups of opinion makers within the developing community should be identified and their views and approval sought at all stages of the investigation, design and implementation of library services... Librarians, should, however, guard against the danger of accepting the views of elites in developing communities as representative of all the needs of that community.*

One of the strongest supporters of this cooperative approach is Carol Mills, librarian from the University of the South Pacific in Fiji. In "Aid for Libraries: Should One Look the Proverbial Gift Horse in the Mouth?" she criticizes blanket donations given without prior collection management assessment work done by recipients, saying that this lack of joint responsibility institutionalizes aid and causes an "aid dependent mentality."

Special Needs of University/Research Libraries

In her article "Filling Bare Shelves, " Carolyn Sharples laments the fact that as aid organizations and governments of developing nations have focused on literacy and books for children, academic institutions have suffered. Cancellation of journal subscriptions has been common as prices have increased, mostly in the area of medicine. Specifically, she notes that books on "tropical medicine, primary health care, women in development, and intermediate technology are…priorities" for her agency, Book Aid International.

Sharples also discusses the difficulties that academic librarians in developing countries encounter when they try to obtain information about newly published material. It is a "Catch 22" situation if library staff are expected to indicate what they need when they do not know what is available. This situation makes bibliographic and selection tools high on the list of desirable materials.

These concerns are reinforced by Yogendra P. Dubey, Professor in Library and Information Science at Banaras Hindu University in India, who describes in his 1986 conference presentation the problems that Indian librarians encounter when they try to meet professors' and scientists' demands for scientific and technological information. Although widespread use of the Internet now makes some of Dubey's observations about information needs outdated, many of the problems he mentions still exist in academic libraries.

These include heavy reliance by developing countries on scientific books and journals from the West, in the absence of "home-grown" publishing; supply and currency problems; high prices for subscriptions; copyright restrictions that limit the free-flow of information; constraints of multiple indigenous languages; educational systems that foster rote learning and do not promote individual research; low demand for library services due in part to lack of awareness of their role; and passive attitudes of librarians.

Dubey confirms Asheim's observation that when resources are very scarce, service may not be a priority, and "the book" is more important than the person: "they [librarians] are more product than service oriented, *i.e.*, more toward production of bibliographies, catalogues, etc. than toward services directly oriented to users (such as question-answering)." He concludes with a recommended strategy to alleviate these problems that will result in the development of information distribution industries (publishing, libraries, scientific and technical services), knowledge production industries (research and development, education) and information technology industries.

Importance of Local Publishing

Mills and Priestley both emphasize the key role played by aid or assistance to support indigenous publishing: they maintain that such help is essential if developing nations are to gain true autonomy and supply relevant materials to their citizens. Priestley breaks down the book needs of Third World African countries into six categories: capital funding; the need for textbooks to support education; distribution and marketing knowledge; paper; the need for local language translation, co-publishing, and licensing; and training. Her support for local publishing is strong, but she cautions that poverty and inexperience may be the catalysts for corruption within projects: misappropriation of paper stock and "mismanagement by cumbersome, bureaucratic procedures and unqualified officials" are often significant issues to consider. She concludes that for local publishing to succeed, business management training in areas specific to publishing is crucial, to ensure that grant monies are better managed, overhead costs are considered, and marketing plans are developed. Donor countries need to shift from facilitating the dumping of unwanted materials, such as surplus print runs, to supporting indigenous publishing.

Specific Aid Projects

Research Reports

Investigations on the efficacy of library aid projects in specific countries or to particular institutions appear to be very scarce: no research case studies or analyses were located. However, studies that focus generally on library services in one developing country or to one client group in such countries provide informative contextual background. The most relevant research projects that discuss some aspect of library aid are those of Al-Hanari, Bouri, Stander, Floren-Romero, and Zoe.

Abdulaziz Mohamed Al-Hanari's Ph.D. survey research revealed the important roles that national libraries play in developing countries, and resulted in a list of recommended functions for a proposed Saudi Arabian national library. Elizabeth Bouri examined Egyptian public library development in her doctoral research, revealing the positive influence of international agencies such as UNESCO in the 1960s and subsequent public policy choices of the Egyptian government that led to the decline of public libraries.

How to formulate standards and guidelines for school libraries in developing countries was the central question in Cecilia Stander's research, based in South Africa. Stander concluded that basic school library principles can be applied, but that the diverse perspectives of users make adherence to universal standards problematic. Two theses focused on information needs/services of special groups within developing countries: Maria Floren-Romero examined the difficulties that pharmaceutical researchers in the Dominican Republic encounter when trying to obtain information, and their reliance on colleagues' resources outside the Republic, while Lucinda Zoe explored the growth of women's information centres in developing countries – their relationship with and reliance on the international library community.

Book Donations, Publishing and Distributing

In many cases in the past hundred years, libraries and publishing companies shipped off surplus materials to well-intentioned organizations that "dumped" those items in developing countries, notably those in Africa. As described by Mills:

> *First came the missionaries who propagated their faith by direct action, religious and social; their return being souls and the pacification of the area. In more recent times, governments have largely replaced the churches, aiming to spread the word of their friendly intentions. At times, aid to libraries has had little to distinguish it from the 19th century 'books for heathens' syndrome.*

Donors paid little attention to the language, currency, or context of the material, and the recipient countries were rarely, if ever, able to choose their own books. And even if the recipients could choose, they had little knowledge of what to request. In her article for *The Bookseller*, Seaton gives a list of "unhelpful books donated" to Book Aid International's Africa book drive, which includes the *AA Road Map of Bristol*, and *The Garth Brooks Scrapbook*. This problem of inappropriate giving is frequently noted in both research articles and opinion pieces on library aid, with poor communication between donor and recipient cited as the primary cause.

According to Margaret Bywater, libraries in Cambodia receive some material from overseas that is useful, but they have also received material "which is totally irrelevant to [their] needs now or in the future." Filling library shelves with this irrelevant material discourages rather than encourages use, thereby thwarting the donors' intentions. As an alternative, Bywater recommends the donors consider giving monetary grants that allow staff in libraries to select their own books: this will ensure relevancy and support local publishing.

Carolyn Sharples agrees with Bywater regarding "problem" donations and the need to support local publishers. She notes that since 1990, Book Aid International (BAI) has been "refining [their] work to become far more targeted and responsive to the needs of partners overseas." This resulted in project development that specifically targets subject areas where materials are scarce. One project – BAI's Africa Book Collective – purchases African books published locally and then distributes those materials throughout the region, thereby helping to establish a local book market. Sharples acknowledges, however, that despite the increasing output of small local publishers, sufficient "suitable" material is difficult to find, especially children's books, which are in high demand.

"Bywater recommends the donors consider giving monetary grants that allow staff in libraries to select their own books; this will ensure relevancy and support local publishing."

E.A. Mwinyimvua of the Tanzania Library Services Board also discusses the measures that Book Aid International has taken in his country to provide suitable books, promote local book production, and ease the administrative burden on recipients.

Three members representing recipient libraries now sit on the BAI Council, facilitating information flow and influencing policy regarding donations to Tanzania and other African nations. As well, all recipients fill out detailed evaluation forms each year, which enables BAI to select books according to library requirements. BAI also invites librarians from recipient countries to spend three months at BAI Headquarters in England selecting books. To stimulate local book production, BAI provides funds for Tanzanian librarians to purchase books published in other African countries. Mwinyimvua believes that Tanzania will continue to need book aid for many years as currency devaluations make purchase of expensive foreign books even more difficult and as rising literacy rates cause demand for books to outstrip the supply, even with increased local publishing efforts.

The IFLA/UNESCO "Books for All" initiative is another international library project. As project coordinator Lioba Betten explains in "Foreign Aid for Children's Libraries: 25 Years, " its aim is to fight illiteracy through providing children in developing countries with books. Betten notes that Books for All seeks to provide long-term aid to libraries and to local booksellers, authors, and publishers by purchasing books in local languages.

Caroline Horn also is critical of those overseas publishers who donate irrelevant materials and encourage "librarians in developing nations to send their orders outside the country." Speaking specifically of African aid projects, she reports that in Senegal "some 80% of books are imported, but are too expensive for the indigenous population. Once students leave school, they are unlikely to pick up a book again." Local efforts are the best means to ensure literacy and relevancy. In her opinion, "book aid programmes can, where properly targeted, help to overcome some of the shortages [of materials], but while libraries remain dependent on aid they are not supporting local publishing initiatives."

S.M. Made, speaking of African aid projects in the early 1980s and Zimbabwe in particular, notes that "low literacy and purchasing power and high unit costs necessitate small editions [of locally produced material], which in turn necessitate small markets and limited distribution." Local printers in developing countries may lack the capital required to purchase paper stock, which often needs to be paid for in advance. Made adds that various local languages and dialects can pose challenges as they may not translate well into the Latin alphabet required for printing. Aid organizations may assist local publishers to solve these problems by encouraging and funding regional associations or consortia of publishers: combined purchasing power to buy bulk paper stock and combined expertise may help to overcome difficulties.

Carol Mills from Fiji is one of the few voices in the literature with a "recipient" perspective. She examines the reasons why developing countries in the South Pacific are not getting what they need from donors:

> *Donor agencies tend not to set explicit targets, fail to evaluate their donations, and do not properly manage their aid. Books sent at cost may simply sit there if they are not appropriate, making the uninformed donor feel good while creating a burden for the recipient. Sometimes the recipient accepts simply to avoid giving offence and to keep communications open, or else accepts donations with a peripheral value because they are better than nothing.*

Mills' comment is crucial to understanding the complexity of library aid in specific countries because her words concern the power relationship that exists with donor/recipient relationships. Many recipient libraries and information centres are reluctant to express their needs firmly for fear of being cut off entirely. This fear, in turn, is reflected in the collections, as it causes library staff in developing countries to be hesitant about weeding irrelevant material. They do not wish to offend donors by throwing out "gifts" and they are anxious that little would remain in their library if they culled all irrelevant material– collection "starvation rather than poverty." As Margaret Bywater notes in her article on Cambodia: "[there is] a reluctance to dispose of anything... because people still feel strongly the loss of personal possessions during the Pol Pot period." Peter Brush, a consultant at the National Polytechnic Institute in Laos, also writes about the reluctance to weed. He observed that many titles in the Laotian collection were in foreign languages—Russian, English, French and Vietnamese—which presented a cataloguing dilemma because no translation services were available. The library could offer little material in Lao, as Laos has a small population and a very small publishing industry. The Institute had no collection development (or weeding) policy, and the Institute Director was reluctant to dispose of any books, even those outdated, irrelevant, and uncataloged because all had been donated.

Scandinavian countries have a laudable history of providing aid to libraries and other cultural institutions in developing countries. This support is documented in a 1995 issue of Scandinavian Public Library Quarterly that focused entirely on Nordic aid initiatives. The articles report on the purpose and progress of projects in Tanzania, Kenya, Uganda, Botswana, South Africa, Nicaragua, Vietnam, Laos, and Cuba. A typical project is one focused on Africa and funded by SIDA, the Swedish International Development Authority:

> *The SIDA project "Words-Books-Democracy" is one example of an attempt to get a holistic perspective within the literature area. The objective is to create and maintain a literate and reading environment and to protect freedom of expression. This requires access to books, newspapers, magazines and so on. The development cooperation shall strengthen the documentation of oral storytelling traditions, author organisations, independent indigenous publishing, the printing industry, distribution channels, libraries, and so on—all links in the complete chain.*

An annotated list of current and recently completed library aid projects where Nordic funders are involved concludes the issue. Children's books are in great demand in most developing countries, particularly in Africa, but the cost of a book, even one locally published, is beyond the price range for most people. Rebecca Knuth in an *IFLA Journal* article revealed how five international organizations are seeking to redress this situation. An innovative joint project by the International Board on Books for Young People (IBBY) and UNESCO involved the production of 2000 kangas (Kenyan cloth pieces used as clothing or baby carriers) that were "imprinted with words and pictures as a child's first text book." In another project, the International Youth Library (IYL) supported "cross national publication and translation" of books from Africa and Europe, while the IASL (International Association of School Librarianship) and UNESCO cooperated to provide books for school libraries that focus on "local needs" in their collections. Citing a UNESCO project in Croatia as an example, Knuth stresses the special need for children's libraries in war-torn or famine-stricken countries as these libraries help refugee children who are "coping with stress and trauma."

Carol Mills provides the best overall assessment of different aid programmes, based on her experience at the University of the South Pacific (Fiji) where donations form the basis of the collection. Her evaluation includes the book aid models of 1) clearinghouses, 2) twinning (mentor/sister-city programmes) relationships, 3) interest groups, and 4) unsolicited donations. She concludes that clearinghouses have varying degrees of success, providing "unbalanced donations of discarded surplus materials, " and indeed may impose a burden beyond useless books, as recipients may have to pay some or all of the freight costs in shipping materials. She is more supportive of twinning relationships because of the personal element involved, but cautions that these arrangements often cannot be sustained.

Academic Libraries and Archives

Academic libraries and archives in developing countries have garnered less attention in the past decades as aid organizations focused on literacy and books for children; however, several important initiatives are mentioned in the literature.

The International Campus Book Link Project (ICBL) was created in 1992 by Book Aid International to support African university libraries through donations of current and back issues of academic journals, particularly in the area of medicine where the shortage is acute. In describing this project, Sharples notes that journals are particularly difficult materials to supply because of sustainability problems: many aid programmes are short term—three years at the most—and are dependent on fluctuating donations from institutions, not an ideal way to build a journal collection.

The Overseas Library Committee at the University of Calgary, Alberta was very active in the 1980s and early 1990s coordinating shipments of donated materials. As detailed in the *Canadian Library Journal* by King and Matheson, volunteer librarians gathered, sorted, boxed, and shipped scholarly and professional books and journals to universities, colleges and research corporations in China, Central America, Yemen, Bhutan, the West Indies and Africa.

These volunteers clearly recognized the importance of communication between donor and recipient institutions. In this case, as in others identified in the literature, the motivating force for the volunteer librarians was a "feeling of professional solidarity, such as from one library to another." Books were not sent "on spec" to libraries in developing countries. Instead, "inventory lists of donated materials [were] maintained and circulated to interested libraries, where selections were made by librarians. Only those items selected from the inventory list were sent." The project relied on the generosity of the Calgary corporate community, which provided free storage and sorting space, and arranged for free shipping of boxes. However, an economic downturn in the 1990s jeopardized corporate sponsorship, resulting in cancellation of the project.

Jan Lyall focuses on the preservation crisis in research archives and libraries in her *IFLA Journal* article. She cites the need for funding projects to preserve the audiotape and film that historians used to record the oral traditions of many South Pacific nations. Given the general lack of written cultures in this area, these media were very appropriate for information gathering, but their short life span in a tropical climate makes them an archival/library nightmare. Palm leaf manuscripts are another medium of concern in Southeast Asian countries: the leaves themselves are disintegrating, along with the disappearance of the skill to write and read the traditional script of most of the manuscripts. Lyall notes further that the political climate, as well as the physical, is an important factor in this crisis.

Governments in many developing countries are coping with cash shortages, health emergencies, and political strife and instability. As a consequence, they allocate a very low or non-existent priority to libraries, making the largesse of donors to fill this gap crucial. An example of such assistance is the "Preservation of Lao Manuscripts" project, funded entirely by the German government through the "Memory of the World Programme" launched by UNESCO. Its purpose is "to focus world attention on the need to safeguard endangered and unique library and archives collections, and to improve their accessibility to people of the world."

Expertise, Education, and Training

The practice of importing of experts from afar is also discussed in the literature, with most authors stressing that this approach neglects to address the problem of self-sufficiency, and does not promote long-term commitment and sustainability. Kari Gulbraar in the *Scandinavian Library Quarterly* emphasizes the importance of high caliber and accessible library education programmes within developing countries as the alternative to the visiting expert.. She relates the story of the Grace Lema Foundation, started in Tanzania by the Norwegian Library Association, and named after an untrained but experienced library assistant who was unable to enrol at the University of Botswana because she lacked financial resources.

A member of the Norwegian Library Association International Committee supported her cause and through donations financed Lema's two-year programme. Building on this initial success, the Association established a continuing fund to support library training within a developing country. This initiative was recognized as a model for library education aid at a 1994 IFLA Conference. Gulbraar also explains the other methods by which Scandinavian library agencies support education: supporting in-service training courses in Asia and the Pacific, funding scholarships to African, Asian and Latin American librarians for short-term visits to Swedish libraries and cultural institutions, and subsidizing librarians from developing countries to attend international workshops and conferences.

Brush reiterates the importance of indigenous training programmes geared to specific situations and the use of locally relevant methodologies when he relates his experiences as a library consultant in Laos. He attributes most errors in the bibliographic records to cultural and language misinterpretations caused by the librarians' attempts to apply cataloguing systems that are rooted in American culture – Dewey Decimal Classification and Library of Congress Subject Headings – to radically different situations. Brush believes that "visiting experts" would be well advised to promote British librarian Ronald Benge's philosophy expressed in his Cultural Crisis and Libraries in the Third World: "Librarians in developing countries would be better advised to follow the spirit of our librarianship, rather than our cataloguing rules..."

Recommendations for Further Study

This review has highlighted research reports and descriptive articles that address two questions: what are the major needs of libraries in developing countries and, how effectively are those needs being met?

It is apparent from these reports and articles that there are varying degrees of success regarding library aid projects: some address the problems and issues inherent within library aid initiatives and the general donor-recipient relationship, while the effectiveness of others is questionable. The literature indicates that when donors place a high priority on good communication; seek to understand and respect the indigenous culture, language and customs; and learn about the climatic, economic and political challenges that local librarians and publishers face, projects are more likely to succeed. Reports by those in the field show that when donor agencies follow Book Aid International's new slogan: "Give us what we need, not what you don't want" when providing demand-led services to developing countries, the match between donor largesse and library need is much closer.

Another recurring theme in the literature is the problem of short-term aid. Too often, financial and materials aid is "single-event, " with no prior communication, no follow-up, and no opportunity for the recipient librarian to do long-term (or even 2-year!) collection management. To ensure that developing countries really benefit from assistance, commitment for long-term support is necessary.

This literature review reveals that globalization of information has created a double-hook for developing countries: library clients are aware of cultural sources from around the world, but these resources are often less relevant than indigenous ones. Continuing reliance on donated international resources hampers creation of a local publishing industry and precipitates loss of the local culture. There appears to be a gap in the literature regarding the impact of burgeoning globalization on library aid – how has this phenomenon affected the relevance of donations? How has it affected communication between donors and recipients, a crucial factor in the success of library aid projects? How can the negative aspects of globalization be minimized and the positive aspects increased within the donor/recipient relationship?

What is most lacking in the literature, however, is a corpus of in-depth research on this topic. As evident from this review, a wealth of articles exists describing Third World library needs from the point of view of the recipient and the objectives. Many articles also detail individual projects and the fund-raising efforts behind them. Missing are the research surveys and case studies that evaluate library aid in terms of a set of identified needs, and research that examines the changing needs of libraries as cultural and economic globalization advances. The forces of globalization that move us ever closer to a single world society – mass communications, increased ease of travel, commerce, the Internet, popular culture, and the increasingly widespread use of English as an international language – must be included as variables in future research projects. Without these projects, we will not move knowledge in this area beyond opinion pieces to the reliable research results that will better inform the relations of donors and recipients. According to Lester Asheim (whose words introduced this review), "foreign relations are, after all, only human relations complicated by some geographical and some psychological distances. I think, with patience and understanding, we are equal to the challenge – and the opportunity – they present." Clearly, in order to develop effective programmes that make a difference within the new global economy and information world, further research on the challenges and opportunities of library aid is needed.

Professional Competencies among Librarians and Information Professionals in the Knowledge Era

Past is an indication of future. Present connects the two. Given this, the 21st century is all set to be a 'knowledge century' where it will neither be the 'labour' (as in the agricultural era) nor the 'capital' (as in the industrial era) but 'knowledge' and 'information' that will act as a critical resource for socioeconomic development of a nation. This being so, generation (creation), processing and use/application of knowledge will be the hallmark of the new century. Professionals engaged in all these three primary tasks of the 'knowledge cycle' will be required to play a more pro-active role (rather than passive one) as equal partners/collaborators with the scholars. A closer understanding of the available skills/competencies of the professionals engaged in the information sector reveals that they have miles to go if they have to discharge their roles as expected of them. Course curricula imparted at all levels in the discipline of Library & Information

Science need to undergo a sea change to incorporate newer approaches/ concepts. Existing professionals need to be provided with state-of-the-art exposure in art and science of the profession through various in-service (continuing education) programmes. All, existing as well as upcoming professionals, will need to be groomed to take on the role of 'knowledge managers'.

Competencies of LIPs: To take up such a role, Library and Information Professionals (LIPs) will be better off, if they pay serious attention towards developing and enhancing their core competencies. Core competencies in the case of LIPs are: (i) Personal; and (ii) Professional.

Competencies have been defined as the interplay of knowledge, understanding skills and attitudes required to do a job effectively from the point of view of both the performer and the observer. The unique competencies of the librarian include in-depth knowledge of print and electronic information resources in management of information services that meet the strategic information needs of the individual or group being served.

At the dawn of the 21st century, LIPs are experiencing the consequences of three major paradigm shifts. These are:

- The transition from paper to electronic media as the dominant form of information dissemination, storage and retrieval, is the first shift. Convergence of different media, such as text, graphics, and sound, into multimedia resources, has direct impact on this transition.
- Increasing demand for accountability, with focus on quality customer services, performance measurement, bench marking and continuous improvement, is the other shift. Shrinking financial resources for providing quality library and information support services have direct bearing on this shift.
- New forms of work organization such as end-user computing, work-teams, downsizing, re-engineering, outsourcing etc., is the result of the third shift.

Given this backdrop, LIPs can enhance the productivity of those engaged in knowledge creation and its dissemination by playing a more "proactive" role rather than "passive" one. In this changed dimension, LIPs will have to assume the role of analyzers, synthesizers and interpreters of knowledge/information, rather than be content with acquiring, organising and providing information when asked for. Further, the role of traditional librarianship is changing into cybrarianship to include the tasks of scanning, filtering, selecting, organizing and packaging the flood of information. In keeping with their changing role from 'gatekeepers' to gateways to 'information, ' LIPs should be performing such tasks as information audits, training in information, literacy, information of best practices/competencies and helping their users to navigate through the world of information, more meaningfully.

Collection Development Skills

Collection development is a highly challenging task for information professionals. The situation demands that professionals entrusted with this task respond to this situation in such a manner that collections developed by them not only meet the current needs of their clients but also the future ones. To do so, LIPs must be groomed on the following lines to devise ways and means to constantly update the collections:

- Develop proper knowledge of the organisation, its mission, goals and objectives;
- Develop proper assessment of users' diverse needs;
- Have thorough knowledge of full range learning resources: documentary, non-documentary;
- Develop thorough knowledge about the library personnel: their job profiles, strengths/weaknesses, area of specialisation etc.;
- Develop thorough understanding of the vendor profile;
- Be thorough with Web browsing *i.e.* relevant search engines, meta search engines, methods to find web resources, appropriate list servers, databases, directories and other E-information resources;
- Have subject degree relevant to the field of work;
- Devise ways and means to constantly update the collections.

Collection Processing Skills

Results of 'Knowledge Capture' will be effective if post capture steps are carried out as follows:

Knowledge Analyses: LIPs require information skills for analysing the quality of information. These skills comprise filtering out noise and focusing on special needs. Hence, LIPs should be able to:

- Understand that information differs in its level of quality;
- Apply evaluative criteria to both print and electronic resources, such as, author's credentials, peer review, and reputation of the publisher, to assess the authority of the source;
- Assess the relevancy of a source to an information need by examining publication date, purpose and intended audience;

- Recognize omission in the coverage of a topic;
- Recognize and evaluate documentation for the information source, such as research methodology, bibliography or footnotes;
- Distinguish between primary, secondary as well as tertiary sources (print & non-print) in the requisite discipline/s and evaluate their appropriateness to the information need.

Knowledge Synthesis: Having selected and acquired the material, the next task is to organise and synthesize it and make it accessible for the users. The recent developments in the Internet and World Wide Web have brought new challenges to information professionals and consequently a number of researchers are now engaged in organising web-based information. Machine readable (on-line as well as off-line) public access catalogue has totally eliminated the tedious task of making 5-10 cards per document, being too much concerned with punctuation marks and other such parameters, and so on. Although the availability of large catalogue databases on-line and several classification schemes on CDs has provided much needed relief to the professionals, yet to accommodate local requirements, systematic recording of all local additions/updates/variations etc., for use by others in the system will be in order. Here also, constant interaction with the users of the system helps the professional concerned to develop a rich (and practical) knowledge base on the users' information seeking behaviour. LIPs should be able to organise, synthesize, integrate and apply the information in the following ways:

- Use appropriate documentation style to cite sources used;
- Summarise the information retrieved (*e.g.* write an abstract or construct an outline);
- Recognize and accept the ambiguity of multiple points of view;
- Organize the information in a logical and useful manner;
- Synthesize the ideas and concepts from the information sources collected;
- Determine the extent to which the information can be applied to the information need;
- Integrate the new information into the existing body of knowledge;
- Create a logical argument based on information retrieved.

Knowledge Repackaging: Consolidators were filters who will make sense of the world for managers. Few managers have enough time to spend gathering, processing and interpreting all the information they need. The system has become more sophisticated, enabling people to process greater amounts of information. But the very process of development that enables the systems to become more sophisticated also has the effect of increasing the volume and complexity of the information available. For these reasons there will always be scope for division of labour and the creation of posts for information professionals to reduce the burden on managers. They should be very vibrant at collecting information by way of searching databases and other secondary sources. Further consolidators should be able to see the patterns and make the connections in the information they process.

They should be able to interpret the information in the light of the circumstances faced by the organisation for which they work. Also they should be able to develop specialised information products for use inside or outside the organisation or by individual clients.

Hence, to locate and retrieve relevant sources in a variety of formats from the global information environment; the consolidator should be able to:

- Understand the organization of materials in libraries and use locally produces location guides;
- Understand how to use classification systems and rationale for their existence;
- Use location information in the bibliographic record to retrieve locally owned resources;
- Use local resources to locate information sources in the global information environment;
- Understand that libraries have developed methods for locating and sharing resources not owned locally and use the appropriate resource sharing system, such as interlibrary loan or document delivery, to retrieve information;
- Understand that the Internet may be a useful resource for locating, retrieving and transferring information electronically.

Knowledge Retrieval: Retrieval support means assisting users in the proper use of information technology to access the available knowledge. Examples of tasks covered in this area of responsibility include the following:

- Identification of new and emerging technologies to be assimilated and integrated into the organisation to impart competitiveness.
- Develop manageable technological skills, *i.e.*, know how to use available technology creatively in order to achieve the greatest benefit and pleasure from their work;
- Ability to train users to navigate the knowledge base competently themselves;

- Competency in search skills specifically for bibliographic databases, using various permutations and combinations of search terms with boolean operators;
- Competency in IT skills, which can be used for researching sources, accessing information, connecting to experts, communicating ideas and results and packaging the knowledge for reuse;
- Ability to develop user-focused/oriented service skills *i.e.*, linking catalogue searching and other databases to document delivery service.

Collection Service Skills: LIPs have been delivering a wide range of information products and services to meet the needs of their varying clientele.

These range from simple issue/return services to most complex and value added information products and services, in both, on-line as well as off-line manner. What goes on in the planning and launch of these services is:

- Understanding the user *i.e.*, information-seeking behaviour and information needs of the clientele, which is based on survey;
- Understand the library system *i.e.*, resources, tools, techniques, service and people where resources include; Documentary and Non-documentary;
- Match between the two, *i.e.*, in discharging his duties an effective information professional has to be equipped with thorough understanding of users and strength and weakness of the library/ system.

LIPs aim to provide the right information to the right user at the right time and at the right cost. Documenting each and every step in the planning as well as launch/implementation of each and every information product/service will go a long way towards not only standardizing and further improving upon these services, but preparing others concerned to shoulder such assignments, should an opportunity come their way.

Hence, to deliver efficient, innovative and just-in-time services, LIPs will have to keep themselves updated in Internet and information technology skills.

User-education Skills

User education aims to equip users with the needed skills to enable them to make use of libraries and their resources in a use-friendly manner. User education often includes library orientation, induction and information skills training. Hence LIPs should:

- Use wide variety of methods to help users in information skills through lectures, practical 'hands-on' sessions, workbooks, printed guides, videos, and demonstrations;
- Adopt approaches to user education which can reach non traditional students such as part-time and distance learners through information technology support via computer mediated communication;
- Use the web for teaching through linking to ready-made training packages or developing in-house products;
- Use computer-assisted learning (CAL) and hypertext in creating flexible learning packages for developing web library guides.

Education and Training of LIPs

Clearly, an aspiring professional in LIS needs to know the basics of IT, particularly in the area of computer, communication and networking technologies.

The professional also needs to know the principles and techniques of how one structures and organizes information and knowledge so that the right information can be retrieved and so routed at the right time.

This would include all the traditional core skills of library and information science, specifically indexing, cataloguing and authority control, and the creation of synthetic structures to reach the information.

The Internet, in particular, as an information service/system will have a multiple impact on several areas of LIS as an educational programme. Hence present curricula of LIS should specifically be updated with:

- The impact of the Internet on society and Libraries.
- The Internet as an information sources Channel of communication
- Organisation of information through Internet.
- Information retrieval through the Internet.
- Design of information services using the Internet
- Internet databases and interfacing
- Web page design and authoring
- Compilation of directories of subject documents on the Net.

Conclusion

From the above, it may be summed-up that LIPs equipped with the competencies as outlined in this paper will be fully geared to discharge their role, not only as gatekeepers of knowledge, but managers of the same.

Thorough revision of course curricula as suggested will no doubt be instrumental in creating a breed of professionals with a positive mind-set in so far as their role in the knowledge cycle is concerned.

To take care of existing (in-service) professionals, a need is felt to expose them to newer concepts/dimensions/approaches through the organisation of multi-tier short-term/continuing education, teaching and training programmes. Examples of such programme can be found in plenty in India. In particular, present as well as prospective professionals need to be given thorough exposure to various information literacy skills. Need-based and tailor-made short-term training programmes need to be developed for existing professionals, for honing their skills and developing their expertise.

21

Electronic Technologies for Libraries

We have suggested elsewhere in this study that libraries and the books they contain are products of a culture of print. Until very recently, scholarly information needs have been served almost exclusively by the technology of printing developed in Europe in the late Middle Ages. In all of its essential characteristics, that technology was simply a different means of doing what had been done in Europe for more than a millennium: the recording of text (and visual images, musical notation, and so on) on sheets of material, whether parchment or paper.

The great virtue of printing, of course, was that unlike manual copying it permitted multiple copies of a text to be produced with almost trivial ease. It permitted the creation of the first media products with the characteristics described: relatively high cost associated with producing the first copy of the product, relatively low cost associated with producing each subsequent copy. It also ensured that all copies of the text could be virtually identical, which gave it considerable advantages over manual copying in that the variant readings resulting from scribal error or the effects of deliberate emendation or interpolation could be eliminated.

The technology of printing, of course, has other characteristics that are either virtues or limitations depending on one's perspective or on the specific information needs at issue. Its principal characteristic, which it shares with manual copying, is that it produces a physical object—a book, a journal, a magazine, a newspaper—containing a fixed, immutable text permitting the reader to interact with it only in limited ways, as contrasted with conversation, for example; the information flow, that is, is one-way. The information, moreover, is universal—it is not tailored to the specific information needs of particular readers—and in almost all instances is arranged in some kind of linear sequence. Absent the kinds of devices developed in a print culture to facilitate access to information in printed form (for example, tables of contents and indexes), readers with particular needs are compelled to ferret out the pertinent information by systematic reading. The means of facilitating access to printed information are therefore to be contrasted with those permitted by electronic information technologies, which afford almost instantaneous, random access to any portion of the text.

From a Print Technology to an Electronic Technology

Inevitably, the medium of print in which text-based information has traditionally been disseminated has shaped one's most fundamental understanding of the nature of text-based discourse and communication. To some extent, that is, terms rooted in the nature of the medium—-print products—rather than in the nature of the resource—the intellectual content—shape the discourse. The nonmateriality of text-based information as exemplified by the technologies of the late 20th century, in contrast, entails different terms.

Texts are no longer necessarily immutable; rather, they are dynamic. Given that characteristic, interactivity is eminently possible; readers can alter the received texts and reformat the information they contain to suit individual information needs by means of various scanning and sorting mechanisms. Late 20th century technologies, in short, uncouple the material object—the book, the journal, the newspaper—from the intellectual content—the information the material objects contain.

Such fundamental changes in our perceptions of the nature of information were described a decade ago by Harlan Cleveland in his essay in *The Futurist*: we have carried over into our thinking about *information*... concepts developed for the management of *things*—concepts such as property, depletion, depreciation, monopoly, market economics.... The inherent characteristics of information now coming into focus give us clues to the vigorous rethinking that must now begin:

1. Information is expandable.... [T]he facts are never all in....
2. Information is compressible. Paradoxically, this infinitely expandable resource can be concentrated, integrated, summarized—miniaturized, if you will—for easier handling....
3. Information is substitutable. It can replace capital, labour, or physical materials....
4. Information is transportable—at the speed of light....
5. Information is diffusive. It tends to leak....
6. Information is shareable.... [I]nformation by nature cannot give rise to exchange transactions, only to *sharing* transactions. *Things*

> are exchanged: if I... sell you my automobile, you have it and I don't. But if I sell you an idea, we both have it....

So it has to be a mistake to carry over uncritically to the management of information those concepts that have proved so useful during the centuries when things were the dominant resources and the prime objects of commerce, politics, and prestige. These concepts include scarcity, bulk, limited substitutability, trouble in transporting them, and the notion of hiding and hoarding a resource....

Furthermore, Cleveland observes, these changes in our understanding of the nature of information will have widespread consequences, reaching beyond print and libraries, into political economy and the law.

- In political economy, won't the concept of market "exchange" have to take account of the fact that more and more of our economic activity now consists of what are by nature "sharing" transactions?...
- In law, how should we adapt the concept of property in facts and ideas when the widespread violation of copyrights and the shortened life of patent rights have become the unenforceable Prohibition of our time? Aren't we going to have to invent different ways to reward intellectual labour that are compatible with a resource that is both diffusive and shareable?

One observer has suggested that the technology of print, as contrasted with the information technologies of the late 20th century, has had even more fundamental effects on the social and intellectual experience of modern society:

Television is not symbiotic with literature in the way that print was. Literary values—authors, great works, deep meanings—fitted hand-in-glove with print, but television both weakens literacy (the skill on which literature depends) and undercuts literature's basic function. The replacement of the printed word by the image and the voice substitutes immediate, powerful one-dimensional pictures and simple continuities for the ironies, ambiguities, and complex structures fostered by print and idealized in literature. Where the fixity of the printed book encouraged the conception of masterworks and permanent truths so central to literature, databases in which items easily intermix and television programmes that flicker fleetingly past make literary ideas like originality, form, and permanence seem quaint ideas of another age.

Literature, that is, is perhaps "so much a product of print culture and industrial capitalism, as bardic poetry and heroic epic were of tribal oral society, that, like chivalry in the age of gunpowder, it will simply disappear in the electronic age." As a kind of discourse, it is an expression of the technology of print, and new technologies may ultimately spawn a new kind of discourse with fundamentally different features.

The characteristics of print therefore have had profoundly important implications for the storage and dissemination of information, including scholarly information, and thus for the most fundamental aspects of the processes of scholarly activity and communication. The essential distinguishing characteristics of research libraries are themselves expressions of the technology of print, as are those of the various publishing industries that have grown up over the past half millennium. Because printing produces physical objects, libraries, in fulfilling their role as participants in the process of scholarly communication, have accordingly acquired certain fundamental characteristics determined by the nature of the technology and appropriate to the nature of their role in the process of scholarly communication, as currently defined.

Libraries have been and continue to be physical spaces where printed materials are collected, classified, and stored in a way that facilitates access to them. They contain spaces where readers can consult materials in the collection rather than take them elsewhere, and the proximity of members of the library staff—specialists in information management—similarly facilitates access. (Members of the library profession have observed that theirs is one of the few professions identified with a particular facility; librarians ordinarily work only in libraries, whereas attorneys are not exclusively identified with any one kind of facility.) There are constraints of space and time (and of other kinds) resulting from the nature of the prevailing information technology that limit readers' access to scholarly information: the only such information they have immediate access to is local information that the local research library has been able to acquire, and they have access to it only when the library is open.

The technology of printing, further, has defined the role publishers play in the process of scholarly communication. Indeed, publishers became players in the first instance in part because of their professional expertise in the technical aspects of publishing and because of the economies of scale resulting from centralization and specialization in that function. It is important to observe, however, that publishers make other critical contributions as well, including coordinating the peer review process, termed the "gate-keeping" function by some observers.

They solicit opinion regarding the quality of manuscripts proposed for dissemination and make judgments about the importance of their contribution to scholarship. The information technologies of the late 20th century, some argue, may transform publishing in that the publishers' role in the actual process of dissemination may change; there will presumably continue to be a need for the gate-keeping function, however, and the new technologies will not obviate that need.

For the moment, the technology of print requires that both publishers and libraries anticipate demand. It is cost-ineffective for publishers to print either too few or too many copies of a particular title. Given the logistical complexities of disseminating information in printed form (printing and binding, transportation of the resulting material objects to clients, whether individuals or institutions, libraries or vendors), publishers project demand in an attempt to ensure that titles will be available to clients at the moment when they are in need of them.

A similar set of assumptions underlies the acquisitions practices of research libraries. Scholarly publications often go out of print quickly; research libraries therefore wish to acquire them as soon as possible after their publication so as to ensure access to the information they contain. Moreover, the same concern about the ready availability of material governing publishers' behaviour is also operative here. Although interlibrary loan services afford access to material owned elsewhere, for many readers such services seem inefficient. The most desirable option is ownership, and for that reason acquisitions have attempted to be as comprehensive as institutional resources have permitted, so as to build a self-sufficient collection with all the advantages of ready access it entails.

This model has been described as the "just-in-case" model; libraries acquire materials in anticipation of readers' needs, in accordance with an assumption that a particular reader may at some future time wish to consult a particular volume. Given the prevailing information technology, this model in many respects has indeed been the most appropriate. It may be added that for many scholars a rich, self-sufficient collection of millions of volumes has another, critically important advantage: it permits serendipitous, potentially interesting discoveries that result when scholars chance upon titles while browsing in the stacks.

The information technologies of the late 20th century compel us to rethink the most basic assumptions underlying the processes of research and scholarly communication. They affect not only the nature of scholarly activity in the first instance but also the nature of the contributions of other agents—publishers of scholarly materials, academic booksellers, research libraries—participating in the process of scholarly communication.

Some of these technologies have already been effectively employed to streamline and improve various library functions, especially acquisitions, cataloguing, and circulation. The cataloguing function in particular has been transformed as a result of the new technologies. As we saw in a previous section of this study, individual institutions contribute catalogue copy to databases maintained collaboratively and can retrieve and easily reformat records contributed by other institutions, so that there is a degree of uniformity previously unachievable.

The automation of cataloguing has had the added beneficial effect of permitting collaborative collection development; the catalogue copy in the database serves as a record of other institutions' holdings, so that individual institutions, building on local strengths, can make informed decisions about acquisitions that do not replicate decisions made elsewhere within the consortium. While the implementation of collaborative collection development schemes is not perfect, the new technologies make these efforts feasible on a scale that would have been impractical in an earlier era.

The Reconfiguration of Scholarly Communication

Until very recently, however, the new technologies have been employed simply to automate *existing* functions. They hold enormous potential for a much more fundamental reconfiguration of the entire process of scholarly communication and for libraries' role in that process. Nina W. Matheson, professor of medical information and director of the Welch Medical Library at Johns Hopkins, has written of the "de-materialization" and "de-institutionalization" of information: it need no longer be made available to us in printed, immutable forms collected by libraries, where access to the universe of scholarly information is governed by local constraints affecting the size of the acquisitions budget and the physical plant where the print products are stored.

Rather, just as automatic teller machines have revolutionized banking (an individual's banking needs are now met by machines that are located everywhere, function 24 hours a day, and afford access to global information), so the information technologies of the late 20th century facilitate access to an ever-larger universe of scholarly information beyond that contained in one's own local research library.

To anticipate the content of much of the remainder of this section, we might summarize some of the characteristics of the new technologies. There is, first, the possibility of ever-greater bibliographic control over the professional literature. The automation of cataloguing and the availability of catalogue records on the Research Libraries Group's Research Libraries Information Network (RLIN) afford scholars remote access to an extraordinarily rich store of information about the existence and location of scholarly materials held elsewhere and bibliographic information on those materials.

As various observers have suggested, however, library catalogs ordinarily contain complete bibliographic information solely on the monographic literature. Since the most current information is often contained in the serial literature and intellectual advances often occur on the basis of interpretations argued in that literature, especially in particular disciplines, it is a limitation that the bibliographic record ordinarily does not extend to the level of the individual article. Increasingly, however, there are bibliographic services available in electronic form that index and abstract the serial literature. By no means are there adequate services of this kind in all disciplines, and the existing ones are expensive to use. Nonetheless, scholars in some fields are certainly closer than before to being able to achieve relatively complete bibliographic control over the literature of their disciplines. Increasingly, the technologies are being applied not solely to problems of access to information about information but to problems of assembling and ordering the primary information itself and of providing access to it.

In all disciplines, including the humanities, the advantages to particular kinds of scholarly activity of the availability of electronic versions of texts and data are clear. As many observers have suggested, such databases are dynamic phenomena; because "the facts are never all in," in Harlan Cleveland's words, it is useful to be able to assemble them in a form that allows one to make additions and refinements easily and manipulate the texts or data in various ways.

For many scholars the new means of storing text not only facilitates traditional kinds of research but also permits one to ask new kinds of questions that would have been literally impossible to pursue with text and data in printed form. And although the availability of the full texts of secondary literature—works of synthesis and interpretation—in electronic form is still a very recent phenomenon, there can be no question that such material will increasingly be available.

The potential utility for libraries of these means of capturing text-based information is obvious. "Information is transportable—at the speed of light," Cleveland has written. The dematerialization of information may ultimately permit specialization in collection development and collaborative collection development in that the full texts of materials not owned locally would be readily available from other institutions within the consortia to which individual libraries belong. It would permit the ideal of resource sharing, which depends upon more-or-less immediate access to materials owned elsewhere, to become a reality. That these technological developments are occurring at a time when resources do not permit the traditional model of the self-sufficient library to be sustained is perhaps fortuitous, perhaps not. One must not underestimate the difficulties involved in realizing such a reconfiguration, however. Some of them will be explored in greater detail in the chapters that follow. There are, first, enormous cost implications. The sharing of information in electronic form assumes greatly upgraded computing and telecommunications networks, and many institutions will simply not be in a position to absorb their share of the capital expense.

Moreover, electronic versions of material challenge some of the most fundamental assumptions underlying copyright legislation. There are, further, issues of standardization. Over the course of the past half millennium, we have become accustomed to using text-based information in printed form and are conversant with its conventions, while text-based communication in an electronic environment will require different conventions and protocols that have not yet been settled upon. It is important to add that print products have some considerable advantages over electronic products, especially for certain purposes.

Alvin Kernan has observed that print yields particular kinds of text-based discourse, and although his observation pertained principally to literature, it might be extended to include certain kinds of scholarly discourse as well. The utility of electronic versions of primary texts and data is, for many scholars, unarguable. Using search engines one can readily locate references and patterns in the texts or data, conduct particular kinds of analyses, and retrieve virtually all the pertinent material. Works of synthesis and interpretation based on the underlying data or texts, however, especially in the humanities, might share with literature some of the ambiguities, deep meanings, and complex structures for which print is a more appropriate medium. Print's suitability to some kinds of scholarly purposes should not be underestimated, and one needs to be attentive to differences among disciplines.

Humanists work differently from scientists and may therefore have some different kinds of information needs. A great advantage of the present situation is that a choice between print products and electronic products need not be made, at least on technological grounds. Cost factors will, however, force almost all institutions to make certain choices irrespective of technological constraints or possibilities. Such choices can be made on the basis of the suitability of various options to specific scholarly objectives.

These late 20th century technological developments have still another implication for libraries. Once the preeminent information service for research and scholarly communication, the library is now complemented by an entirely new set of information services provided by computing, each being the expression of a particular technology.

Librarians have experience in thinking about the nature of information as a commodity, about how one establishes its authenticity and orders and classifies it so as to facilitate access. Some institutions have undertaken an administrative re-organization that may reflect their belief in the importance of integration of computing and library services.

Information is regarded as one of the institution's most important resources, like its financial and human resources. At some universities, accordingly, a single vice president for information services, comparable in stature and in the scope of his or her responsibilities to the vice presidents for finance and human resources, has responsibility for both the library and the computing and telecommunications services. Such an administrative structure permits decisions about the allocation of resources for information services to be made in a centralized, coherent way.

We turn now to a more complete consideration of some of these developments and their importance both for scholarly communication and for libraries' role in the process. To many observers it is clear that we are in a period of transition.

What many envision, ultimately, is a situation in which the full range of information services and products would be available to the individual end-user at his or her own workstation: fully machine-searchable bibliographic services that abstract and index the existing printed literature; databases of primary material; the full, machine-searchable texts of works of analysis with primary material integrated with it through sophisticated windowing and hypertext functions (these would lead the reader to the entire literature and substantiating primary material on any point he or she wishes to pursue); downloading and print options that would permit the end-user to excerpt and reorder portions of the full range of material available and print it locally; flexible protocols for communicating among heterogeneous systems, what one member of the library profession has called "systems with rich and varied access vocabularies [that address the] individual needs, sophistication level, and viewpoint of the user." One cannot know precisely where in the transition we presently are, though we are surely much closer to the beginning than the end. The objective in Part 2 is to describe some elements of the transition and assess their potential utility.

Bibliographic Information in Electronic Form

Whatever promise the new technologies hold, one may be certain that printed scholarly literature will continue to exist for a long time and that adequate bibliographic control is essential to scholarship. We might begin, therefore, with a fuller description of the ways in which the new technologies have been applied to the problem of access to global bibliographic information about the existing printed literature—in the first instance, information on the monographic or booklength literature and, in the second, information on the serial literature.

Electronic Access to the Monographic Literature

Since the early 1970s, university libraries have contributed catalogue records to databases maintained collaboratively. A critically important role in the collaboration has been played by two organizations, the OCLC (originally the Ohio College Library Centre, now the Online Computer Library Centre) and RLG (the Research Libraries Group).

Online Computer Library Centre (OCLC)

OCLC was founded in 1971, and its database, the Online Union Catalogue, currently contains information on more than 24 million books and other materials held by more than 4,800 member libraries. The database is accessed by nearly 14,000 libraries in 46 countries for cataloguing and reference purposes and in order to arrange interlibrary loans. It is growing by more than 2 million records annually; every seven days the Library of Congress adds an average of 4,200 machine-readable records. The database is extraordinarily useful not only because it permits uniformity in the content of catalogue copy but also because it affords access to information about the existence of materials and serves as a record of the location of particular titles within the national system.

OCLC's database has traditionally been used principally by library professionals. In October 1991, however, the organization made available a service called FirstSearch, which permits individual patrons to access the database directly to search for materials. FirstSearch employs a menu that guides readers through a series of options; whereas the database was previously searchable only by author or title or a few other categories, the individual reader can now access the records by subject as well. Patrons pay a fixed fee for each search rather than by the minute. The system can be accessed either over the Internet, described in greater detail later, or in some instances over OCLC's new, high-speed, $70 million private telecommunications network, soon to be completed. OCLC has contracted with vendors such as H. W. Wilson Company to provide databases containing information on materials other than monographs.

Research Libraries Group (RLG)

Of at least equal importance to research libraries of the type considered here are the achievements of the Research Libraries Group. Founded in 1975, the RLG by 1991 had 112 members, among them universities, independent research libraries, archives, museums, and learned societies. In September 1991 its bibliographic database, the Research Libraries Information Network (RLIN), an online information system reflecting the combined holdings of the member institutions, contained 50 million catalogue records for books, serials and their contents, musical scores, sound recordings, archival collections, maps, computer files, visual materials (films and photographs), and art sales catalogs. In 1992 RLG is adding a number of specialized indexes to RLIN that are now available only in print. Among the important databases already available are the *Avery Index to Architectural Periodicals* online, which analyzes articles from more than 700 publications; the *Eighteenth Century Short Title Catalogue*; and SCIPIO, the art sales catalogue database, which provides citations for catalogs of sales dating from 1599 to the present, often valuable sources of information on the provenance of art objects, collection patterns, and so on.

RLIN is available to individual scholars, and readers need a personal computer and modem, a telephone line, and a searching account and password to access the records over the GTE Telenet communications network. Through one's local campus mainframe computer, the database is accessible also over the Internet. (There is currently no communications charge for this means of access.) The database is searchable by personal names, title words in any order, subject headings, and more than 40 additional categories, including the International Standard Book Number. Search results can be limited by language, date and place of publication, and holding library.

The organization is currently engaged in efforts to make RLIN records available on local campus online library catalogs. Library patrons at a particular institution will be able to search for records in RLIN as they would in their own institution's online catalogue. To cite an early example, at New York University, where the first phase of a three-phase project has already been completed, since March 1990 a daily average of 350 bibliographic records has been transferred electronically from the RLIN system to the Geac system at New York University's Bobst Library. The next phase entails the transfer of records created or updated on NYU's Geac system to RLIN for incorporation into the database, and the final phase will permit online searching of the RLIN database locally by NYU's faculty and students. Other libraries are proceeding with similar plans. What is envisioned, ultimately, is a situation in which all RLG libraries are linked electronically.

Of particular importance is RLG's interest in improving the quality of bibliographic information on what might be called nontraditional materials. Increasingly, scholars, specifically in the humanities and related social sciences, are making use of images, the texts of musical compositions, unpublished archival sources, ephemerae, and other such materials. Access to these sorts of materials is difficult because bibliographic information about them is either not available or is not organized in the same way as information on the published scholarly literature. As boundaries between existing humanistic disciplines are re-negotiated and scholarly information needs change in response to this development and others, the information services designed to address those needs may change accordingly. In this respect RLG's interest in developing appropriate services is potentially of great importance.

Other Initiatives

In addition to the catalogue records maintained by OCLC and RLG, many research libraries have also made their own online catalogs available on the Internet. Information about the existence and location of materials not contained in the OCLC and RLG databases is thus provided. Moreover, catalogue copy written locally may contain idiosyncratic bibliographic information, potentially of great interest to library professionals and scholars elsewhere. One of the difficulties in making information of this type available on the Internet, however, is that there is a great deal of such information. Two publications in particular, *NYSERNet: New User's Guide to Useful and Unique Resources on the Internet* and *Internet Resource Guide*, serve as invaluable guides to some of the more important resources.

The much more significant problem is that the bibliographic record was not automated at most research libraries before the late 1970s. As a result there are hundreds of thousands (in some instances millions) of catalogue records not contained in individual institutions' online catalogs. Libraries will have to undertake the retrospective conversion of their card catalogs to have a single integrated record of their monographic collections.

This conversion can be done manually for small collections with efficiencies being achieved by searching the OCLC or RLG databases for records matching local holdings. But for major research libraries manual conversion will be so costly as to seem unfeasible. Ultimately, all research libraries will need to put their entire catalogs into machine-readable form. The cost of doing so will be high but may be appropriate in relation to the ongoing costs of library operations and catalogue maintenance. More than half of ARL member libraries report that they have already converted 90 percent or more of their card catalogs to machine-readable form. One challenge, of course, is to prevent invaluable local cataloguing information from being lost in the process.

Princeton's university librarian, Donald Koepp, and its vice president for computing and information technology, Ira Fuchs, have proposed to convert the university's printed catalogue records in a different way. In the first of two phases, high-speed scanning technology would be used to produce digital, bit-mapped replicates of the cards; the resulting images would be stored on optical platters. Although the images would be electronically searchable only in ways approximating the kind of manual searching one does in a card catalogue, they would be available online; readers would thus be able to access the entire catalogue electronically, although in a two-step process, and from any properly equipped remote station anywhere in the world, since the catalogue would be available on the Internet.

The second phase, which would entail converting the optical, bit-mapped records into MARC (machine-readable cataloguing) format, in which author, title, and other such information were adequately distinguished, would employ optical character recognition technology and automatic error-handling algorithms, rather than having the MARC tags assigned manually to each field in each record. The records could then be integrated with those in the online catalogue. Princeton's approach may prove to be stopgap, as the costs of other technologies decline, but would be a step forward in any event.

Electronic Access to the Serial Literature

The automation of the bibliographic record of the monographic literature has been paralleled by similar services providing information about the serial literature. There is an important difference between the two kinds of service, however. Libraries themselves assumed responsibility for providing bibliographic information in electronic form about their monographic collections, as a continuation of the traditional cataloguing activity. Information in electronic form about the serial literature, on the other hand, is in many instances provided by commercial services. The cost implication for libraries is significant: if they wish to offer a comprehensive array of bibliographic services, they must absorb the substantial cost of acquiring the commercial services, and in many instances members of the university community demand such services in addition to traditional acquisitions.

Rila, Rilm, Info-south

The array of information such bibliographic services can provide is illustrated by RILA, *Repertoire International de la Litterature de l'Art* and RILM, *Repertoire International de la Litterature Musicale*, RILA's prototype.

RILA provides bibliographic information (and in many instances abstracts) for current publications in the history of Western art: monographs, book reviews, conference reports, exhibition catalogs, periodical articles, *festschriften*, and other publications. It is produced by the Getty Art History Information Programme (AHIP) and has recently merged with the *Repertoire d'Art et d'Archaeologie*, a parallel French bibliography produced by the Centre Nationale de la Recherche Scientifique. More than half the records contain abstracts written by staff members of the AHIP whose responsibility it is to review the current literature, locate and identify publications worthy of being indexed and abstracted, and write brief synopses.

As of January 1991 the database contained more than 130,000 records on items published from 1973 on. The bibliographic records and abstracts are available in printed and electronic form. The comparable publication in the history of music, RILM, is produced by the International Musicological Society and the International Association of Music Libraries. It shares many of its essential characteristics with RILA, with two exceptions: there is a five-year interval between publication of the literature and publication of the index, and many RILM abstracts are written by the authors themselves.

Both databases are available online through the DIALOG Information Retrieval Service, from Dialog Information Services, Inc., a Knight Ridder Company. Similar databases are available through WILSONLINE, from H. W. Wilson, and ORBIT Search Service, a division of Maxwell Online, Inc., which provides electronic versions of such scientific indexes as *Chemical Abstracts*.

Another example is INFO-SOUTH, the Latin American Information System, which is a comprehensive database of abstracts of the contents of 1,600 publications on all aspects of society and change in South America, Central America, and the Caribbean. Included are newspapers, news magazines, and journals. The University of Miami manages INFO-SOUTH and permits subscription by either hourly rate or annual fee for unlimited use.

It would be difficult to exaggerate the advantages to scholars of having such bibliographic information available in electronic form, in part because of the nature of the information itself, which extends to the level of the individual item (the individual article or book review), and in part because of the ability to search the literature completely for virtually all items of interest and, in contrast with manual searching, with considerable ease.

As Michael L. Dertouzos has noted, such services "relieve many of the repetitive, boring and unpleasant tasks related to processing and communicating information." However, one should not underestimate the cost of utilizing such services. DIALOG's promotional literature suggests that "[a] typical 10-minute search can cost from $6 to $16.50. (These examples include telecommunications costs but do not include offline print charges.)" Accordingly, while some university library systems have chosen to make such online services available directly to the individual reader, others, understandably, have restricted their use to members of the library staff so as to keep searching costs to a minimum.

Services Offering Individual Access to Databases

Many scholars have argued for individual access to the databases for the reason that "scholars need to be guided by their instincts when they search databases just as when they search card catalogues or browse the stacks," as one proponent of individual access has phrased it. In response to the interest of individual scholars in having direct access to indexes of the type described here, some institutions have purchased computer tapes containing the bibliographic records and the requisite software from the vendors and have made the databases available on local-area networks, which saves the cost of the long-distance telecommunications connection.

In such instances individual users may have a menu of options available to them listing various kinds of campus information services: the online library catalogue, various bibliographic services, and so on. Individual patrons may then search whichever database is pertinent to their purposes. In other instances vendors have made portions of their complete databases available on CD-ROM, and libraries have made the discs available as they would traditional printed indexes. Although the discs share with other electronic media the advantage that one can easily search the database, vendors have tended to stipulate in the rental or sales agreement that they not be mounted on a local network. In such cases they share with printed indexes the disadvantage of being available to only a single patron at a time, as contrasted with the online databases, accessible by more than one patron simultaneously.

Both OCLC and RLG offer yet a third option; they have acquired some of the existing indexes directly from the vendors and have mounted them on their information systems. OCLC, for example, has contracted with vendors such as the H. W. Wilson Company to add to the existing databases already available on OCLC's system. RLG, too, has added various indexes to those available on RLIN. For a fixed annual fee institutions are permitted unlimited searching of some of the files and thus enjoy the advantages of having such indexes accessible locally without having had to assume responsibility for the technical demands involved in mounting them.

A further important issue is that many disciplines, in the humanities and related social sciences in particular, either do not have bibliographic services of the type described here or are dissatisfied with the ones they do have. Here again, the Research Libraries Group has played an important role in working with learned societies to identify information needs and assess the adequacies (or inadequacies) of existing bibliographic services.

An experiment conducted by Dialog Information Services at Earlham College in Indiana was designed to gauge faculty and student response to the availability of its services and gather information about their use of the databases. Dialog provided Earlham with a year's free access to its bibliographic and full-text databases and absorbed the telecommunications charges during the academic year 1990-91 and during the following academic year permitted unlimited searching at a discounted rate. The college has received a $200,000 gift from an alumnus to endow online searching. During the first year of the experiment, more than 90 percent of the faculty and 80 percent of the students accessed the databases at some time, although the percentages of those making extensive use of the services were probably lower. Many faculty members testified to the promise these services hold for scholarship and, notably, for teaching. As one faculty member observed:

In *Notes on Virginia*, Jefferson described the process[:] "A patient pursuit of facts, and cautious combination and comparison of them, is the drudgery to which man is subjected... if he wishes to attain sure knowledge." Jefferson is still right about the patient pursuit of facts.... We have, however, taken much of the drudgery out of the process and made it easier to find sources, but we still have to read carefully—probably more carefully than ever—and we still have to think. The difference is that searching no longer takes much time and energy from the scholarship of thought.

The experience at Earlham gives some sense of the utility of these services and of the importance to scholarship of facilitating access to information about information. To be sure, there is a superabundance of information available, and in attempting to establish bibliographic control over the literature on a particular topic, scholars face formidable challenges resulting from that very superabundance. Moreover, as some faculty members at Earlham suggested, there is the risk that easy access to information will lead some students to substitute the exhaustive assembling of facts and others' opinions for their own critical evaluation and interpretation of issues.

Relatively complete access to global bibliographic information is a critically important objective. Scholarly arguments based on thorough knowledge of the professional literature are at minimum better informed and obviously to be preferred over those that are less firmly grounded. At the same time the cost to institutions of the services that provide access to such information should not be minimized. In an era of limited resources, difficult decisions will have to made about possible tradeoffs in acquisitions between traditional printed materials, which will continue to be fundamental, and services like those described here.

Indeed, one of our purposes is to highlight some of the tensions that now exist and will continue as the new information technologies are found to have ever more useful applications to scholarship. The argument is that providing scholars with readily accessible information about the existence and location of scholarly materials held elsewhere is in many respects a more important objective than building a free-standing, self-sufficient local collection.

Electronic Publishing

Scholarly activity ordinarily culminates in publication (literally, the act of making public), the communication to colleagues and students of results, observations, and interpretations emerging from one's research. It is at this point that libraries have traditionally entered the process; they have collected and classified printed products published by academic and commercial publishers that serve as vehicles of scholarly communication. But libraries are, of course, indispensable to scholarship from its very inception. They give scholars access to past work and thus make future contributions possible. Those contributions represent not only a culmination, in that they communicate results of work brought to the point where publication is deemed warranted, but also a beginning, in that they furnish material that supports new scholarly ventures and stimulates new analyses.

Primary and Secondary Texts: The Genbank Example

One characteristic of electronic information technologies is that they establish a different relationship between interpretive works and the underlying data or primary texts on which they are based. Consider the difference between the more traditional approach to assembling and publishing data and the electronic procedures of GenBank, the national repository for nucleic acid sequence data. In the past scholars and scientists gathered data in an attempt to test a particular hypothesis. When sufficiently important results were obtained, a paper describing them would be published and the authors would typically include some of the data substantiating their conclusions. After electronic databases such as GenBank were established, the data contained in such articles would then be extracted and stored electronically.

There were limitations inherent in such a model, however: the period between the submission of the manuscript of an article and its publication was inordinately long; and as the volume of data increased, publishers were understandably reluctant to include anything more than excerpts, especially given that sequence data in printed form was of limited usefulness. These features of the current model argued for different procedures altogether.

It was proposed that the full range of substantiating data be made available electronically at the same time that a paper presenting conclusions based on them appeared in print. The scientists responsible for maintaining GenBank have secured the cooperation of journal editors so that submission of the data to GenBank would be a necessary condition to publication of a paper based on them. Authors are required, further, to submit data in "machine-parsable" form. The direction of flow of the data between published articles and the databank has therefore reversed. Authors are now able simply to excerpt or cite data from the database. Readers are able to retrieve the underlying base data at the same time that they receive the articles themselves.

Such a model might apply to humanistic scholarship and scholarly communication as well. Many humanists would be as interested as scientists in having ready access to the full range of primary material underlying scholarly arguments (in this instance, of course, the material is ordinarily different in kind, usually text rather than data). In historical disciplines, for example, one can distinguish between the sources—contemporary chronicles and narrative accounts, letters, diaries, works of art, literature, and music, debit-credit registers, data on demographic trends, government statutes, and so on—and analyses that make use of such material and attempt to package and interpret it in particular ways.

It is in the comprehensive assembling of the primary material that electronic information technologies are especially flexible and powerful tools, in part because "the facts are never all in," as Harlan Cleveland has said, and one therefore wants to be able to assemble material in a way that is appropriate to the dynamic quality of scholarship, and in part because the new technologies permit one to search the assembled primary material with ease and reorder and reassemble it in ways appropriate to one's purposes.

In the humanities, as in the sciences, many publishers are increasingly unwilling to print lengthy original source material because it is so costly to do so. "[P]rinting costs," wrote the late Eric Cochrane of the University of Chicago, "have all but extinguished the four-century-old tradition of European text editing."

These developments highlight the virtues and limitations of each medium and the appropriateness of particular media to particular material. Electronic media are better suited to storing underlying raw material, whether data or texts. Print, in contrast, is better suited to presenting works of synthesis and interpretation that make use of the raw material. As Henry Riecken has suggested, "It may be no more sensible to publish a commentary on the *Miller's Tale* in electronic format than to embalm in a printed work the data from the *Current Population Survey*.... The text of the *Federalist Papers* was put into machine-readable form in order to carry out an analysis that resolved questions of disputed authorship of some of the papers; but the new format did not replace the bound volume for readers who want to absorb the thoughts and reflect on the aspirations of this stately document."

The example of GenBank suggests that, at least in some scientific disciplines, printed journal articles need not contain the documentation for the argument they advance. A more appropriate means to handle documentation might be through reference to the contents of the dynamic electronic database, thus consigning the type of material to the medium that handles it best. One advantage of this approach is that it may lead to shorter, less expensive print products that contain little or no documentation. Storing the raw material in electronic form, conversely, would in principle permit individual readers to manipulate it in ways that print clearly does not. The GenBank model of publication also avoids what might be characterized as the compromises and half measures typical of the traditional vehicles of scholarly communication—printed articles that contain the scholarly argument in the main text with brief excerpts from the underlying documentation in footnotes, tables, and appendixes.

But the GenBank example assumes that secondary works will appear in print. The new technologies will also permit a fully integrated process in which works of synthesis and interpretation are also published electronically and linked to underlying base data or texts through flexible, sophisticated hypertext and windowing functions, which offer considerable advantages over print in their ability to connect primary and secondary material.

To be sure, various kinds of intellectual material (we purposely avoid the word "information") have distinctive characteristics and purposes. But that need not imply that literary or philosophical writing or scholarly works of analysis and interpretation should be exempt from electronic publication in the first instance. It is rather that the arguments for electronic publication of such works are not the same as for substantiating data or documentation. Print continues to be the preferred medium for certain purposes: the printed page is still more readable than a computer screen; a book is more transportable than a portable computer; a subtle argument that unfolds over many "pages" is often more accessible in print than on a computer screen.

These are arguments for a print option *at some point* in the process of scholarly communication because of the advantages that print affords; they are not necessarily arguments for the production of texts, whatever the genre or intellectual purpose, in printed form in the first instance. Even in the case of a commentary on the *Miller's Tale*, there are advantages to having the text stored electronically, in that a reader can instantly locate a passage in the commentary of particular interest using a search-engine.

Electronic media may also be more appropriate media of distribution, with respect to economic cost-effectiveness, in very specialized fields where monographs can, at best, be expected to sell just a few hundred copies.

The availability of text in electronic form has important potential advantages, moreover, for purposes of resource sharing among institutions, in that texts stored electronically are almost instantaneously transmittable. One of the main impediments to resource sharing—the cost and perceived inefficiency of traditional interlibrary loan services—is therefore resolvable, at least in principle.

Current interlibrary services, which have been described as "a bulky process in which a dozen people [labour to bring] forth a mouse," could be completely transformed.

A reader at a university library in California might be able to review, on a read-only basis, the first few panels of a text maintained electronically at a library in Massachusetts and decide whether to request that the text be downloaded and printed. A transaction that may take weeks under present circumstances could take seconds, and the reader could choose not to request the text at all after having reviewed a small portion of it.

Electronic storage of text also permits the reader or end-user to tailor universal information to individual needs. McGraw-Hill, Inc., has developed a programme that permits faculty members at the University of California at San Diego to design their own textbooks; they can search an online catalogue from a computer in the university's bookstore for materials in McGraw-Hill's Primis database, which contains the full texts of books, journal articles, and so on.

The on-site publishing centre compiles the materials, creates a title page, and adds an index, table of contents, and page numbers; the entire process can be completed in 48 hours. McGraw-Hill has been granted permission from copyright holders to reprint all materials in the database. Because the texts are created and "published" on demand, faculty members need not anticipate class enrolments weeks or months in advance to order books. More important, faculty members can design texts more precisely suited to their pedagogical purposes. The economic implication of such a capability, as one economist observed, is that "[l]argely because of the changes in costs due to electronics, the size of the minimum press run for a title has become smaller. Indeed, McGraw-Hill publishes textbooks on demand from a database of articles or chapters.... The minimum press run is approaching one. The number of titles produced grows in part as titles for narrower audiences become economic."

Electronic publication, finally, has the virtue that it is the only existing medium appropriate for publishing material of certain types, as Jerome Yavarkovsky, director of the New York State Library, has observed:

> *In some instances, research results are not published by conventional, printed means because the results can't be printed and still be meaningful. This is true, for example, when the results are three dimensional, graphic, moving simulations, or animations, or when the outputs are dynamic visual representations of variable processes or theoretical constructs. Traditional, printed publication is completely inadequate for disseminating research of this kind. Yet, this research should be included in what we refer to as "the literature."*

Because few electronic journals presently exist, no one can confidently predict what new paradigms of scholarly communication in the electronic age will eventually emerge. Our objective in this section is simply to offer a few suggestions as to how scholarly publication might work. We would do well to heed the challenge issued by Ann Okerson, director of the Office of Scientific and Academic Publishing at the Association of Research Libraries:

> *It is critical that in starting virtually "from scratch" with a brand new "making public" vehicle, we are unfettered by old modes of viewing and doing publishing: by existing notions of publishing offices; marginal cost structure of publishing; the idea of "circulation;" indexing and abstracting; "monographs" and "serials;" advertising; ownership; possibly even profits. We have the opportunity to begin with a blank page—even that notion needs a new metaphor.*

Electronic Production and Distribution

Assuming that the principal current document formats—monographs and periodicals—will continue to exist in an electronic environment, at least for a time, the new technologies will no doubt first be applied to the tasks of producing and distributing traditional kinds of documents. Let us begin with production.

When a scholar finishes the manuscript of a journal article and sends it to a publisher, it is ordinarily subjected to editorial and peer review. Some observers have suggested that the traditional editorial and peer review processes might be circumvented altogether because electronic information technologies so facilitate communication among scholars. In Henry Riecken's words, "[a] jaundiced view might hold that desktop publishing suffers from the same blight as computer network `bulletin boards'—anyone with the equipment can `publish' whatever he wants, of whatever merit or interest, and the potential audience is left with the task of sifting through the midden."

In our view, however, as in Riecken's, the peer review process is so fundamental to scholarly practice that it will continue to be critically important, whatever the medium of distribution. However, the new technologies may well expand the review process and change its character, with preliminary versions of manuscripts being made available on a network for comment by interested readers. The author would then prepare a final version, incorporating any suggestions that seem to have particular merit. Even if this expanded process does not develop, the traditional one is greatly expedited in an electronic environment. Editors can send manuscripts to reviewers and receive responses much more quickly, thus reducing the period between the time of the manuscript's submission and editorial decisions.

The manuscript then goes into production, and here electronic technologies have already been effectively employed. If the author has submitted his or her text in electronic form, the cost of original typesetting is considerably lower, since the compositor's task is simply to edit the electronic version of the text, and original keying of characters is kept to a minimum. Both author and editor can have changes made readily, using global search and change functions.

Whether the new technologies will result in other significant production cost savings is difficult to determine at this point. Many of the principal costs have less to do with the medium than with the nature of the activity. For example, many of the costs associated with the highly labour-intensive editorial and peer review processes will remain, while some costs associated with the actual production of the text---typesetting, in particular—can almost certainly be reduced.

Once author and editor have settled upon a final version of the text, it is distributed. Traditionally, distribution has consisted of shipping or mailing printed and bound copies of the first copy to individuals, vendors, and libraries. In an electronic environment there might be a variety of distribution media. Publishers might continue to make hard copy available on demand from their own printers to clients who do not yet have the means to make use of electronic versions of texts (or prefer paper). Alternatively, they might issue titles on CD-ROM or floppy disc; these have an advantage over printed volumes in that they miniaturize the text, so that the considerable space problems libraries face might be addressed by this kind of distribution.

Such products might either be sold to the user, whether individual or institutional, or leased. In either case the option to download and print the text or any portion thereof might be controlled by the sales or rental agreement. If the CD-ROM or floppy disc is sold or leased to an institution, the publisher might also specify in the agreement that the text is not to be mounted on a local-area network, so that more than one reader can have access to it simultaneously. In any of these cases the cost of printing, if it is permitted, could be the responsibility of the individual user, just as now the individual ordinarily incurs the cost of photocopying printed material in a library's collection.

The option that appears to be of unusual interest is that texts will be mounted on a local-area or wide-area network and clients provided with direct access to them online. Under such circumstances one can envision a variety of retrieval architectures. Individual institutions—colleges and universities—might choose to maintain local electronic repositories of frequently used titles they had purchased outright from the publishers; in that case the cost of the telecommunications connection with the publishers would be eliminated.

Alternatively, some publishers might choose not to sell titles but rather maintain them at central sites themselves and charge users on a fee-per-use basis. Yet a third kind of architecture may eventually evolve in which libraries at different institutions collaborate in collecting electronic materials; under those circumstances the consortium will own a full complement of resources but will distribute them among the different members of the consortium. Malcolm Getz has described an architecture of this type as "decentralized... with multiple, autonomous nodes subject to a standard protocol that allows participants to search multiple sites easily."

To what extent any of these methods of distribution will result in cost savings is difficult to determine now with any precision. Any of them could have significant positive implications for libraries' space problems, as we have suggested, although there will continue to be substantial costs associated with storage, especially if texts are maintained in online databases. William Y. Arms suggests that "[t]oday, storing a document on a computer is more expensive than on paper, but prices are falling rapidly. By the end of the decade, online computing will be much cheaper than storing books on library shelves."

There are other costs entailed in distribution. Let us consider, for example, a journal published by a university press that is currently mailed to subscribers; if the texts of the articles are instead mounted at the university's BITNET node and subscribers elsewhere retrieve them from the network, the cost of mailing, currently recovered in the subscription price, is eliminated, as are the costs of printing and binding on the publisher's part. On the other hand, both the university where the journal is produced and the university where it is received incur costs associated with the operation of the computing and telecommunications facilities supporting the electronic distribution; such costs are ordinarily hidden, at least from the individual subscriber, yet they nonetheless exist. How the costs for various phases of the process of scholarly communication in a fully electronic environment will compare to those incurred now is clearly a subject for considerable further investigation, as is the associated question of who will absorb which costs.

Now let us consider some of the possibilities inherent in these various options. First, individual readers could tailor the information to particular needs. The reader might be able to excerpt and print a single chapter (or page) of a monograph or a single article of a journal issue. Indeed, as several observers have suggested, the very concept of an issue of a journal is challenged by electronic information technologies. Articles are currently collected together and an issue published when there is a sufficient number of articles available to make up an issue. In an electronic environment one can envision a situation where a single article will be mounted on a network as soon as it clears editorial review; there will be no need to wait for other articles to reach the same point in the process. It is in this sense that some of the distinctions entailed by the technology of print invite reconsideration, as Ann Okerson has suggested.

Precisely because electronic technologies permit individual information needs to be met, different subscription and pricing schemes and practices will almost surely develop, whether for individuals or institutions. For example, publishers or vendors would presumably be able to charge on the basis of the amount of material retrieved: the entire text of a monograph or any part thereof, an individual journal article, a page or even a few paragraphs of material downloaded selectively. Case Western Reserve University and IBM are attempting to monitor this process within the university through a software that functions as a kind of royalties manager. On a larger scale CitaDel, the new citation and document-delivery service of the Research Libraries Group, allows for online ordering, delivering, and billing.

Publishers, moreover, may choose to offer various services of other kinds. Although many subscribers will wish to continue to receive routinely all the articles published in a particular journal, it will be possible for publishers to facilitate selective acquisition as well. A comprehensive, fully integrated service could provide tables of contents, lists of article titles, or abstracts of periodical articles or monographs, as INFO-SOUTH now begins to do for Latin American studies. Prospective buyers could skim portions of a full text on a read-only, not-keep basis. Readers could order individual items of interest by means of a simple command; the document could then be delivered by any number of methods.

Some redefinition of the traditional roles of publisher, vendor, and library and of the relationships among them is almost inevitable. Because individual end-users will be able to purchase information tailored specifically to their needs, they will perhaps be more inclined to interact directly with publishers or vendors—that is, readers may not need to rely as much on the library. (One makes certain assumptions about the pricing by publishers and vendors of such services).

Libraries, for their part, may develop a different approach to acquiring materials, more appropriate to the characteristics of electronic technologies. Such an approach has been termed the "just-in-time" model, as contrasted with the "just-in-case" model currently governing libraries' acquisition practices. Because libraries will ultimately have ready access to electronic versions of texts stored elsewhere, they will be able to base acquisition practices on immediate reader needs rather than on *a priori* assumptions about what those needs might be. Instead of subscribing to a certain number of journals, for example, libraries may instead negotiate contracts for a certain number of discrete articles from a national database of articles, acquired in response to readers' requests.

It also seems clear that there may be some blurring in the distinctions among the historical roles of publishers as producers, vendors as intermediaries, and librarians as archivists. Scholarly publishers have traditionally allowed titles to go out of print because of libraries' willingness to serve as "a sort of secondary distribution system and warehouse," to quote Henry Riecken. The costs associated with archiving materials have been the responsibility of the library. In an electronic environment, where texts can be miniaturized and storage costs greatly reduced, publishers and vendors may be more inclined to maintain archives of texts for many years.

It may also be that traditional models of resource sharing among libraries will be affected. Libraries have historically turned to other libraries for materials not owned locally; if such materials continue to be available from publishers or vendors, libraries might be inclined to acquire them directly, if resources permit and the demand justifies acquisition. Under any of these circumstances, the rapidly changing state of the technology is likely to be an important dynamic. As Jerome Yavarkovsky suggested, "A necessary feature of online accessibility and network publishing is a commitment to archival storage. Once an article is accepted and published online, the publisher, or some other agency, must keep that publication available in perpetuity, in the same way that traditional publications are held permanently by research libraries. This archival responsibility might even be one of the roles possible for research libraries in the future."

Changes in Scholarly Ethos and Communication

Electronic information technologies may, some observers think, bring about far more significant changes. Indeed, some envision fundamental changes in scholarly ethos and practices of scholarly communication as a result of their introduction. Apart from the expanded processes of peer review described earlier, the new technologies could permit immediate and public response from readers to electronic publications and allow them access to the reactions of prior readers. Further, since their invention centuries ago, footnotes and bibliographic references have connected texts to prior pertinent writings and documented the arguments authors wish to advance. As such, they serve as print equivalents of hypertext, as we have suggested. But the analogy is far from perfect. Footnotes and bibliographic references are always selected samples of the full range of material that might be related to the text at issue. Electronic technologies such as hypertext permit access to a much wider range of relevant materials—both primary and secondary, substantiating and contradictory—than those authors have elected to call to readers' attention. In this new environment readers need not rely on authors' selective presentations of related materials and can, if they choose, seek additional references for themselves using electronic media.

Some have suggested that the technologies may permit the emergence of new institutions or infrastructures supporting scholarly communication.

As Patricia Battin has observed, "The advent of electronic capabilities provides the university with the potential for becoming the primary publisher in the scholarly communication process. At the present time, we are in the untenable position of generating knowledge, giving it away to the commercial publisher, and then buying it back for our scholars at increasingly prohibitive prices. The electronic revolution provides the potential for developing university controlled publishing enterprises through scholarly networks supported either by individual institutions or consortia."

How might such a system function? One proponent envisions two broad types of campus network nodes, editorial and distributing. The first of these would offer editorial software for creating and reviewing papers. As demand dictated, it might also store publications held by an editorial node at another campus, a redundancy that would reduce telecommunications costs and network traffic. The second type of node would exist solely to distribute publications by making them accessible online and would resemble traditional libraries by serving as repositories of publications created and issued elsewhere. The distinction expressed in this scenario is familiar and approximates the distinction between the collecting or archiving function currently performed by libraries and the production function performed by university presses. In the new environment librarians might continue to be responsible for decisions about which materials are made directly available to local readers. Access to materials stored elsewhere, however, might well be more directly controlled by the individual reader than is the case under the terms of current interlibrary loan services.

A variety of pricing and compensation schemes, similar to those anticipated earlier, might emerge: a licensing fee paid to a particular publisher might permit a local node to provide access to all the publisher's works; subscription fees might be based on anticipated use of subsets of a node's publications, with users—institutions or individuals—paying for access to parts of the node's holdings; alternatively, access might be on a fee-per-use basis. For individual institutions there will continue to be important and difficult questions to resolve concerning the extent to which the costs of these services are assumed by the institution or passed off to the individual user.

One can envision how the system might operate. Individual scholars interested in accessing particular titles at their own workstations might first determine whether the titles were among those purchased by their institutions and loaded at the local campus network node. If the texts were available locally, the individual readers might be able to access them on a read-only basis, just as now they access printed materials in the university library on a read-only basis. If they chose to download and print portions of the text retrieved, they might be expected to assume some of the cost of doing so, just as now they assume the cost of photocopying printed material.

If the text were not available locally, they might be able to scan the first few panels of text on a read-only, not-keep basis by means of a telecommunications connection, either with the publisher's (editorial) node or with the distributing node at another campus within the consortium (in this instance, the local library or its descendant institution might continue to act as mediator in the process). If they decided, once again, to retrieve and print all or part of the text, they might be charged according to whether the title was acquired directly from the publisher or from a fellow member of the consortium.

What any of these scenarios might permit is an assertion (or reassertion) of the university's direct role in scholarly communication, as Battin suggested. The commercial publishers entered the market because they offered economies of scale and technical expertise to professional societies interested in publishing conference proceedings and professional papers. To a considerable extent these new technologies may eventually obviate the need to rely so much on the commercial publishers for their expertise, especially since many of those involved in editorial work for learned journals, even those published by commercial publishers, are academics with university appointments; copyright, if it remains in force in anything like its present form, can be held either by the author or the sponsoring university.

Issues to be Resolved: Adulteration of Text, Functioning of the Network

Clearly, a number of issues must be successfully addressed and resolved by all the relevant parties before electronic technologies, whatever their virtues, will be seen as preferable to print as a medium of distribution. There is, first, the question of ensuring the authenticity and integrity of the text. "Electronic text," Riecken notes, "is far more susceptible to distortion, adulteration, and mischievous or criminal alteration than printed pages are." Text on CD-ROMs (read-only memory discs) cannot be changed and thereby prevent alterations of the sort that concern Riecken.

The very characteristic of electronic text that permits easy adulteration is in another way a source of concern to publishers, and in what follows here we are anticipating some of the substance of the later discussion on copyright. A technology (photocopying) already exists that provides prospective buyers of a printed media product with an alternative to buying it (although a less satisfactory one). Anyone who would otherwise subscribe to a journal who instead photocopies selected articles of interest takes advantage of an existing technology to avoid subscribing, and the publisher is denied revenue. Publishers are understandably concerned that making texts of scholarly material available electronically will greatly facilitate this kind of circumvention. Publishers of computer software programmes, for example, are aware that there are a great many pirate copies of their products. Their response is to charge substantially for every copy legitimately sold to offset the economic effects of illegal copying, just as University Microfilms, Inc. does for photocopies of journal articles.

It will be important, moreover, to refine and extend electronic access functions approximating the kind of intellectual activity occurring when a scholar browses in a library or skims the pages of a learned journal. When the latest issue of a core journal in a particular discipline is published, many scholars at least skim the opening pages of articles outside their own subspecialty to have some sense of what colleagues are writing about generally in the discipline. If one had to retrieve the text of the latest issue from a network, would one be more inclined to retrieve and print only the articles in one's own subspecialty? Would one's own interests become ever narrower as a result? As suggested, a related issue concerns the ability to browse in a library. Some interesting discoveries are made serendipitously; will scholars be able to make such discoveries as easily in an electronic environment?

Illustrative material—black-and-white or colour reproductions of works of art or other images, graphs, and charts—presents particular problems, which may explain why until very recently there was not a single peer-reviewed electronic journal in the sciences, where scholars make extensive use of such material. It is certainly technologically possible to offer such material and with fully satisfactory results; the issue is rather that to do so assumes the availability of specific equipment and software. There are not yet universally accepted conventions for representing images digitally, and the inconsistent methods of representing and resolving such information are an added complexity.

Finally, there are many questions to be resolved concerning the functioning of the network and the principles governing scholarly publication therein, some of which have been discussed by Ann Okerson. Among them are issues of availability, affordability, and friendly access; the consequences of a shift from the current subsidization of the network to its eventual commercialization; intellectual standards (the integrity of texts and privacy); underlying cost structure (cost recovery, methods of collecting and distributing revenues, and so on); ownership and copyright practices; and academic culture (incentives or disincentives associated with publishing one's work on the network instead of by traditional means). In the culture of print, the fundamental issues of this type were addressed and resolved many years ago, and paradigms governing scholarly practices and the functioning of the entire system, with all its complexities, have been widely accepted. The new technologies provoke fundamental reconsideration.

The various scenarios sketched here suggest both the potential and flexibility of electronic technologies and also some of their current limitations. The discussion to this point has been relatively abstract; one means of achieving greater specificity is by surveying some of the characteristics of the relatively few electronic journals currently existing and some of the issues libraries encounter in collecting them.

One electronic journal attracting particular attention is *The Online Journal of Current Clinical Trials*, edited by Edward J. Huth, M.D., former editor of the *Annals of Internal Medicine*. For our purposes *The Online Journal* is an especially serviceable example since it typifies some of the issues presented by materials of this sort. It is believed to be the first peer-reviewed electronic journal containing illustrative material. It will, moreover, be available only to subscribers who meet particular hardware and system requirements, at least initially, though eventually subscribers will be able to retrieve it using other systems as well.

The contents will be machine-searchable by key words, subject, author, and title; in this instance the distinctive advantages of electronic text are thus exploited. They are further exploited in that texts will be corrected after their initial publication and marked to indicate that they have been so revised. Moreover, readers will be able to customize their subscription, specifying topics of particular interest on which they especially wish to receive articles and to some extent controlling format specifications.

The TULIP project of Elsevier Science Publishers mentioned earlier makes bitmapped images of articles in some of its printed materials-science journals available on the Internet. Elsevier will be responsible for mounting the journals on the network; each of the clients—colleges and universities—will be responsible for determining how it will retrieve them. Materials science journals were selected precisely because they contain graphs, illustrations, and other such matter. Unlike completely electronic texts, which are transmitted in alphanumeric form, the bitmapped images made available through TULIP cannot be altered or customized by users nor are they searchable. In these respects TULIP's capabilities differ markedly from those provided by *The Online Journal of Current Clinical Trials*. Elsevier does plan, however, to supplement the bitmapped image of a text with searchable bibliographic information: author, title, and so on.

These initiatives present challenges to library staff members and others involved in providing information services to the members of an academic community. Many of the challenges have been discussed in a valuable study by members of the library staff at M.I.T. Among them are issues of selection (including the matter of simply being aware of the existence of particular electronic journals), acquisition (knowing the correct subscription information and successfully placing orders and retrieving and downloading the texts), cataloguing (providing readers with adequate access information, including information about the medium, how one subscribes, how one specifies the "location" of electronic materials within the "collection"), access and retrieval (including "adding value," such as the possibility of doing keyword or simple string searches of the ASCII text), indexing of contents, archiving, and so on.

Various initiatives at a number of institutions are likely to yield lessons of value to many others. At Carnegie Mellon University, the Mercury Electronic Library now stores information resources of various types, including the page images of the journals included in Elsevier's TULIP programme. These can be read online over the campus network. The key feature of CMU's practical success is the early adoption of a distributed approach to computing—that is, acceptance of diverse types of workstations and formats for the storage of information, as well as of the concept of dispersed storage of information.

At Stevens Institute of Technology, students and faculty will be able to retrieve the texts of journals published by Engineering Information, Inc., from the campus network. At Cornell University, readers located at their own workstations will be able to retrieve bibliographic information and abstracts of articles published in twenty of the American Chemical Society's principal journals since 1980, as well as the full, machine-searchable ASCII texts and images of illustrative material: line drawings of apparatus, plots of spectograms, chemical structures, photographs.

More important than the differences among these projects is their common assumption that the roles of the component institutions in the process of scholarly communication are changing and in ways that can be understood only by practical attempts to discover what is effective.

Collection Development and Document Delivery

Thus far we have considered various bibliographic services and publishing ventures that make information about information and scholarly information itself available in electronic form. The availability of text and data in that form—whether so produced in the first instance or converted retrospectively from print products—in principle permits a degree of resource sharing among institutions that was unimaginable in the past. The extent to which institutions will practice it, however, will depend upon a host of other considerations.

Two broad types of information service, bibliographic and full text, constitute the minimal necessary preconditions for successful resource sharing. Sharing depends on adequate information about the existence of materials and their location, which the various bibliographic services described earlier furnish, and on the availability of full texts in electronic form, which are more easily transmittable than printed texts. What many envision, ultimately, is a situation in which the individual reader at a particular institution is led easily through a series of options culminating in direct access to the aggregate content of the nation's principal research collections, in which local and remote library catalogue entries and bibliographic records merge with readily retrievable electronic versions of full texts that can be downloaded and printed locally at one's own workstation.

Just as the texts of secondary works in electronic form can be integrated with the underlying base data in a more fully electronic environment, so there might eventually be an unbroken continuum of types of information, from entries in the bibliographic record of monographic collections, to records in various bibliographic, indexing, and abstracting services, to full texts of databases of primary material and studies based on them. The sharp distinctions we now make among these different kinds of information are implicitly challenged by electronic technologies.

Although university libraries have practiced resource sharing for years, for many the preferable option nonetheless remains local ownership of as much of the universe of published scholarly material as resources permit. Interlibrary loan services are thought to be inefficient; the lending library, understandably, attends to its own readers' needs before addressing those of readers elsewhere. The difficult economic circumstances in which research libraries currently find themselves argue for new models, and electronic information technologies seem to hold particular promise.

The degree to which such sharing will necessarily result in cost savings to individual institutions is difficult to determine at this juncture. New paradigms governing local collecting and sharing within consortia will entail new economic relationships among publishers, vendors, and libraries. New pricing schemes will be related to the resolution of copyright issues.

Another important argument for the new technologies is that they will streamline and extend the entire process of scholarly communication in some of the ways considered in the previous section. If such a vision is to be realized, however, it will require reallocation of resources away from expenditures associated with building a self-sufficient collection and toward those associated with cooperative collection development and sharing. The aggregate cost to individual institutions may not be lower, but access to larger universes of material may be facilitated.

Examples of Document Delivery Mechanisms

In this section we will consider the characteristics of some of the resource sharing and document delivery arrangements various consortia have already attempted. We briefly described one such initiative at James Madison University, the University of Virginia, and Virginia Polytechnic Institute and State University. What this initiative and other, similar ones have in common is that they apply existing services and technologies—interlibrary loan, photocopying, telefacsimile—to the problem of access to materials held elsewhere, a problem resulting from the prices of scholarly materials and the consequent inability of any individual institution to provide comprehensive access. Although they assume the medium of print and therefore do not adequately suggest how such sharing might function in a more fully electronic environment, they nonetheless might serve as prototypes of the kinds of infrastructures and organizational principles that might eventually emerge, instances of responses to the current situation anticipating what more might be possible in a fully electronic environment.

Conspectus

The Research Libraries Group has played a critical role in collaborative collection development initiatives from its founding; indeed, cooperative action has been fundamental to RLG's mission from the very beginning. In January 1980 RLG's Collection Management and Development Committee endorsed the recommendation of a subcommittee that:

> *the committee develop an RLG collection policy statement... to serve as a vehicle for cooperation with the Library of Congress and other major research libraries in developing an eventual national research resource collection of materials held... by RLG and other major research libraries,* with primary collecting responsibilities distributed among those libraries and LC*, and with LC acting as a kind of "system equalizer" to minimize the impact of local programme change on national research library resources. [emphasis added]*

The result was the RLG Conspectus, which permitted participating institutions to build collections complementing those of other institutions, thus ensuring the availability of rare titles.

How does such a scheme work? The designers of the Conspectus recognized, first, that it had to respect the autonomy of individual institutions, to facilitate planning but not have the prescriptive force of a policy. Each institution was free to base collecting practices on the profile of its academic programme, for example, or on the availability of resources locally. The Conspectus was seen simply as a means to facilitate coordination of individual institutional efforts.

The Collection Management and Development Committee envisioned an interactive, online format that would allow one to search the Conspectus database by subject, institution, Library of Congress classification, and so on. If bibliographers at a particular university had to decide whether to purchase a certain title, they could first search the RLIN database to determine if any other RLG library had purchased or ordered it.

If no record were found, they could then search the Conspectus database for information about collection strength in the field in question at other institutions. If they discovered, for example, that another RLG library had both a comprehensive collection in that field and a commitment to continue to collect at the current level, they would have the option of choosing to rely on the other institution's collection.

If there were at least three collections in a particular subject at levels termed "research" or "comprehensive," coverage was thought to be adequate; if two or fewer RLG libraries had research-level collections, it was thought that a member should be identified who could accept primary collecting responsibility.

The Library of Congress agreed to consider assuming a primary responsibility in fields where there was neither an RLG member with a strong academic programme in that field nor one interested in increasing its collecting to a level considered desirable by the membership. In return, the Library of Congress hoped to be able to depend on the collecting responsibilities of other research libraries in the country.

Although the Conspectus was first designed for purposes of collaborative collection development, it has a number of other uses, as the authors suggest: it is being used to assign responsibilities in preservation; it can help identify materials for storage, in that diminishing local emphases in collection development might suggest lower use, a usual qualification for storage; and it can be used for purposes of allocation of staff and materials expenditures, in that it aids in collection assessment and therefore in appropriate allocation of resources. Collection interdependence remains central to RLG's mission.

There is currently an initiative designed to ensure that critical resources in particular journals remain accessible. Titles in chemistry, business, and mathematics considered essential to scholarship have been identified by subject specialists, and one or more institutions have agreed to continue their subscriptions to particular titles, regardless of other claims on the materials budget. Lists of the titles in question, annotated with information about collecting responsibility, are available on RLIN. The initiative will be expanded to include periodical titles in foreign law, geology, physics, and German literature, as well as art exhibition catalogs, German monographic series, and foreign newspapers.

As we have suggested, efficient document delivery services go hand-in-hand with collaborative collecting initiatives. The effort RLG is currently engaged in, for example, also involves the development of access and delivery procedures; the Task Force on Interdependent Collections is responsible for designing a service that would expedite delivery of copies of articles from the core titles to members requesting them.

Before the development of electronic delivery technologies, document delivery relied entirely on methods familiar from traditional interlibrary loan services. Under the terms of the understanding that led to the RLG Conspectus, for example, members agreed to give priority to loan requests from other members, to respond within three days to any request, and to ship materials by United Parcel Service. Electronic technologies, telefacsimile in particular, have greatly expedited transmission of shorter items; for book-length materials, telefacsimile is clearly not an appropriate distribution medium.

UnCover and Ariel

Two organizations in particular—the Colorado Alliance of Research Libraries (CARL) and RLG once again—have prominently featured document delivery by electronic means among their services. CARL's UnCover service, for example, furnishes bibliographic information on articles from some 10,000 periodicals in a variety of disciplines; the information is entered into the CARL database when the latest journal issues are received by the CARL libraries.

UnCover2, the companion delivery service, delivers the full texts of articles from the journals indexed in the UnCover service. More than 97 percent of requests are met, all within 24 hours; 40 percent of the articles requested are sent by telefacsimile within the same working day, and optically stored articles are delivered in less than an hour. A copyright royalty fee is collected for each article ordered; publishers are compensated either directly or by arrangement with the Copyright Clearance Centre. CARL offers a variety of payment schemes: clients may either pay by credit card or maintain deposit accounts; the average size of an account is $500 to $700, and reports on account use are provided monthly.

Of special interest and importance is RLG's new document transmission system called Ariel. Any printed material can be scanned, stored, transmitted, and printed, including material containing photographic plates, charts, formulae, and tables; the system affords its users rapid, error-free transmission and print images of high quality and is designed for transmission of images over the Internet from one user's workstation to another and local printing on laser printers (the telecommunications charge incurred when telefacsimile is used instead is thus avoided).

What many of these initiatives and services involve is the prior conversion of printed material to electronic form; if scholarly materials are increasingly produced and distributed in electronic form in the first instance, sharing of materials will be easier still. In the case of distribution by telefacsimile, an existing technology was exploited almost immediately for purposes of resource sharing among libraries.

The Ariel system offers advantages over that technology. Documents of any size up to 8 1/2 x 14 inches can be scanned directly; there is no need to photocopy them first. The transmitted images can be printed on bond paper of various sizes. Scanning, transmission, and printing are more rapid, and multiple transmissions of the original document are permitted. The user has access to the stored documents, so that any of them can be selected for transmission to other destinations; for copyright purposes a count of the number of times the document is transmitted to different destinations is displayed on the screen when the file is accessed.

It should also be noted that many of the commercial bibliographic services described earlier also deliver full texts in electronic form. Dialog Information Services, for example, in addition to the abstracting and indexing services described earlier, also offers the full texts of such publications as the *Atlantic*, the *Boston Globe*, *Consumer Reports*, *Harvard Business Review*, *Scientific American*, *Time*, and the *Washington Post*, among a great many others; most of the full-text databases are machine-searchable.

Although such services are examples of document delivery services, they are obviously different in kind from the sorts of services considered thus far in that they are provided by commercial vendors; they are not the sorts of services, therefore, that would complement collaborative collection development efforts within library consortia. Moreover, the kinds of texts they deliver represent only a small portion of the kinds of materials academic libraries collect. They do, nonetheless, give some sense of how the full texts of materials of various kinds are increasingly available to individual scholars at their own workstations.

Faxon Finder

Of potentially far greater significance for academics (because of the nature of the material) is a service OCLC and Faxon Research Services, Inc., have recently initiated. Called Faxon Finder, it provides bibliographic information through OCLC's FirstSearch and EPIC services; alternatively, institutions may purchase a site license and load the database locally. The companion delivery service, Faxon Xpress, delivers copies of journal articles located in the Faxon Finder database.

The scanned document, which may contain images, illustrations, and other nontext material, is delivered to the user's telefacsimile machine or to a computer facsimile board; orders received by 6:00 P.M. are shipped by 6:00 A.M. the following day. Faxon offers a variety of accounting and billing plans: institutions may arrange for a deposit account; individuals may have their credit card accounts charged. The user is charged a fixed price and applicable copyright fees, and to ensure compliance with copyright provisions Faxon retains the bit-mapped image of the article only so long as to complete the transaction.

At present, users of the Faxon service are able to receive copies of articles from a limited number of journals; eventually, the service will extend to all journal titles. Further, "[i]n five years," according to K. Wayne Smith, OCLC's president and chief executive officer, "you will look up a journal through OCLC databases, punch a button on the computer, and get the document in your hand."

These various current initiatives permit one at least to envision what kinds of creative, productive resource sharing arrangements and document delivery services might eventually emerge in the electronic age, even if the current services will ultimately be seen as only first approximations of what is possible.

The services of the Colorado Alliance in particular illustrate the kinds of advantages consortial arrangements offer; no one institution in the consortium could envision offering the full range of information services the members acting together can offer one another. The alliance could serve usefully as a prototype of similar arrangements other institutions might attempt. Only when there is fuller experience with such arrangements, moreover, might institutions undertake careful analyses of the contrasting cost implications of either attempting to build self-sufficient collections or instead distributing resources and delivering copies of materials not owned locally to fellow consortium members.

Among the costs of the latter model are those of electronically sharing bibliographic information on one another's holdings to permit collaborative collection development; disseminating copies of materials, either by telefacsimile or some other means; and compensating publishers in accordance with copyright provisions. Fuller data on these different elements of the cost structure should permit at least some preliminary analyses of the relative cost to individual institutions of each of the two principal models of scholarly communication considered in this study.

22

Accessing the Library Websites

Libraries strive to provide access to information for patrons regardless of age, ability, socioeconomic status, cognitive skill, and other potential discriminatory criteria. Accommodating the disabled can be a challenge for libraries. Nationwide, libraries have made admirable progress in upgrading their facilities and services to make access more convenient; however, one area that is frequently overlooked is the library's website. This article explains why website compliance with recognized standards is essential for your library and offers suggestions on how to make your site more accessible. We conclude with a list of recommended web resources.

Website accessibility is becoming increasingly important. According to the *Pew Internet and American Project,* 12% of Internet users have some type of disability. This number will increase as people live longer. According to the Census Bureau, almost half of us can expect to have some sort of disability by age 65. When you combine this with the fact that many Internet users are using old and inadequate equipment, accessibility becomes a much larger issue.

No otherwise qualified individual with a disability shall, solely by reason of his/her disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any programme or activity of a public entity.

Library websites are integral to the programmes and activities offered by hosting libraries, but the federal government did not originally provide guidance on how to meet this mandate, although that has changed recently. In 1998, a law known as "Section 508 of the Rehabilitation Act of 1973" requires the federal government to buy and develop information systems that are accessible to people with disabilities. The legislation is broad and covers all sectors of technology, including websites. This spurred the creation of a set of guidelines for website accessibility by the Access Board, a federal agency committed to promoting accessible design.

The legislation not only affects government websites but also requests all vendors who do business with the government to comply. At this point the guidelines are just that: guidelines, which are non-enforceable. Eventually, the government plans to enforce Section 508. One of the benefits of the law has been the development of the guidelines discussed here. As far as libraries are concerned, the guidelines provide a much-needed outline for dealing with a challenging and time-consuming issue.

Website accessibility is a labour-intensive goal and it will not be accomplished overnight. Trying to implement every aspect of the guidelines can be both frustrating and time consuming. We recommend starting small and with something familiar. The guidelines are directed at large government and commercial websites that often use animation, pop-ups, pull-downs, etc. Many of the guidelines will not apply to library websites and most librarians do not have the time or expertise to develop complicated sites.

Basically, the guidelines cover sixteen key areas (labelled a-p in the legislation). They all rest on the foundation of (a), which states that websites must provide "a text equivalent for every non-text element." For example, screen reader software (software that helps legally blind individuals read web-based text) and other assistive technologies cannot interpret graphical images. Rather, they look for distinct containers called "alt tags" to describe the unidentified picture or graphic. Adding alt tags to your site is easily accomplished.

The two major web editors, FrontPage and Dreamweaver, both accommodate inclusion of this tag. Simply click on the image and add a description in the appropriate location. Another important task is to include text links that parallel any graphical links. For example, one site we worked on recently was partially built using PhotoShop, software used to create graphics and graphical text. In order to remedy this we put regular html text links across the bottom of the page.

Guideline (b) focuses on multimedia presentations. This topic is probably not an issue for many libraries. However, a number of large and medium-sized academic libraries are incorporating multimedia into their sites. The guidelines state that websites must provide "equivalent alternatives" to any multimedia presentations. If your site includes video or audio clips, you must provide some kind of alternative access to this material. For example, you must include audio descriptions of videos and text captioning for any audio clips.

Colour (c) is addressed next. The guidelines recommend that any information conveyed by colour be available without colour. This can be accomplished by labelling any coloured buttons that you have on your site. Also, it is important to provide text descriptions for any colour pie charts, bar graphs, etc. One way to tell if your colour choices are good is to print a page of your site using a black and white printer. If everything is easy to read and makes sense, then your colour scheme is probably acceptable.

A recent popular website innovation is the use of cascading style sheets, and they are the topic of guideline (d). They have been a real boon to web developers because they allow designers to easily control and adjust headings, fonts, colours, and more for an entire site. However, they can be a real accessibility problem.

For one thing, many older browsers do not support style sheets. We had serious problems getting our style sheets to work with Netscape 4.7. Another problem is that people with visual impairments frequently have their browsers set to the maximum font size and alternate colours to make the text more readable.

It is important to design your site so it works well with and without style sheets. Test your page(s) by changing the font, size, and colour settings in various browsers to see how it looks. Another alternative is to use only the style sheet options that minimize interference with screen readers and work across various browser versions. Sections (e) and (f) deal with image maps.

Image maps are graphical images with "hot links" imbedded in them. An example of an image map would be a graphical representation of the United States with each state "hot linked" to information about that state. Image maps are necessary when employing graphics. However, they present an accessibility problem, as a screen reader cannot "read" an image map. One simple solution is to assign "alt tags" describing each active region of your image map. Another solution is to provide regular text links in addition to the image map.

Many web developers use tables for layout designs. Layout tables present problems because screen readers start at the top left of a page and read left to right, dropping one row at a time. This may not be how your site is normally negotiated. The guidelines (g-h) state that any tables used (both layout tables and data tables) should be clearly identified and labelled. For layout tables, this can be accomplished by including a "table summary" in the html. This makes the site more navigable.

Data tables should include both a table summary and a description of what's in each cell.

Frames were a popular in the recent past for dealing with webpage formatting. Many web designers are now avoiding them. Guideline (i) states that if you must use frames, you must meaningful descriptions for each frame and what it does. We would recommend not using them at all.

The next guideline (j) deals with "flicker." This one is not really a problem for library websites, since most do not have pages or images that flash or flicker. The guidelines state that if sites have these features, the flicker must be 55 Hz per second or less as higher rates could induce seizures in people who are photosensitive.

Many government and some commercial sites give users the option to view a text-only version. There are several reasons for this. First, for users with a dial-up connections, load speeds can be painfully slow for graphically rich sites. Another reason is to make it easier for those with a visual disability to navigate the site. Guideline (k) recommends that all sites provide a text-only option. The text version must be kept as current as the graphical site. The object is to provide an alternative for users who cannot access the graphical site. The challenge in implementing this guideline will be the time required to operate and maintain two parallel sites. At this point, we are not doing this at our library, although we try to keep graphics to a minimum.

Guideline (k) focuses on dynamic content. Many commercial sites contain dynamic content, *i.e.*, content that users can manipulate. Some examples include pop-up menus, shopping carts, and rollovers. These effects are created using scripting languages like JavaScript. Dynamic content may require the use of a mouse, whereas people with disabilities often use the tab key to navigate the web. Guideline (k) states that if your site uses scripting to display content, the information displayed by the execution of the script must have a text equivalent. This can be difficult to do, so consider whether your site really needs the scripting. What does it accomplish? If it is not necessary, do not use it. For simple things like rollovers, include an alt tag description that explains what the script is executing.

Guideline (m) deals with plug-ins and is straightforward. If your site requires a plug-in (*i.e.*, an additional software package, like Adobe's Acrobat Reader) to do something, then provide a link to the plug-in. The problem is making sure the plug-ins provide content that is accessible; however, this is really the responsibility of the producer of the plug-in. Adhering to this guideline should not become a primary concern as the most commonly used plug-in for libraries is Adobe Acrobat, and Adobe is a leader in making its products section 508 compliant.

Many libraries use forms for everything from answering reference questions to submitting interlibrary loan requests. Guideline (n) states that forms should be designed with accessibility in mind. Most forms are created within tables, which often generates difficulties for screen readers. The solution is to build your forms without tables, or use a very simple table layout that reads left to right. For example:

Remember to include a table summary at the beginning of the form explaining exactly what it is and how to use it. Also, avoid programming your form so that the return key submits the form. People who navigate web pages by using the tab key use the return key to select check boxes, follow links, etc. One way to accomplish this is to set up your form so that it will not submit the form on return unless all the components are filled out (this is called "validating the form").

The next guideline (o) recommends skipping any repetitive navigational links. Unfortunately, repetitive navigational links have become very popular. Many websites, for ease of use, include a standard toolbar on every page so a user can easily navigate the site; it gives the user a sense of direction. Repetitive navigational links are frustrating and time consuming for someone who is visually impaired. Each time a visually disabled user visits a page, the screen reader methodically reads through the toolbar links. One solution is to include a "Skip Navigation Link" at the beginning of each page. The user could then just click on the link and be jumped to the main content of each page. For those who do not want this link to appear on each page, another solution is to make the "Skip Navigation Link" invisible by making it a button that matches the background colour of the page. You would then need to include an "alt tag" description of the button so the user would know what to do with it.

The last guideline (p) deals with timeouts. If a time response is required, the site must give users sufficient time to respond and alert the user when time is about to expire. This is another issue that would not apply to most library websites, but it is of concern to libraries, since many of the database vendors' websites time out after a period of non-use. As with plug-ins, this is a problem that commercial vendors will be required to solve.

For libraries, the guidelines can be summarized in the following points:

- Provide alternative text for any graphics on your site.
- Provide alternative text for any multimedia content.
- Any information conveyed by colour must have a text explanation.
- Pages should be readable without style sheets.

- Provide text links for any image maps.
- Make tables accessible by labelling them clearly.
- Avoid using frames.
- Eliminate flickering or flashing graphics.
- Provide a text-only parallel website.
- Eliminate pop-up windows, rollovers, etc.
- If your site requires a plug-in, provide a link to access the software.
- Make forms accessible by using a simple design format.
- Include a "skip navigation" link for sites that use a standard toolbar of links.
- Allow users plenty of time to navigate your site.

Many of the guidelines are design techniques that many of us already use, or they are not generally applicable to library websites. The greatest challenges include making tables and forms accessible and providing a parallel text-only version of the regular site. Making forms and tables accessible can benefit all users as doing so will make your site more user friendly. However, designing and maintaining a completely separate text-only site is a major undertaking that many library webmasters will not have time to complete or maintain properly. We recommend viewing website accessibility as an ongoing project. Make the changes you feel comfortable doing now. Make other changes as you add new pages, when time permits, or when you redesign the site. Making your library's website comply with section 508 guidelines will take time and dedication to complete, but it is well worth the effort.

At this point the guidelines are simply recommendations, but there is momentum building to make them law. We are now in the testing phase. The Access Board has developed these guidelines in the hope that government and commercial website developers will begin to experiment and implement them. Updates and changes will occur, but it is unlikely that the standards will diminish or disappear. Accessibility is here to stay and it is a good idea to begin taking some steps towards making your library's website more ADA friendly.

Digital Reference

In his 1876 paper, "Personal Relations Between Librarians and Reader," Samuel Green wrote that it is essential to provide reference assistance to help users locate information because the public is not trained to find information (Bopp & Smith, 2001). By the end of the nineteenth century, the role of the librarian had expanded to include reference service, and it has been part of the profession since then. In the interim, great advances have been made in the field of librarianship. New technologies change the way we search for information and what we expect from reference service. With the introduction of the computer and the Internet, libraries expanded the role of reference beyond the use of the mail, telephone, or the fax machine. However, Green's point remains pertinent: having access to sophisticated technology and more information does not mean that users have better research skills.

In the past ten years, libraries have become both more sophisticated and more dependent on new technologies. For example, libraries migrated from card catalogs to online catalogs. With so many changes in the profession, reference service has also changed. Today, librarians not only help patrons at the reference desk but also in cyberspace. This new type of service, called digital or virtual reference, has emerged as the result of various factors, including the advent and wide use of the Internet and the development of software capable of providing synchronous and asynchronous service. Digital/virtual reference is quite new, but has quickly become popular because of demands by patrons to access information anytime, anywhere.

Digital/virtual reference service allows librarians to help patrons access information in a virtual environment, using various methods such as e-mail or chat. Each type of service has positive and negative features. Although digital reference lacks the face-to-face communication that is an integral part of reference service, the reference techniques used and the scope of the librarian's role have remained the same.

This paper discusses issues related to the use of digital/virtual reference in academic libraries in the U.S. The first section clarifies the terms "digital reference" and "virtual reference," which are often used interchangeably, and explains the slight difference between the two. The second section provides a brief history of the evolution of digital reference. Section three explains how digital reference works, and section four discusses the implications for users and librarians. The last section offers speculations about the future potential for digital/virtual reference.

Digital or Virtual?

The interchangeability of the terms "digital reference" and "virtual reference" and their relative newness have caused some confusion for both the novice and the veteran in reference service. With the advent of the Internet, libraries began to offer online services to their users. One of the simplest types of digital/virtual reference service is online access to the library's catalogue. Digital/virtual reference service developed from the interest in using available technology to provide better access for users. Patrons can be assisted remotely and, in many cases, 24 hours every day of the week.

Digital/virtual reference is a new system, and many issues surround it. Some are being resolved, while others need more attention, including clarification of the terminology. Many dictionaries offer the same definitions for "virtual" and "digital". According to the Merriam-Webster, "virtual" is something that it is not physical, but is made real with the aid of a computer, while "digital" involves the use of computer technology in capturing, storing, and providing information. Both virtual and digital reference make use of the computer to provide information. But do they mean the same things?

Lipow (2003) writes that at the present time there is not a clear use of the words "digital" and "virtual" in the context of reference service and that both are used with the same meaning. She and others in the field agree that digital reference includes a variety of electronic resources, like e-mail or chat, that provide reference service using the Internet. Lipow's statement is consistent with the definitions that others give the terms.

Some professionals simply define the terms "digital reference" and "virtual reference" as similar in service and scope (Borchardt & Croud, n.d.). Others provide a more specific explanation. Kenney (2002) says that digital reference is also "called chat reference, virtual reference, online reference, and synchronous reference" (p. 46). Lankes and Shostack (2000) write that digital, virtual, and e-reference are the same type of service and that they all use librarians as intermediaries to assist users in finding information in a digital environment. Most authors provide examples of digital and virtual reference. For example, the National Information Standards Organization (NISO) (2001) defines digital reference, virtual reference, and online reference as using either synchronous technology, like chat, and/or asynchronous tools, such as e-mail, to provide and assist in the retrieval and use of information.

The Washington State library (n.d.) defines virtual reference as a service that encompasses many electronic aids all having in common the use of the Internet. Some use e-mail, videoconferencing, mail lists, and chat rooms as examples of virtual reference (Gray, 2000); however, many authors prefer to use only e-mail and chat as examples (Fritch & Mandernack, 2001; Francoeur, 2002).

Janes, Carter, and Memmott (1999) define digital reference as, "a mechanism by which people can submit their questions and have them answered by a library staff member through some electronic means (e-mail, chat, Web forms, etc.), not in person or over the phone" (para. 7). Kasowitz, Bennett and Lankes (2000), Wasik (1999), and White (2001) define digital reference as Internet-based services that use humans as mediators. Throughout the literature, the terms digital and virtual are applied to the use of computer-based technology. Library professionals use both terms, and everyone agrees that digital/virtual reference is a new type of service based on the same question-and-answer type of assistance provided in traditional in-person reference.

Sloan (2002), who has been active in the field of digital reference for many years and has worked with the academic Ready for Reference project in the Alliance Library System in Illinois, writes: online or virtual or digital reference services, *i.e.*, the provision of reference services, [involves] collaboration between library user and librarian, in a computer-based medium. These services can utilize various media, including e-mail, Web forms, chat, video, Web customer call centre software, Voice over Internet Protocol (VoIP), etc. (2002, para 1).

Sponsored by the Department of Education, the Virtual Reference Desk (VRD) is committed to the progress of digital reference and the development of Internet services. VRD provides this definition of digital reference: Digital/virtual reference, or "AskA", services are Internet-based question-and-answer services that connect users with experts and subject expertise. Digital reference services use the Internet to connect people with people who can answer questions and support the development of skills (2002, para.2).

There is no consensus on which term to use. Digital or virtual reference provides the same type of service: it allows users to access information and assistance online, using e-mail, chat, video, voice software, or any other Internet technology. "Digital reference" will be used for the remainder of this paper.

History of Digital Reference

Reference service began in the late nineteenth century, and it defined the role of the librarian as a provider of information, assistance, and instruction (Bopp & Smith, 2001). These services have not changed. What has changed is how librarians provide these services. Today, librarians not only help patrons in-person but also virtually. It is important to briefly discuss the development of the Internet while talking about the evolution of digital reference, since the latter would not exist without the former.

Online technology developed in the early 1960s, but did not receive much attention until the 1980s. Early computer systems, such as BOLD, designed by Harold Borko in 1964, provided a glimpse of the possibilities for the retrieval of information (Hahn, 1996). During this early period, libraries became interested in developing a system that would allow them to retrieve information faster and more accurately. To demonstrate the potential for the use of computers in libraries, the American Library Association (ALA), in collaboration with Joseph Becker and Robert Hayes, developed a system that allowed users to search a bibliographic database through a computer using a standard telephone line.

The device was presented at the 1964 New York World's Fair in the Library/USA exhibit. The equipment allowed the librarians to provide answers to 800,000 questions in 18 months (Hahn, 1996). These first systems were difficult to use and costly to maintain, and did not provide enough incentive for companies to invest in something they believed was not going to be marketable. However, not everyone was skeptical about the potential of online systems.

In 1964, Roger Ken Summit, a researcher who worked for Lockheed Missiles and Space Company, was developing a system for NASA that used computer technology for the retrieval of information. Foreseeing the potential of the system in the private sector, Summit (1999) redefined the procedure and, by the 1970s, DIALOG, the first commercial database, was created.

At the same time that Summit was developing DIALOG, Vinton Cerf and Robert Kahn, in collaboration with the US Defense Department, developed the Advanced Research Projects Agency Network (ARPANET). The system connected three computers in California with one in Utah, creating a network in which data were shared. In order to allow the computers to share resources across a network, the system used the TCP/IP protocol. Three standard elements of the TCP/IP protocol are (1) the ability to do file transfer protocol (FTP), which allows any computer to get files from another computer, (2) to have network terminal protocol (TELNET), or remote login, which permits a user to log in and use any computer on the network, and (3) to have computer mail, which allows the user to send messages to other users on other computers (Newton, 1987). The purpose of this experimental project was to facilitate computer communication between people, and eventually, the system developed into what we know today as the Internet, a network of networks, which also allows libraries to provide online catalogs, access to full text material, e-mail communication, and chat capabilities (Bishop 1991).

The increased interest in providing digital reference, the advent of the Internet, and evolving technology led to a dramatic increase in web servers, from 130 in 1993 to 11,576 in just two years (Bournellis, 1995). By 1994, 77 percent of the libraries in the US provided their users with Internet access, and three years later, all of the libraries were using web-based systems (Tenopir & Ennis, 2002). The Internet has allowed users to become more independent in searching for information and at the same time provided librarians with a tool to reach out to users.

Following DIALOG, other databases were developed such as Information Bank, ORBIT, and BASIS. These systems allowed librarians to either limit or expand their queries, thus making their searches more exact. Most importantly, with this new technology the need for a computer programmer was eliminated because the new system supported command-driven searching.

These types of searches were still limited, however. Librarians were the only ones who had the appropriate training and access to use the new systems. Reference service expanded from directing users to print material to retrieving information from databases. By 1980, online searching became a standard part of reference service, requiring all librarians to have more technical skills than in the past (Hahn, 1996). In time the Internet became widely used not only in libraries, academia, and government, but also in the private sector. The success of this service relied on the ease with which people could find information and connect with each other on a level never possible before (Hauben, n.d.).

Because of the new technology, communicate and sharing of information changed. The first type of digital reference was e-mail. E-mail was first used by librarians to communicate with one another and, soon, with users as well. In 1984, the University of Maryland Health Sciences Library and the Health Science Library at the University of Washington developed a service called Electronic Access to Reference Service (EARS), which provided reference assistance via e-mail (Still & Campbell, 1993). Three years later, the libraries at Indiana University developed an e-mail system called LIRN (Libraries Information and Reference Network), which was menu-driven and part of a network system (Still & Campbell, 1993).

Interest in digital reference increased steadily; the users wanted to have access anytime, and the librarians wanted to provide a better service, while companies were interested in developing new programmes and tapping into a new field of service. ASKERIC, developed in 1992 as a project of the ERIC Clearinghouse on Information and Technology, began to offer digital reference services, and, according to its director David Lankes (2000), the usage has increased 20 percent annually since then. As of 2002, one thousand libraries offered digital reference in the form of either chat or e-mail (Dougherty, 2002).

Interest in digital reference spread among librarians. In 1999, the conference of the Virtual Reference Desk (VRD) drew 220 people. The following year attendance doubled (Oder, 2001; Borchardt & Croud, n.d.). Consequently, the use of digital reference service increased dramatically. By 1999, 75 of the 122 libraries of the Association of Research Libraries (ARL) offered digital reference via e-mail or used a web-based system (Fritch & Mandernack, 2001), and by mid-1999, 358 of 473 academic libraries provided digital reference (Janes, Carter & Memmot, 1999).

As users became aware that they could access librarians from the comfort of home, the number of requests increased. An ARL survey done in 1988 showed that 20.25 percent of the patrons used e-mail for help with reference questions (Still & Campbell, 1993).

The Tompkins-McCaw Library at the Medical College in Virginia saw an increase in e-mail reference from 19 questions in 1990 to 38 the following year (Still & Campbell, 1993). A survey from ARL showed that in 1999, the average number of questions received by reference librarians was 67 per month (Horn, 2001).

Christina Peterson (personal communication, March 12, 2003), distance librarian at San Jose State University, commented that between October and December 2002, the library received from 65 to 80 questions. Patrons use e-mail to ask a variety of reference questions. Librarians at the University of Illinois at Urbana-Champaign reported that nine percent of the questions received involve ready-reference, while 20 percent require research (Janes, 2002). Coincidentally, the increased use of digital reference has decreased the use of in-person reference services (Tenopir & Ennis, 2002; Montgomery, 2000; Coffman & McGlamery, 2000; Whitlatch, n.d.).

Digital reference evolved from basic e-mail correspondence to more sophisticated systems that allowed librarians to show search results to users. One of the first projects was “See You See a Librarian” developed in 1996 by Eric Lease Morgan. The purpose of this service was to investigate the possibility of providing chat communication between librarians and possibly between librarians and patrons. By the end of the 1990s, several companies began to develop software for reference applications.

LSSI was one among the first pioneers in this field and presented the first digital reference service software at the ALA conference in 2000 (Oder, 2001). In 2002, the Library of Congress with OCLC developed Question Point service, a collaborative reference service (Question Point, 2002). Today, there are many digital reference systems. The only two that are non-profit are OCLC and 24/7 Reference (Hirko, 2002).

How Digital Reference Works

As we saw, digital reference uses the Internet to allow people to connect with a librarian. Libraries are using two types of digital reference services, e-mail and chat. In both cases, librarians must do an interview to understand what the user needs. This section discusses how the process of reference interview applies to digital reference and explains how e-mail and chat reference work.

When conducting in-person interviews, librarians rely on many clues from the users, including body language. With digital reference, neither the librarian nor the user have access to these important clues, thus doing a thorough reference interview is critical in helping the user. The service virtual users receive must be comparable to that of in-person users.

The Reference and User Services Association (RUSA) (RASD, 1996) has developed five steps to follow when helping in-person users: approachability, interest, listening/inquiring, searching, and follow-up. How can these points be used when doing digital reference? Many of RUSA suggestions are not feasible for a digital reference interview; however, they can be modified to fit this situation. For example, to demonstrate approachability, the librarian should acknowledge the user by sending a short message and indicate the possible wait time. Sending messages to the user and keeping him/her informed of what the librarian is doing are all-important elements to show interest.

The listening/inquiring part is when the librarian should ask questions and, at the same time, make sure that what she/he understands is what the patron needs. Questions, such as "What have you found so far?" and "What did you use in your research?" are commonly asked in a person-to-person interview, and should be used in a digital reference session as well. During the search the librarian should provide a variety of accessible information to the user and then ask the patron if his/her question was answered. The follow-up question allows the librarian to verify that the user is satisfied with the material provided, and possibly to refer the patron to a library subject specialist. A recent study on digital reference showed that 60 percent of reference queries are assigned to experts (Pomeratz, Nicholson, Belanger & Lankes, 2003). The reference interview will differ according to whether the librarian is using e-, mail or chat.

E-mail Reference

E-mail reference includes e-mail and web-based forms. E-mail service provides asynchronous service; that is, the user sends the message and receives an answer at a later time. The user can usually find a link for the e-mail service on the library's web page, with a form to fill out. Some libraries and AskA services provide archives where the most commonly asked questions can be found. When a query is sent, the system automatically matches the question with the information in the archives. Although 63 percent of the questions can be matched, only 25 percent of the users find their requests properly answered (Pomeratz et al. 2003).

The questions that are sent are saved on a campus mail server, and librarians rotate the task of answering them. In general, e-mails are checked once or twice a day, and if a question requires complex information, it is forwarded to a library subject specialist (Peterson, personal communication, March 12, 2003). When providing digital reference, librarians must maintain a professional attitude. They should always include a greeting, identify themselves properly, make sure their messages are clear and free of errors, and avoid the use of abbreviations and emoticons.

The major problem in providing digital reference using e-mail is the inability to do a thorough interview. It takes several communication efforts between the librarian and the user to make sure that the information provided answered the user's question. Ideally, the e-mail reference interview should consist of three e-mails, the first one sent by the user with the question, the second sent by the librarian with the information, and the last sent again by the user confirming that the information received satisfied his/her question (Viles, 1999; Archer & Cast, 1999).

In order to conduct an effective e-mail interview, Abels (cited in Archer & Cast, 1999) suggests using one of two methods. With the first method, the patron is required to fill out a form specifying any limitations they have such as language, due date, or amount of information. The second approach requires the librarian to respond to a question that is not clear with a list of questions that will help the librarian find the appropriate information. The second approach requires more time of the librarian's time, and there is no guarantee that the user will want to answer the questions required to help them. In fact, according to Carter and Janes (cited in Pomerantz et al., 2003), 30 percent of users who are asked to provide more explanation of their query never answer. Moreover, only 17 percent of librarians can establish if the communication is a follow-up or a new question because often the user fails to provide conclusive information (Pomerantz et al., 2003).

Chat Reference

In an academic library, students are the primary users of digital reference, and they tend to prefer chat reference service over e-mail because it involves a two-way conversation in real time, very much like talking to a reference librarian in person. Chat users can receive immediate feedback, thus they can use written language in the same manner used in a person-to-person conversation (Riva & Galimberti, 1997).

There are several chat systems libraries can chose from; the most widely known are 24/7 Reference, LSSI – Virtual Reference Toolkit, and QuestionPoint. Although these types of services are commonly associated with a 24-hour-a-day, seven-days-a-week service, they can also be modified to offer reference service at specific times. As with e-mail service, typically a link from the library's main page will direct the user to the service. Janes, Carter and Memmot (1999) report that half of the libraries they surveyed had a direct link from the library's homepage.

The first step in asking a question using a synchronous reference service is for the user to complete a login screen. Some libraries only allow users from their institution to use the service, thus identification is required. In all of the chat services currently in use, the users are cautioned not to use the refresh or forward buttons, as they will be disconnected from the chat session. After the question has been sent, the software notifies all of the librarians who are online and monitoring the queue, and the first available librarian answers the question.

In answering questions online, librarians use the same criteria used at the reference desk. Librarians who work with digital reference tend to prefer web-based or electronic sources because they are easier to access and to share with the user (McGlamery, personal communication, March 19, 2003), in fact, in 80 percent of the cases librarians are helping users without the use of print sources (McGlamery, cited in Kenney, 2002). Users want more online resources, including access to full text material and not just abstracts. Malinconico (1992) states that because of this new need, many academic libraries have begun to budget more money toward digital reference rather than print sources.

Chat differs from e-mail because it provides real-time help. Although there may be multiple communications between the user and the librarian, using chat they are completed in the same session. As with e-mail, if the librarian cannot satisfactorily answer the request of the user, he/she can forward the question to a specialist who will get back to the patron. In this case, the patron will need to provide an e-mail address or other form of contact. One important skill that a librarian working with this type of service must develop is to keep the interview short to prevent the users from becoming bored or the system from logging off (Coon & Wojtowicz, 2002). This can be a challenge since the average time of an interview in a digital setting is ten minutes (Janes, 2002). That may not be long in a face-to-face setting, but online it seems an eternity.

With chat, librarians can use a variety of tools to facilitate communication with the patron. One of the most important features in chat reference is the use of software with the ability to co-browse. This feature allows the librarian and the user to communicate while viewing the same web pages. To respond quickly, the librarian can also use pre-written messages. These messages involve typical greetings and sign off texts and are used to reduce the time and typing involved in the reference interview. Other features include the ability to highlight text on the user's screen, as well as screen sharing, where the librarian can view the user's screen, and share forms, where the user has the capability to see what the librarian is typing while doing the search.

Implications of Digital Reference

Digital reference provides an unprecedented type of service. The academic community and libraries around the country welcome it; however, as with all innovation there are questions. Some important ones relate to staffing and training, policies, legal issues, and assessment of digital reference. Digital reference has raised expectations about the availability of service. When libraries offer digital reference, they must consider the expectations of the users. Students, in particular, expect to be able to find help anytime. As with in-person reference service, librarians and libraries must strive not only to provide the best service to their users but also to teach patrons how to use resources available to them. In order to provide a service with such standards, adequate staffing and training must be taken into consideration.

Not everyone sees this new service as necessary. Some librarians are questioning the need for such service, if it provides the same quality as person-to-person reference, and they wonder how librarians can manage this added task in their workload (Stover, 2000; Coon & Wojtowicz, 2002; Tenopir & Ennis, 1998). Digital reference requires not only reference service but also assistance in using hardware and software (Tenopir, 1998).

These demands can cause librarians to experience physical and psychological distress, more commonly referred to as "technostress," the inability to cope with greater demands of service and increased use of computer-based technology (Kupersmith, 1992). To foster knowledge, connect people with information, and promote the library, librarians must continue to evolve and learn. In order to promote information and access to information, librarians will constantly need to stay up to date with technology, because "[t]here will be no place… for librarians who are not willing to interact with technology" (Zink, 1991, p. 76).

To lighten some of the burden that digital reference may bring, some suggest using a system that will draw from a database of questions. However, this type of software has a relatively low rate of success because the computer is not able to "think" like a human. Dilevko (2001) suggests creating call-centres that utilize paraprofessionals to answer general questions, but this creates two problems. First, it may decrease the use of professional librarians, and secondly, teaching information literacy skills is an important component of reference service, and most paraprofessionals are not trained to do this. The main purpose of reference service is to help users find information. In a virtual environment, users need to be able to understand how digital reference works and, especially, how to use it. Librarians should experiment with the type of software they want to use, and make changes accordingly. For example, North Carolina State University had to modify its digital reference service because the system was too complicated for the patrons to use (Boyer, 2003).

Policies must be flexible enough to allow for the changing needs of the users and technological developments (Kasowitz, Bennett & Lankes, 2000). These policies, according to Sloan (1997), should include when the service is available, what the service provides, and who can access such service, for example the public or only the academic community.

Another consideration is the costs involved in establishing and maintaining the service, which include software, hardware, technical support, and staff training. Prices vary and libraries should shop around. For example, Susan McGlamery (personal communication, March 19, 2003) of 24/7 states that the cost of their software is $4,000 per seat set-up, and $3,600 per seat per year thereafter for support and maintenance, with a one-time charge of $1,000 for training. The training, adds McGlamery, is for any number of librarians who want to participate, while the annual license fee depends on how many librarians are logged on simultaneously to answer questions. Although librarians can receive excellent training by vendors, Eisenberg and McClure (2000) emphasize that digital reference training must have some standard guidelines and that training needs to begin in library school. Not all librarians may be suited to work with computer-based services. Librarians may find it useful to develop aptitude tests to discern whether a reference librarian has the personality to work with this type of service (Abbas, 1997).

Digital reference also provides the opportunity to collect data for statistical purposes. It may also collect contact user information in case a librarian needs to provide more information to a user. However, collection of this type of information can lead to abuse or dissemination of private information. Access to personal information has become an important issue for librarians, especially after the enactment of the USA Patriot Act in 2001. Librarians may be asked by the federal government to supply information about users' library activities. To avoid potential problems, academic libraries should develop and post privacy policies, as some public libraries already do. One example of such policy is posted on the web page of Internet Public Library (2003). Kasowitz, Bennett and Lankes (2000) provide additional standards on how to develop such policies.

One of the most pressing issues surrounding digital reference is effectiveness. There is not enough data to ascertain how well digital reference works or whether it is as helpful as person-to-person reference. Eisenberg and McClure (2000) emphasize that librarians must develop a set of criteria for user satisfaction, because right now there is no way of knowing if the service is effective, if people like it, and if people return to use it. Without this information, it will be difficult to improve reference service.

The Future of Digital Reference

There are mixed feelings in the profession of librarianship about what the future of digital reference holds. Some librarians feel that it reference will fade away, while others think it is here to stay and will evolve. The general feeling is that digital and traditional reference services will coexist (Straiton, 1999). Oder (2001) points out that both services are needed because each provides a specific type of service. For example, questions that require more interaction and are detail-oriented are better handled in person, while ready-reference questions are better suited to chat, and questions that require longer research are best answered using e-mail. Providing this variety of reference services is important, since patrons process information in different ways. As technology becomes more sophisticated, libraries will use more and more digital reference. Users like to have access to the Internet.

It is convenient and many students have practically grown up using online services. The move toward a more digital society is apparent in libraries. Straiton (1999) notes that as time goes by, the term "reference service" has mutated from "reference" to "reference and information service" and finally to "information systems and technology". This interest in moving toward a more technological culture is also reflected in the increased number of computers available in academic libraries, which increased 14 percent between 1994 and 1997 (Tenopir & Ennis 1998). As technology continues to bring new tools into our lives, digital reference must keep up with the pace.

Because librarians will need to rely more and more on material found online rather than print sources, there is an urgency to convert information into digital format. Providing patrons with online resources will soon not be enough, librarians and users want more interactivity. One of the major requests made by reference librarians to vendors is to have the capability to scan material in print and send a PDF to the patron (Kenney, 2002).

Another trend that will become more common in the future is that academic libraries will become part of larger consortia in which information is shared among all participants (Malinconico, 1992; Kawositz, 2001). Beside providing around-the-clock service, libraries will be able to decrease their collections budgets and take advantage of special collections provided by other libraries.

Because of the need to share information, new policies must be developed to address all aspects of digital reference, such as standard vocabulary for answering questions, copyright, privacy, charges, what materials can be used by each library, and so on.

Among the innovations that reference librarians want are the ability to conduct videoconferences (Oder, 2001; Eisenberg & McClure, 2000), to have wireless hand-held computers to allow movement around the library (Lipow, 2003), to provide Voice over Internet Protocol (VoIP), as well as to develop systems that are compatible with assistive technologies for those with disabilities, to allow them to access and receive the same level of service (McGlamery, personal communication, March 19, 2003). Will the reference librarian of the future be able to talk to and see the patrons, walk around the library showing resources, and scan and send information from in-print and online sources? Only time will tell. Digital reference is in its infancy and anything is possible.

Conclusion

With the arrival of the Internet, libraries are expanding into cyberspace and are reaching out to segments of the population that otherwise would not use a library. Even though librarians must adapt to new technologies, the notion of providing reference service, first mentioned in Green's paper in 1876, will not change: reference librarians will continue need to reach out to patrons and help them find and use information.

Digital reference service has introduced new opportunities as well as challenges for librarians, users, and vendors. Librarians should embrace this challenge and seek out new and improved methods to provide reference service.

The Development of Chinese Modern Library

Library Buildings

China has a long history in library cause. Tianyi pavilion, which was built in Ningbo of Zhejiang in Ming dynasty (1561 1566), is the oldest library building that still remains in china. After that, the seven pavilions (Wenyuan pavilion in Palace of Museum in Beijing, Wenyuan pavilion in Yuan Ming Yuan, Wensu pavilion in Shenyang, Wenjin Pavilion in Chengde, Wenjiang Pavilion in Yangzhou, Wenzong pavilion in Zhenjiang and Wenlai Pavilion in Hangzhou), which were built for collecting Sikuquanshu (full books of four storehouses) in Qing dynasty, were built by emulating the style of Tianyi pavilion.

The main function of the seven pavilions is collecting of books, but borrowing books for reference seldom happened. It was after the War of Opium that China began to build the library which has the characteristics of modern public libraries. The reading rooms for readers to read books were first provided in sequence in Storage Building for Old Books built in Shaoxing of Zhenjiang in 1897, the Ji angnan Library built in Nanjing of Jiangsu in 1908 and Jingshi library built in Beijing in 1916 and so on.

In the beginning of 20 century, the library buildings with European and American styles were built in sequence with the input of western cultures, such as the 'Tsinghua University' library building which was built in 1919 and enlarged in 1931, the Mengfang library of Southeastern University which was built in 1922 and enlarged in 1933 with three independent parts for collecting, borrowing and rea ding, and with uncrossed streamline for readers and books. These libraries have not only been used for collecting of books, but also for borrowing, and become the public activity sites of readers. According to statistics, there had been 2935 libraries of various kinds by 1930 and 6191 libraries by 1936 throughout the country.

After the P.R. China was founded in 1949, there have been great development in library. Especially during the past 15 years, Chinese library buildings have had breakthrough not only on numbers and scales, but also on levels. According to incomplete statistics, from 1949 to 1987, there built 1440 public libraries on and above the level of county, 1158 university libraries, 4500 special libraries, 246000 trade unions's libraries (rooms) and 32264 military libraries (note 1). Compared with the beginning of P.R. China in 1949, the numbers of various libraries have increased more than 40 times. The numbers of university libraries increased 7.9 times from 132 in 1949 to 11175 in 1989, with the total collections reaching 400 million volumes and areas totalling 4,400,000 square meter. The libraries under the China academy of science increased 7.4 times from 17 in 1949 to 143 in 1990, with the total collection of 80,000,000 volume (note 2). Up to now, China has 2579 public libraries on /above the county level, and also has 77 independent libraries for children and juvenility, and more than 160 motional libraries (note 3).

The Library Buildings in Different History Periods1949-1957

During the period from 1949 to 1957, most of libraries were rebuilt or enlarged. Most newly built libraries are not in large scale, except several university libraries such as the libraries of China Southern Industrial College built in 1952 (8600 square meter, 1200 reader's seats, 1,600,000 volumes), the library of China East Normal University built in 1953 and enlarged twice (20288 square met er, 900 reader's seat, 1,800,000 volumes), and the Nankai University's library built in 1956 (10287 square meter, 1100 reader's seats, 1,000,000 volume). The Chinese libraries adopted management method of close shelf in past long time. For the systematization of collection and completeness of reservation, more attention was paid to the three functions of collecting, borrowing and reading, and libraries were divided into independent parts.

With the continued improvement and completeness of management, and more and more definite technical requirement, the library buildings mainly with management of close shelf have been completed increasely. The library of China Southern Industrial College built in 1952 with the plane of nn turned 90 degree and the library of China East Normal University with the plane of nn are both divided into three large spaces of collecting, borrowing and reading according to flow line of books and journals, the main character of which is to keep stacks as indpendent unit and make other rooms around stacks. This design influenced the later ones greatly. Because of limited conditions, most of libraries built during the 1950's adopted composite structures with small opening, wood and sloop roof, and no mechanical equipments to move books. The period of 1958 1965

During the Period of 1958 1965

Libraries had great development throughout the country and many new libraries were built. The number of libraries had reached 573 with average annual increasion of 22, and the number of university libraries also reached 434 (note 4). Among these libraries, the larger ones include the library of Heilongjiang province (11000 square meter), the library of Shanghai Academy of Science (8600 square meter), the library of Beijing Normal University (9300 square meter) and the Library of Xian Transportation University (11200 square meter). By 1965, the building design of Chinese libraries adopting management method of close shelf had been nearly completed. Most of libraries were designed into traditional or little changed traditional plan of nn shape. According to statitics, about 70% of libraries built in 1960's used this design.

The main idea of the design followed the principal of management of close shelf that collection is the first factor to be considered. In this design, stacks lie in the back with reading rooms in the front and circulation desk in the middle. This arrangement has definitely divided districts, convenience the management, make each streamline uncrossed, meet the requirement of reading and management of close shelf, and also has a more simple building structure. During this period, a set of new libraries were built in this design style. Therefore, this style with same history characters and definite content under special economic, technical and management condition was developed into a settled library type, which was late called Chinese traditional library and whose shape of nn, J, E½, nn (turned 90 degree) and nö developed from nn shape were called traditional plan.

1966 1976: During this period, the library cause suffered serious damage because of the political reason. Very few libraries were built and most of new libraries built in this period were in small scale except the Beijing University's new library in larger scale which has area of 24,000 square meter and was built in 1974. This library can be considered as the representation of traditional plan arrangement of library buildings built in this period, with 2400 reading seats, 3,100,000 volumes and plan of nö shape. The library absorbed the advantage of the reading rooms which had aid stacks and was divided according to speciality subjects in the late part of 1960's, therefore, had more rational functions. This is a distinquished progress of library building design. During this period, in some small libraries there also appeared some improved designs based on traditional plan, which had more flexible functions and arrangement, rational application and beautiful shape so as to make people have a new feeling. Among these libraries, the better examples are the library of Suzhou Medical College, Shanghai Science and Technical Library and the Library of Zhongqing University.

After 1977: With the Chinese government's solving the chaos, returning to the correct course, and performing the policy of reformation and opening, Chinese libraries cause appears new situation of flourishing development and a great set of new libraries have been built, for example:

- the Library of Sichuan province (13000 square meter),
- the Library of Wunan province (29000 square meter),
- the Library of Zhongsan University (14000 square meter),

- the Library of Sichuan University (15000 square meter),
- the Library of Wunan University (12500 square meter),
- the Library of Northeast Industrial College (15000 square meter),
- the Library of Wuhan University (15000 square meter),
- the Library of Fudan University (12000 square meter),
- the Baozhaolong Library of Shanghai Transportation University (26000 square meter),
- the Library of China East Normal University (21000 square meter),
- the Library of Beijing Normal University (13000 square meter),
- the Library of Tsinghua University (20000 square meter),
- the Library of Beijing Agricultural University (12000 square meter) and so on.

In addition, there were also a large set of county public libraries and libraries for children and juvenility in middle and small scale. During this period, with the reform and progress of library management work, the new library had the new breakthrough in the plane of architect design in addition to the characters of large number and scale. For example, the library of Hefi industrial college was divided into four units according to function requirement. These four units were combined freely and appeared as the yard made of four houses (Siheyuan), therefore, broke the style of normal symmetric and strict layout.

The plane of the library of Nanjing railway Medical College is normal rectangularity, adopting 5.0 m by 5.0 m rising planet structure with column net, large opening and depth. The library used light seperating wall to divid space, with the ability to rearrange and move the wall. The stack lies in a corner of the rectangular plane, the building of the library has same story height, which provides the conditions for future open shelf reading. This building was one of earlier practical example attempting to combine foreign design method of modular library with practic al situation in China. With the flourishing development of *"four modernization construction"* in China, normal traditional borrowing and reading method of books and materials cannot meet the need in large.

Therefore, the requirement of borrowing and reading in open shelf were put forward in general. Out of question, this was a powerful impulse to management and building design of libraries. In the beginning of 1980's, professionel persons sysmatically import the design method of modular library developed after the World War Two, which made more designers to explore a new way adaptive to building design of libraries in China according to the practical situation of China.

In 1987, *"the Building Design Code for Library"* was approved and promulgated by the Ministry of Urban and Rural Building and Environmental Protection, Ministry of Culture and State Committee of Education, and was enforced on Oct. 1 of the year. The code was the first technical regulation for building design of library since the P.R. China was founded and also was the summarization of more than 30 years' experience of building design of library. Management system of open shelf such as reading in open shelf and in stack was first put forward by universities, science and research institutes and some libraries in basic units.

What this management method pay attention to are more close and wide contact and the largest shortening of distance between readers and knowledge carries, and most simple procedure of borrowing and reading. Therefore, the management system of reading in open shelves appeared and the function of collection, borrowing, reading and management in reading room began to form a unified unit, which was one of big breakthrough in building design of libraries. With the appearance of the unit mentioned above, the space of reading room was required to be enlarge d and to had adequate possibility for flexible arrangement so that the opening and depth of building were enlarged. In order to solve the contradiction of light and ventralization and strengthen changeability of application, some new forms were studied out, in that reading space can be freely divided, actively separated, changed in area and adjusted.

For example, the library of Funan University have made the attemption and achieved good effect. After that, the requirement for unified column net, unified floor loads and even for unified story height to the design of libraries were put forward by many designers for the purpose of making the whole building more adaptive. In addition to this, with the import of advanced technology and equipment of library such as computer, microfilm and video/hearing and so on, a set of new library with Chinese characteristics were sprung up in sequence during the period. At same time, most architect also paid attention to interior and exterior environmental design and strive to create a new, unaffected and cultural shape, and provide interior space of good reading condition for readers, which was also one of the characteristics of library building in this period.

Now, some library buildings having characteristics and breakthrough are generalized as follows: Design of the Library of Sichuan University was based on reading and management of open shelves, breaking traditional plane of nn shape composed of four large parts of collecting, borrowing, reading and management, and adopting design method of modular type to unify column net and form several facult and student reading units in different district, and several parts of the district of stack, reservation and special collection and so on. Each district depends on other and also is independent ralatively.

Considering open shelf reading, the library was designed for the possibility to enter into the stack to read, with 2.8 m story height. Each stack story is structure story using beamless roof and motivable shelves. The advantage of this design is that the flexible arrangement in near future and reading and management of open shelves in long future can be made Chinese libraries building gradually formed own design module (close shelves: 1250 mm, open shelves: 1500 mm) by absorbing the advantage of foreign modular design.

Major opening and dimension of column are determined based on times of basic module, which are not only adaptive to desk and chair arrangement of reading room, but also additive to shelf layout in stack, with the possibility of interchangebility. By practical summarization, the column net dimension in general use is 5.0 m by 5.0 m for close shelves and 7.5 m by 7.5 m for open shelves. This unit area under column net is more adaptive to reading of open shelf, collection of close shelf, reading in the stack and division of general official aid rooms.

The Library of Funan University

Which has one story under ground and eight stories above ground, use centralized plane and vertical layout of low stack and high reading room. The library has the faculty reading room in lower story and student reading room in upper story, with the 30 m by 35 m plane of standard story. The middle part of the library had aid stack between two stories, connected with reading space, which can be use d for close shelf, half open shelf, and also for full open shelf, with the advantage of flexible use, elasticity of enlarging and contracting, and adaptivity to development and change in long future. During this period, there are also some exploration for the problem whether the library can be built in high building.

In addition to the library of Funan University and Baozhaolong Library of Shang hai Transportation University, the library of Wuhan University, breaking 4-5 story limit of regular libraries, designed 8 story building and use vertical layout of high stack and reading room, with each story having basic unit consisting of basic stacks and reading rooms. Each story has reading room and related stacks according to speciality, which can be used for close shelves and open shelves, shorten the traffic line, have direct contact and also simple plane combination. That faculty reading rooms lie in upper stories aided by elevator and student reading rooms lie under the four story better solve the contradiction of centralization of person movement and unconvenience of vertical traffic, which explored a new way for libraries of high building. The new library of Tsinghua university which was built in 1991, was built beside the old library.

Because the design fully consider unification of forms between new and old library and harmonious of the new and old library with space environment of nearby buildings, the new library was unified as a whole body with old one after the new library was completed, which got the good appraisal from all fields. What deserve to be mentioned is the library of Beijing Agricultural University completed in July of 1990, which were designed and constructed carefully according to Chinese own conditions after the advantages of foreign modular library were fully studied and absorbed, and realized large space (6.6 m by 6.6 m column net), full open shelf, and an organic whole of four functions of collecting, borrowing, reading and management.

After the library have been used for 3 years, it was considered unanimously as one of good libraries among the China's modern libraries under the appraisal of experts from both the fields of library and architects. The efforts and attemption of the library to realize modernization of library have made active contribution to construction and development of Chinese university libraries in the future. The library of Shenzhen City, the Library of Guangdong Province and new Beijing Library which is the highest level in China can be considered as the representations of libraries with high standard, technology and level in this period. The appearance of them marks that the construction of Chinese modern library has reached the international advanced levels. The common characteristics of them are as follows:

1. The plane layout does not follow the conventional pattern, but fully consider the need of functions and use, with free combination, flexibility and spacious:
2. Fully meet the need of open shelf reading and management. The column net, story height and load are unified and there is large opening and depth in building design. The major reading space make the four functions of collecting, borrowing, reading and management into an organic whole.
3. There are complete facilities. The libraries have not only general subject reading, but also have the reading of rare books and special books: have not only the function of borrowing and getting the books, but also have the function of exchanging and transmitting information, consultation, video reading and academic exchange. In addition, the Children and disabilities can also read in the libraries.

4. Facilities are advanced. The system of computer management, microfilm copy, video production, security and fire extinguishing, transportation, communication and television have all reached international level.
5. The traditional major axis (hall circulation hall basic stack) has recede to second consider, substituted by convenient traffic and spacious communicating space and yard, which provide good environment for academic exchange, contact, consultation, and transmitting of information. Most of library have unified the reading, rest and acadamic exchange to an organic whole and developed toward the direction of multi functions.
6. The building pattern of many libraries have obvious nationality characteristics and local style, and also made the contribution for creating Chinese own new building figures in art modelling.

The New Beijing Library

Which was approved by central government in 1980, was included in national construction planning according to the design plan approved by premier Zhouenlai. The library has area of 140,000 square meter, 20 million volume and 2,000 reading seat.

The major building can be divided into 11 units, with basic stack, rare book and social science reading unit, social science reading and study building, catalogue and circulation hall, natural science reading building, natural science reading unit, newspaper and audio visual material building, material reading unit, official affair building, exhibition hall and report hall and so on. The open shelf reading is the main consider in design and multifunction of collection, information and so on are considered in symposis. The library is a super large building with story structure, designed according to 8 degree earthquake resistant grade, having 3 5 grade air defence basement. The library building is site cast reinforced concrete frame structure system.

The single or double side plastic plate with dense ribs are used in floors and the complicate structures such as steel stretched table and large space net and so on are also used. The technical system is complete. There are security system of alarm for protection and extinguishing of fire controlled by micro computer, air condition system for cool and heat, programme control telephone system, trasmitting message by air, automatically trasmitting system of books, elevator system, power system controlled by high and low voltage switch, heating and lighting system, control centre of electric computer, net system, closed supervision television, broadcast, interpret in same time, record, video and microfilm, etc.

The new Beijing Library are considered to be the representation of Chinese modern library buildings in this period not only on building design and technical level, but also on shape and arts, in which much experience can be summarized and absorbed by late people.

Development of Chinese library

In general, modern libraries have three large characeristics and eight aims:

That is high efficiency, flexibility, good environment, microfilm of collection, audio and video of books, computerization of catalogue, retrieval, borrowing and reading; automation of transmit system, audio visual of reading, net of information system, science of management procedure and changeability of adoption to development.

At present, the *"eight aims"* have been realized at different degrees in newly built libraries. The policy of undertaking building design based on the directive idea of open shelf has been accepted by large numbers of libraries building designers and readers. Therefore, It is necessary to summarize experience more deeply, strength the understand and complete practice so that Chinese library cause can develop continuously to good direction. According to Chinese situation, study and use *"modular library"* for reference. 1, In the aspect of shorting the distance between acceptors of knowledge and information (readers) and knowledge media (carrier) and advancing efficiency of borrowing and reading, great amount of work and attempt has been made for recent more than 10 years in China.

The open borrowing and reading, and management method such as open shelf reading and entering stack reading, etc. which give readers most convenience and most effect service have been accepted and welcomed by both librarians and readers. Therefore, after World War Two, the building type of modular library developed in Europe and America, attract the attention of Chinese library field.

The obvious characteristics of this type is designing according to a certain principle of modular type, having bigger space and unified column net, story height and loading capacity (called *"3 unification"* in abbreviation), forming different function space by furniture and try to adapting to need and development of multi functions of libraries (note 5).

Therefore, this type has stronger vitality. Because the foreign examples are not fully adaptive to Chinese situation, in the practice of building library in China, the *"3 unifications"* principle of dular library are absorbed in more cases. But the importances of bigger space, more adaptivity, making the collection, borrowing, reading and managing into one body and forming the relative independent work and building unit are not fully understand.

I believe that it is convenient to readers and has obvious effect to centralize reading area relatively, enlarge space appropriately and increasing books which can be readed by readers. The quality of management work can also be advanced so that librarians have further understand and command to the books in the units under charge of them, and there are possibility to connect contact and communication between readers and librarian to make librarians in each units of reservation, borrowing, reading and management become important media between readers and books and catalyst to make knowledge and information to produce efficiency most fully.

Therefore, clerks are not only circulation workers and reservation workers, but are more material workers, consultors and information workers, even the instructors of readers for study. This is the direction for future development and inject the new blood into library work and give the library new vitality. The future library should be the service centre of comprehensive communication of knowledge, materials and information, etc.

Just by this reason, there are more urgent need to enlarge suitably reading space of library, and this will be certainly realized. Try best to quantitize the design of library A building is matter, but also has the side of psyche; building is engineering, but also has the requirement of arts. Therefore, it is not possible to demand building design to quantitate in each step and each procedure, but the library can not all be designed by sense perceptions. Every affairs always has objective appraisal standards and the parts which can be quantitated should be tried best to be determined by quantity. Such building design can only just be more scientific. The problems such as *"3 unifications"* need to be unified further. What *"3 unifications"* means is the unification of loading, column net and story height of reservation and reading space in modular library.

At present, the *"3 unifications"* is made only in a library self, but under the same conditions, the libraries are not unified each other. According to statistics, the loads, story height and column net of more them 10 large libraries which were built recently are all not unified, each one having own parameters.

Therefore, the problem of *"3 unifications"* should be studied as an important subjects, striving to search for a best datus which is more adaptive to multi needs and is economic so that the "*3 unifications*" are really realized.

(1) *Loads:* By investigation, the basic loads of stacks are 400, 500, 550, 600, 650 kg/square meter and even more. The difference of highest and lowest load is 500%. So big difference exist two dangers: (n») if lowest load is reasonable, the highest load causes big economy and materials waste (n) if the highest load is reasonable, the lowest load will cause unsafty of structure. The results of both the two problems are serious and needs to be studied urgently and a definite value needs to be made. I believe that for comprehensive space of reservation and reading, the loads should be unified as 400 500 kg/square meter.

(2) *Story height:* At present, for reservation space of story shelf type, there are story height of 4.2m, 3.9m, 7.5m and even 7.5m The area of these libraries is nearly same, but the difference between biggest story height and smallest story height is more than 30%. For house with several stories, each 10m reduction of story height will low 1% total cost. If there are 60 cm difference of story height in above mentioned libraries, the total cost will be saved by 6%. Such save is so big so that it will attract our constructors and designers enough attention. For piling up type story height, there are more difference. The piling up type story height is normally about 5m. Compared with the 4m piling up story height, the 5m piling up story height can not be considered conceptly to save more cost, because compared with space used by each readers, 5m piling up story height can save 10% cost than 4m piling up story height. Seen by above mentioned statements, unification problem of story height needs to be solved by quantitation and waste of space is waste of investment.

(3) *Column net:* Basic modules adaptive to Chinese standard book shelf and normal reading desk and chair is generally considered as 1.25m, so under the conditions of closed shelf reading of library, the stacks and reading rooms frequently adopt 5m by 5m basic column net. After adopting open shelf reading, the book shelves need to be put in reading rooms and the distance between the shelves are expected to be enlarged until 1.4 1.5m, but the difference of closed shelves in stacks can still be kept as 1.25m. In order to take account of the arrangement of reading desks and chairs, and multi requirements of reservations in both open and close shelves, 7. 5m column net can be adopted to meet above mentioned consider and requirement, but 7.5m and 6m column net are not big enough to make good use of area. By analysis of practical examples, using 7.5m column net can save not only about 40% structural columns,

but also a great amount of usable area than using 5m column net. According to statistics, for a library of 1000 square meter, using 7.5m column net can save about usable area of 360 square meter than using 5m column net, that is, using rate is rised about 5%, which is equivalent to reserve 1 millon books in addition. Pay attention to environmental design and create reading conditions of high level. Environment is materials and is also space.

Environment also has obvious use functions and value of appreciation of arts. The creation of environment has same importance as the creation of buildings.

1. Try best to protect natural environment and maintain original equivalence of ecology and natural appearance, especially when undertaking *"seven connections and one level"* before constructions, protection of ecology environment should be kept in minds and we can not think that the more level and smooth, the better the site is for ecology.
2. Under the condition of unfavourable natural environment, try best to get the effect of natural environment through construction in later period. For example, exterior environments are imported into buildings and mutual penetration of communication between outdoor space and indoor space is made. In addition to green environment, indoor artificial environment also includes reading environment. A reading environment with the effect of homelike academic living rooms can be created through elaborate design and arrangement of furniture, and providing of various kind of apparatus which are convenient to readers.
3. Strength the construction of sound and light environment and physical environment such as artificial weather, etc. and create reading environment of high standard by scientific method. For example, the quiet environment of reading rooms is maintained by a set of building physical methods such as absorbing sound, insulating sound and preventing noise, but it is very difficult to keep very qui et environment. How to solve this problem? I think that some active physical methods may also be used, for example, some very low, clear and beautiful music is played in reading rooms to cover some scattered noise so as to keep relative quiet reading environment.
4. Pay attention to creation of psychological environment. Good environment can give people psychic enjoyment, and psychological feedback of people to environment can produce association extension and new feeling. For example, brown colour environment gives

people the feeling of stable and deep; orange or yellow colour environment give people the feeling of light and activity; blue or green colour environment give people the feeling of clear and open. The colour environment can even cause excitation or deep. Using colour laws to decorating buildings and indoor can get expected psychological effect. By same principle, the difference of feeling to quality of different materials can cause different association and feedback. To design buildings into different disposition can reach different effect. Introduce behaviour science and improve the library quality from deep levels.

Distance: From the view of behaviour science, the distance to keep between one person to another relatively under different relation, occasion and different contact method is different. People live under certain environment and have desirable undisturbed least space, which is called the domain of people.

By investigation, the domain is about 70 120 cm. If this requirement can not be me t, people will feel crowded and unsafety. At present, seats in our libraries are arranged in very compact method and distance between two seats is only 70 80 cm. I think that this arrangement violate behaviour law of people in some degree.

Therefore, we can often find that readers don't sit by shoulder or on opposite side when there are not many readers, because they don't hope their domain to be contracted. For this purpose, the distance between two seats in reading rooms ought to be enlarged to about 100 cm or seats may be insulated or sheltered in some degree so that readers feel their domains not to be encroached.

The size of rooms is a very important problem of library buildings. If a reading room is a little big, some people will always worry that there will be noise and disturb, but, in fact the order of readers in a big reading room is much better than that in a small reading room. In addition to the reason of management, analysing from behaviour science, it is mainly because psychology of readers in reading rooms of different size are different. The more people, the bigger mutual restrictive force there is, and the more standardized behaviour readers have.

When there are only a few readers, the self control force of people will be relaxed and the behaviour will be out of control. Therefore, seeing from behaviour science, a little bigger reading room is feasible and also necessary.

How large a consulting room is better and how long a consulting desk is better? From behaviour science, I think that the size of a consulting room and length of a consulting desk are based on that consultors can concentrate their attention and deal with the problems asked by all readers. By investigation, the biggest number of a consultor can serve at on time is 7, because according to people's behaviour of identification of quantity, the number which a person can control most agilely and quickly at one time is not over 7.

How to determine the size of a study room? Determination of the size of study rooms is also based on the investigation result of behaviour of users of these rooms. Study rooms are mainly used for study and discussion and it is best for each participant to have chance to give his views and to have conditions to pay his attention to discussion.

According to statistics, when there are 24 delegates as a group in a small seminars, there are often 6 participants who will not give their views; when there are 12 delegates as a group, there are only about 1 participant who will not give his views. Therefore, if we want to discuss some problem with high efficiency and high quality, it is necessary to limit the number of participants. I think that it is better to design a study room according to the capacity of about 10 participants. This small study room is the most efficient one.

The building designs introducing the views of behaviour science has made more deep step than these designs based only on function and activity. This try and attemption has just begun and I wish my colleagues to consider this factor in future building design and explore this field actively. It is estimated that some breakthrough achievements are going to be made if we continuous to do this research.

It is an inexorable trend that libraries realize electronic controlled system in every field. The wide application of Multi Medium will necessary bring revolutionary change again to the function of libraries. Chinese libraries will inevitably develop toward this direction in near future. But this is another broad subject and now I don't discuss this problem in details.

Chinese library buildings, with the continuous development of Chinese library cause, will certainly have new development. During the course of development, we want to exchange and study mutually with friends and colleagues of all countries for the purpose of progress in common.

Development of Library : Problems and Solutions

Libraries have been part of the world, including South Asia, for centuries. Who can forget the University of Taxila and Nalanda Libraries which flourished in India during the fifth and seventh century AD respectively? Nalanda University Library was the biggest in Asia during the seventh century and at its peak of reputation and international glory in the ninth century AD.

These libraries had thousands of books and even hand-written manuscripts and other types of materials for the benefit of their users, including scholars from many Asian countries. It has not been established whether or not the Asian libraries during the ancient times had periodicals in their collections. According to various dictionaries, a periodical is "a publication with a distinctive title which appears at stated or regular intervals ...". The birth of the first periodical took place on January 5, 1665, at Paris, France.

On this historic day, the first scientific journal, entitled Journal des Scavans, was published. It was the creation of Denys de Sallo, who was a counsellor of the French Court of Parliament. The first issue of this journal had only twenty pages and included ten short articles, a few letters and notes. It is a well known fact that the field of library and information science is relatively new in the modern world.

The first library school in the world, known as the Columbia School of Library Economy, was opened by the late Melvil Dewey in the United States in 1887 at New York.

He was also the first editor of the Library Journal, which started publication in 1876 by R.R. Bowker from New York, and is still being published on a regular basis. The growth of journals in all fields of study was slow during the late nineteenth and early twentieth centuries but it picked up rapidly in the second half of the present century, including in the field of library and information science.

"Regardless of the publication medium, serials [periodicals] remain the key tool for scholarship and the primary source of current information and topical news in all fields of endeavor.". According to the 37th edition of Ulrich's International Periodicals* Directory, about 157,173 serials were published in the world during 1998, including 1,600 journals in the field of library and information science and computer applications.

These figures include 110 journals published from Asia. According to my research, Asian countries publish over 200 journals in our field in English as well as in vernacular languages.

Therefore, the information contained in Ulrich's International Periodicals Directory is not complete. Unfortunately, only 22 Asian titles have been abstracted in Library and Information Science Abstracts (LISA), published in the UK, and Library Literature, published in New York, has only four titles published from Asia, and two Asian titles published in the UK and USA.

Japan took the lead in Asia by publishing in 1907 the first library journal, entitled Toshokan Zasshi, which is still being published on a regular basis. In 1912, India followed by publishing the first Indian library journal in English, entitled Library Miscellany. It was the brainchild of William Borden, an American librarian who was working in Baroda at the time. Unfortunately, Library Miscellany ceased publication in 1920. In 1916 Iyyanki Venkata Ramanayya started a publication in Telugu, entitled Granthalaya Sarvastvamu, which is still published on a regular basis.

China, known for inventing paper and having a long tradition of scholarship going back to 26 BC, was behind in publishing library literature. The most populous country in the modern world, China published its first journal in librarianship in 1972 in the Chinese language.

The title of this journal is Tushu Gongzuo Tongsum (Book Services Newsletter). At present, 92 journals are published in China, including 62 journals in library science and 30 in information science, the majority in Chinese.

In the view of Cheng, "there are 12 excellent journals of library science in China. They are the most representative core journals in library science research in China." During the first half of the present century, about ten library journals were published in Asia. But during the second half, from 1950 to 1999, about 200 new journals started publication, including titles like Herald of Library Science, Pakistan Library Bulletin, and Eastern Librarian. Many good journals such as Modern Librarian and Indian Librarian ceased publication for various reasons, which will be discussed later in the paper. At present, Japan publishes 63 journals but only seven of them are in English.

South Asia

South Asia has a long history of excellent libraries dating back to the fourth century BC. This area includes Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka.

India

The Republic of India is the largest country and occupies the major part of the South Asian region. India has the advantage over other Asian countries in publishing library journals in the English language because it has the largest English-speaking population in the world. It publishes 57 journals in the field of library and information science, a majority of them in English. According to my research, India is the leader in publishing journals in the field but only a handful of them are known and available outside India. There are a few other good journals published in India, including the Bulletin of ILA (Indian Library Association).

It was launched in 1933 when the ILA was formed, but it has changed its title many times. Professor P.N. Kaula started his own journal, entitled Herald of Library Science, in Varanasi in 1962 and it also has been published on a regular basis for the last 37 years. Prof. Kaula edits a few other journals, including International Information, Communication and Education; it is a multi-disciplinary journal, published semiannually, and was launched in 1982. Granthalaya Vijnona, also published semiannually, in Hindi, started publication in 1970. In 1998, Prof. Kaula launched another journal, Ranganathan Research Bulletin: Supplement to the Herald of Library Science.

It is the only journal in Asia, rather I should say in the world, that is devoted exclusively to a particular school of thought in the field of library and information science.

It seems that it will be an "effective medium to propagate Ranganathan's ideology and his school of thought.". Other notable Indian journals in the field are: IASLIC Bulletin (1956-), International Library Movement (1979-), and Journal of Library and Information Science (1976-). In my view, one of the best Indian journals is Library Science with Slant to Documentation and Information Science. It was started by Ranganathan in 1964, and is a publication of the Sarada Ranganathan Endowment for Library Science in Bangalore. In addition, there are a few journals published in regional languages, including Bengali, Gujarati, Hindi, Kannada, Malayalam, Marathi, Tamil, and Telugu.

Bangladesh is situated in the northeast corner of the South Asian sub-continent. Before becoming an independent country in 1972, it was part of Pakistan from 1947 to 1972, and part of India until 1947, when the country was divided by the British at the time of independence. Bangladesh publishes only two journals in the field of library and information science.

The Eastern Librarian is a publication of the Library Association of Bangladesh and has been published on a regular basis since 1966, though issues do not always appear on time. The last issue of this publication was a combined volume 20-22, published in the spring of 1998. A new journal was launched earlier this year in 1999: Bangladesh Journal of Library and Information Science. In addition, a few newsletters in Bangla are also published in Bangladesh, including Informatics.

Bhutan is a small country in the Himalayan region between India and Tibet. The development of libraries and librarianship is still very limited. According to my information, no library journals are published from this country. The Maldives is the smallest country in the region, south of India. It publishes no library and information science journals.

Nepal is another small country, which divides India from China on the foothills of the Himalayas. There are no major publications reported in the field of librarianship, with the exception of an annual publication of the National Council for Science and Technology, which deals with libraries in the country.

Pakistan was created in 1947, when the British divided India in two regions at the time of independence. It is situated in the northwest of India. Pakistan has "1,500 libraries and 3,000 professional librarians... [and] six library schools.".

There were no major library journals in Pakistan until the Pakistan Library Association was founded in 1964. The Pakistan Library Bulletin, a quarterly journal, started publication in Karachi in 1968. At present, there are eleven journals and newsletters published in Pakistan, of which ten are in English and one in Urdu. It is possible that there may be a few journals published in regional languages such as Punjabi and Sindhi, but I am not aware of them.

Sri Lanka is an island to the southeast of the southernmost point of India in Tamil Nadu. It has a good working network of libraries and a few library schools. At present, four library journals are published in Sri Lanka. They are Sri Lanka Library Review, published semiannually in English, and Journal of University Librarians Association of Sri Lanka, an annual publication in English, and two other quarterlies, which are trilingual (Sinhalese, Tamil, and English).

A limited number of journals (ranging from one to four) are published in various other Asian countries in both English and regional languages. They include two each in English and Indonesian from Indonesia; one in English and three in Malay/English from Malaysia; four (in English) from the Philippines; three from Singapore; two from Korea; one in English and four from Taiwan (including one in English); two from Thailand; and four from Vietnam.

Problems and Solutions

It is certainly good to know that Asia produces over 200 journals in the field of library and information science which includes over 70 journals from South Asia. I have been editor of Library Times International since 1984, and associate editor of International Leads since 1996. I have been interested in research, writing, and publishing since my high school days. At present, I read many library journals regularly to enhance my knowledge, and to see the quality of the library journals from an editor's viewpoint. I have examined a majority of South Asian and many other library journals for this paper. From an editor's view, I must say that there are many problems with Asian journals including South Asian journals which need immediate attention.

A majority of library journals in Asia, including South Asian countries, are published quarterly, a few semiannually, a few yearly, and some even published irregularly. It is very disappointing that many journals do not appear on time. Sometimes a few issues, or even a few volumes, are combined. The editors are to be blamed for this unprofessionalism. They should know the importance of research and timely information needed by scholars, researchers, faculty members, librarians, students, and other users.

A journal is a "primary means of scholarly communication... [it] offers authors and readers some advantages over the monograph:... [including] intensive study of very specific questions or aspects of large problems, and the timely publication of intended communication.". Therefore, all library journals must be published on time for the benefit of interested users and readers.

The invention of printing in 1440 provided a new tool for sharing and communicating thoughts with others in a form which led to the birth of periodicals. Unfortunately, the paper used by a majority of publishers for printing library journals is of very poor quality. It becomes yellow within a few years. Maybe, it is not acid-free, thus shortening the life of paper. Therefore, it is very important to use an acid-free quality paper to preserve the writings of all scholars in every language of Asia including English, and to make microfilm copies of all important library journals.

Many articles in South Asian English-language journals are of very poor quality. First, writers do not make sense and write poor sentences. Many times there is no link between paragraphs. It seems that the editors are desperate to get articles and publish them in their journals without looking at their quality.

They need to be edited properly, and good proofreading should be done before the final copy of any journal is approved for printing. Perhaps poor quality of the paper, poor writing and poor editing are the main reasons that these journals are not subscribed to by many libraries, and as a result they have small circulation. Even Ulrich's International Periodicals Directory does not give circulation figures of many journals published from South Asia and other Asian countries. Many editors have started their own journals in South Asia without proper planning, finances, and marketing.

This has resulted in the premature death of many journals. A majority of the editors are part-time, without any proper help, which makes it very difficult to run a quality and profitable business.

Even many library associations have part-time editors for their journals. It helps to have full-time staff for those journals and newsletters that appear monthly or more frequently. It is important to include only the best articles on important topics to attract more readers and subscribers. It is always good to have a few referees to read manuscripts and act on their advice. I would like to know how many manuscripts are rejected by editors.

Another problem with a few South Asian journals is that their foreign subscription rates are very high, with the exception of a few journals and newsletters from Sri Lanka, making it very difficult for Western countries to subscribe to them.

It seems that editors and/or publishers want to become rich overnight without delivering the product on time and in many cases without the necessary quality in their publications. If the price is right and you have a quality journal, you will certainly attract more subscribers, and you will make more money, if that is your motive. Otherwise, subscription figures will not improve.

Excellent marketing of library journals is the key to success. I have been very active in the field of librarianship for over twenty-five years. During these years, I have not seen any letters or sample copies of journals from any editor or publisher from South Asia. I have not seen any advertisements for Asian journals in publications of South Asia and North America.

It is very important to have a good plan to market a library journal. It should be done on a regular basis by advertising in various library journals, direct marketing by sending sample issues to prospective subscribers, distributing free copies to librarians at various regional and national conferences, calling people on the phone, hiring firms to do marketing for you, and even giving discounts to various subscription agencies to market and sell your publication.

Another problem with a few publishers is that lost and damaged copies of their journals are never replaced free. Often even authors do not receive free copies of journals and/or offprints of their articles.

Times have changed due to the introduction of technology. Many journals are available in full text on various databases on the Web and on CD-ROM. It helps readers to do research much faster. But I have yet to see a South Asian journal on any North American database on the web and/or on CD-ROM. A majority of good South Asian and other Asian journals in the field of library and information science should be made available electronically as soon as possible for the benefit of researchers and other users. It will help in publicity also.

I have been an advocate of excellent service and quality journals. As editor of Library Times International since 1984, I believe we have succeeded because of our commitment to excellence, good marketing, and assistance from a team of 55 reporters. Our reporters from many countries, including a few from South Asia, send in their reports on a regular basis for every issue, our editors and staff work very hard to gather stories, and we publish each issue on time.

We have subscribers in over sixty countries. We have heard only good comments from libraries and librarians. Everything is possible in the world with hard work, determination, and goals, and we know that the sky is the limit.

Not all western journals and newsletters are of top quality, but many of them have succeeded because of their excellent services, and publishing every issue on time with a few exceptions. There are 56 ALA-accredited library schools in Canada and the United States. I conducted a survey of the holdings of Asian library journals in their libraries. Only 32 schools responded by fax, mail, e-mail, and voice mail. Ten schools do not get any library journals from Asia.

The University of Hawaii receives 54 journals, followed by the University of Illinois at Urbana-Champaign, and University of Pittsburgh. Other schools subscribe to only a few journals. According to deans/librarians of these schools, budget is the main problem for not ordering any journals from Asia.

A second reason is that there is no interest in the faculty or students to read these journals. Another reason mentioned was the Asian languages with which their students are not familiar. A few librarians and library educators have even mentioned poor quality of journals, and others mentioned self-promotion by one editor of an Indian library journal.

It is unfortunate that a majority of these schools do not offer any courses in Asian librarianship, comparative librarianship, or international librarianship to their students. The American Library Association with its 57,000 members is the largest and the oldest library association (founded in 1876) in the world. It has been advocating "Local Touch and Global Reach." How can it achieve this goal when a majority of the accredited schools in North America do not offer any courses in librarianship in Asia, where over two billion people live, and do not subscribe to Asian journals?

Martin Richardson, Journals Director of Oxford University Press, is of the opinion that "both authors and readers of learned journals are increasingly expecting their publishers to exploit the many advantages of online distribution. Important research can be disseminated faster, and relevant material can be found more precisely. But this will not happen if each publisher erects ring fences around their own portfolio of information."

He added, "Clearly, there is a need for a 'one-stop shop' where all the major journals from whatever publishers can be searched and accessed without time-consuming visits to a succession of different websites [or journals] ... [Therefore, we should] maximize the exposure of our authors' research to the global community of academics, researchers, and practicing professionals.".

The publishers of Asian, including South Asian, library journals must work together and include their journals on major Website databases. It will give them more publicity, and their material will be used by many interested scholars, researchers, students, and others for their needs. If no action is taken by publishers and editors, they will be left behind in this race on the Information Superhighway of the twenty-first century.

A few more observations from an editor's point of view. As noted earlier, many journals do not appear on time. The same is true of abstracts and indexes. For example, Indian Library Science Abstracts, Guide to Indian Periodicals, and Index India are also published late. All journals, abstracts and indexes should be published on time for the benefit of researchers.

All journals should also include an index for each volume and letters to the editor. Publishers may consider including a few advertisements from other publishers, booksellers, vendors, and subscription agencies; this may give their publications more visibility, increase subscriptions, and improve cash flow. Perhaps it is time for commercial publishers to take the responsibility and start publishing a few quality monthly library journals and newsletters in South Asia and other Asian countries.

Excellent product and service should be the main concern of all editors and publishers. It will not hurt the editors and publishers to take a few courses in journalism and editing to enhance their knowledge. Even an internship with a leading journal and/or a newspaper would help present and future editors. There are many good books in the market on publishing including a new publication, entitled Journal Publishing, which can teach all of us a few important and basic principles of editing and publishing, which in the long run will benefit everyone.

Finally, we must keep in mind that journalism in librarianship covers local, regional, national, and international news and scholarship. Journals will continue to play a major role in dissemination of ... information for a long time because they are indispensable. Therefore, we editors must present our quality publications in such a manner that they will have a positive impact on the field, and help every interested individual in the profession rather than only a few of us. Otherwise, we will not be successful in our efforts to improve the field of library and information science in the third millennium.

23

Resource Sharing through Internet

Astronomers have always had a special need for rapid communication over long distances. More recently the increase in international colloboration has given an incentive to explore the latest electronic innovation, namely the electronic mail and internet access for faster communication. These have become an integral part of scientific organisations and libraries (Rajashekar & Sreenivasa Ravi, 1993)

Previously, communication among libraries and library personnel was through traditional methods like the post and teleprinter links. In some cases, the telephone link was used in urgent cases. Now, the internet concept has changed the scenario even in Indian libraries. Libraries are able to access databases outside the country without much difficulty. This has revolutionized not only the information seeking behaviour of the scientists but also the role of the librarians. Librarians are working towards maximum utilization of resources available and in this context we are thinking of networking all astronomy libraries in India.

Why Networking

1. For better resource sharing
2. To reduce costs
3. For speedy delivery of documents
4. To keep abreast of new developments
5. To give access to advice from colleagues with similar problems through a newsletter.

There are eight organisations marked in the map according to their geographical location. All these organisations are fairly well equipped libraries and they have jointly formed a Forum called FORSA whose main objective is to promote resource sharing.

Participating Libraries

There are eight scientific institutions in India, for which astronomy is the major research area.

Indian Institute of Astrophysics Library (IIA): It is more than 200 years old and has a rich collection of books and journals in Astronomy and Astrophysics. Some of the astronomical journals start from volume 1 dating back to the nineteenth century. The library has most of the old observatory publications. They form an important part of the collection as many astronomical catalogues are published here which are still used by our scientists.

Inter-University Centre for Astronomy and Astrophysics Library (IUCAA): It is an autonomous institute, located in Pune, and has been established recently. The main areas of research are Astronomy and Astrophysics, General Relativity and Gravitation. Though the library of this institute is new, it has succeeded in building up a very good collection of books and journals in Astronomy and Astrophysics. The majority of astronomy journals are received by airmail at IUCAA.

National Centre for Radio Astrophysics Library (NCRA): It has a wide collection of materials on radio astronomy and astrophysics. This institute is located in Pune, close to IUCAA.

Nizamiah Observatory Library: This Observatory is very old and functions under Osmania University, Hyderabad. The present library was established in 1961 and it has a fairly good collection of old books and journals. The Observatory has been receiving reprints and publications from the beginning of this century from all over the world on exchange basis, so the library is rich in old material.

Physical Research Laboratory Library (PRL): The Physical Research Laboratory, located in Ahmedabad, has a library, funded by the Department of Space. The Institute carries out research in many areas of Physics. In addition, it also concentrates on Astronomy and Astrophysics, Infrared Astronomy and Radio Astronomy.

Raman Research Institute Library (RRI): The Raman Research Institute Library has been developed around the library started by the nobel laureate Prof. Raman and is also located in Bangalore. With his diverse interests in different branches of science and deep interest in reading, Prof. Raman had added invaluable books to the library. It has a rich collection of astronomy and astrophysics books. Its preprint collection is also a valuable resource for sharing.

Tata Institute of Fundamental Research Library (TIFR): Tata

Institute of Fundamental Research Library, Bombay was established in 1945. In addition to books in various branches of physics it has a large collection of books and journals in the areas of astronomy, astrophysics and space physics.

Uttar Pradesh State Observatory Library: Located in Nainital, the library has built up a vast collection of books and journals in astronomy in the short span of 45 years and is very keen on expanding its collection and services.

What to Share?

Books	Policy Decisions
Journals	FORSA Forum
Observatory Publications	Current Events
Preprints	Newsflash
Catalogues	
Lists of Publications	
Recent Additions	
Newsletters	

The table shows that four libraries have automated their library catalogues using the same library software called LIBSYS and two libraries use a software called SLIM. LIBSYS is a fully integrated multi-user library system designed to run on a wide spectrum of hardware and software platforms and it can also import databases built on other software (*e.g.* SLIM). This is one of the important criteria which will make this networking feasible.

Resources and Services Available at FORSA Libraries

No.	Library	Software	Coll.Books	Coll.Jour.	Jnl.Sub.
1.	IIA	LIBSYS 3.X	13,300	18,400	142
2.	IUCAA	SLIM 2.0	10,000	4,000	150
3.	NCRA	SLIM 1.1	5,400	3,300	104
4.	NIZA.OBS.		5,340	3,995	10
	Library				
5.	PRL	LIBSYS 3.1	16,500	25,000	197
6.	RRI	LIBSYS 3.X	19,613	23,273	137
7.	TIFR	LIBSYS 3.2	55,000	56,000	656
8.	U.P.State	Acquiring	8,273	8,061	76
	Obs.Lib.	LIBSYS			
		Total	133,426	142,029	

It is evident that the collection of books and journals of all the libraries put together is not very large and will occupy less than 2 GB space.

Networking Models

1. Interconnecting all astronomy library homepages.
2. Creating an integrated library database.
3. Establishing connectivity using search-engine architecture.

Model I: In this model, which is the simplest, the home pages of the participating libraries will be linked.

Many research organisations in India have designed their home pages and libraries are also a part of their homepages. Similarly, member libraries of FORSA also have their independent web pages and they are accessible on the internet. Since these web pages will exist independently, a scientist looking for a document will be able to trace it eventually, if not immediately (Madalli 1998). At present, only six libraries out of the eight FORSA libraries have internet connection, but we hope that the other two libraries will be able to get their home pages soon.

Model II: In this model, the databases of all individual libraries will be merged. Since the total collection of books is 133,426 and there are 142,029 journal volumes we will not be requiring more than 2 GB space for an integrated database.

The merging of books and journals will be effected with the help of a unique feature like the ISBN numbers. Since the physical location is one of the fields in the data entry form, it is not difficult to reflect it in the merged database.

This has a major advantage from the user's point of view. It will be less time-consuming, since the scientist will have to access only one server where the inte-grated database will be located. The LIBSYS software, used in most of the libraries, has the facility to display the availability status of the document. It is mandatory for the library personnel to maintain, rather than update this integrated database.

It could either be a commitment from an exclusive group of people or it could be done remotely from individual locations. We are also planning to create a profile of all member libraries as the common web page, which will be linked to the integrated database. In the event of any exclusive feature of a particular library being listed, it is easier to access that feature from the common web page. For example, in our library we have many old documents, which will be catalogued in a database and any individual interested in the archival material can access that database from the common web page. The availability of electronic journals will be another feature which could be accessible only by the individual institute's scientists, though it will be a listed item in the common web page.

Incorporating too many icons and graphics in a web page is a time-consuming factor at the time of retrieval. Keeping all this in mind, we will design soon our common web page to facilitate an easy navigation and retrieval through the internet, not only for our scientists, but also for the international community. We are also gearing up our library staff to undertake training in handling the network, especially hypertext linking. Though we have a very good technical support from the software company, we are getting equipped with basic knowledge of software maintenance and also the optimum usage of the features of this software.

Funding for this joint project is envisaged from member libraries and also from the Department of Science & Technology of the Government of India.

Model III: In model III, which is a sophisticated model, the databases will be connected with the help of search-engine architecture. In the March 1997 issue of Scientific American, Lynch (1997) describes one such model called HARVEST which derives indexing terms using software called "Gatherers" that reside at web sites. By doing so, the search engine can avoid downloading all the documents from a web site which would burden the network traffic.

The search engine's server takes the help of the Gatherers to create a file of keywords that can be processed into an index for querying by users. Lynch says that "eventually, the librarian's classification and selection skills must be complemented by the computer scientist's ability to automate the task of indexing and storing information. Only a synthesis of the different perspective brought by both professions will allow this new medium to remain viable." If this concept can be applied to the library database, it will be an efficient tool for future retrieval and international cooperation.

Conclusion

India has taken advantage of the wide range of scientific information available through computerised networks. It has already geared up to having modern communication facilities (including satellite communication), adequate electricity, subsidised communication costs, rationalisation of taxes on computer equipment, etc., which gives us a thrust to fully participate in the new information age.

The astronomy librarian of Australian National University has expressed a desire to be a part of this network, thus extending the network to the Asia Pacific region. When this network is realised, it will have a broader subject coverage to include physics and and mathematics, along with astronomy. Eventually it will be an international cooperation with more new ideas and suggestions.

A Clearinghouse for Astronomy Librarians

The World Wide Web is one of the newest media. It is a phenomenon that has achieved an extraordinary florescence, to become almost a commonplace. And, we frequently speak of it as a place. Search engines are *starting points* for web exploration; they help us find web *sites* of interest. When we call a web site a clearinghouse, we are using the architectural metaphor to indicate that we expect the site to function as "... an agency for collection, classification and distribution especially of information..." (Webster's Third New International Dictionary. 1967: 420). Another architectural metaphor that may apply is the concept of an emporium, defined as a "... centre of activity that serves customers... carrying a great diversity of merchandise..." (Webster's Third New International Dictionary. 1967: 744).

Since the PAM (Physics-Astronomy-Mathematics division of the Special Libraries Association [SLA]) web site went public in 1995, a large body of writing has been produced on web site design and planning. New HTML tags, new plug-ins, more recent releases of browsers-all offer options for further development. At this point, with several years of experience to draw upon, we have the opportunity to evaluate the site and what we expect from it. David Stern has sounded the clarion call, "The ability to have the most experienced user-oriented librarians building navigational interfaces is a long awaited opportunity that calls out for action" (Stern 1995).

In this new, nonlinear medium (Gibson 1996), what should be included in our web site? What left out? What emphasized? How ordered? How navigated? Are new standards of evaluation needed? What guidance does our traditional information training offer in planning the next edition of the PAM web site?

Librarians are the ideal group to evaluate information offerings. We have always been involved in matching resources with users' needs. We have developed evaluative techniques and collection development policies for media ranging from paper to software. Judging an offering for content, authority, currency, and organization is still appropriate, whether the offering is a web site, or a paper-based reference book. Additional web-specific criteria include consistent availability and the presence of a site-specific search engine (Collins 1996). And librarians have been quick to gather enough web savvy to set up sites. In their book *Information Architecture for the World Wide Web*, Rosenfeld & Morville (1998) illustrate the value of the approach librarians bring to the information architecture of web sites. We are well situated to construct excellent web sites.

The Eisenberg-Berkowitz Model

The ultimate decisions about web site design and content must be based on the intended audience for the site. The PAM web site has a multifaceted audience: physicists, astronomers, mathematicians, computer scientists, and PAM members. With this assortment, how can the best content and the best arrangement be identified? The Eisenberg-Berkowitz Model of Information Problem-Solving (Eisenberg & Berkowitz 1990), utilized in research training in settings ranging from K-12 through graduate studies, has been expanded to provide a framework for web site evaluation and organization (Cottrell & Eisenberg 1997). Known as the Big Six, this model contains the steps:

1. Task Definition (define problem, identify information requirements)
2. Information-Seeking Strategies (determine range of sources, evaluate sources)
3. Location and Access (locate sources, find information within them)
4. Use of Information (extract information from sources)
5. Synthesis (organize and present information)
6. Evaluation (judge the product and the problem-solving process).

These steps are common sense and seem obvious. If we assume that the users of the web site will be coming to it while engaged in an information search, designing to these phases of activity will enable us to decide what to include as content and what navigational aids to add. I'll use this model to assess the PAM site in its role as a clearinghouse and emporium.

Step One: Task Definition

For instance, the step of "Task Definition" prompts a web designer to inform the user about the site's nature and purpose. As Margaret Rioux points out, "The distinction among public relations, advertising and vanity publishing has become blurred, making it difficult to evaluate Web sites for credibility and integrity" (Rioux 1997). It is important that the sponsorship of a site be immediately clear to the visitor. The site's scope note must explicitly characterize the intended audience.

The PAM site currently provides only the most minimal identifying statement: "This is the web site of the Physics-Astronomy-Mathematics Division of the Special Libraries Association." The user is expected to read the headings and select any of interest. Depending on the user's screen size, the category "Computer Science," occurring near the bottom of the screen, may not be visible. Hence, the searcher with a computer science query may leave the site, unaware of the presence of useful links. If the page contained a more comprehensive statement of purpose and scope, users would be alerted to resources of possible interest. When describing the motivation for establishing a home page for the IBM Thomas J. Watson Research Centre, Falcigno and Green state, "Most of our customers are scientists and engineers with very specific information needs... Our goal for the home page was to design it in a way that provides access to useful information for our customers, while emphasizing the library's value-added service" (Falcigno & Green 1995). This statement addresses the subject interests and skill levels of the intended audience.

It also identifies the desire for the library to have a presence on the web. This type of statement of purpose should underlie the planning of each web site. On the PAM site, the astronomy component should have the range and currency of a high-level reference tool, one to which we can confidently refer our astronomers, and one to which we immediately turn when we find a dead link in our personal bookmark lists.

The often-repeated advice that the contents of a page should not exceed what can be viewed on a single screen will, if followed, aid the user. As will limiting the number of choices (links, buttons, table elements) per screen to between seven and nine (seven plus two), the range of elements people grasp most easily (Stover & Zink 1996). Rosenfeld & Morville (1998) refer to this as the seven plus-or-minus two rule, stating that more than ten options can overwhelm the user. Frenza & Hoffman (1997) suggest not more than 6 sections. Lists can be displayed as tables to eliminate scrolling.

Step Two: Information-Seeking Strategies

Users engaged in the second step, "Information-Seeking Strategies," want to promptly comprehend the scope of the site and see how it is organized. The navigational aids must be planned and positioned to reveal the site structure to users who might enter at any of a number of points, for example, from a search engine "hit list." A site map or index provides a way to find things quickly. A map of the PAM site would enable users to see the connections among the various sections of the site. Links to the site map, home page, and other segments of the site should be positioned on each screen, to enable the user to ascertain useful paths through the site. A simple navigation bar could be placed at the top or bottom of each screen. The one on the Astronomy page would show:

It is with the information-seeking user in mind that site designers must evaluate the roles of graphics, backgrounds, animations, frames, sound, etc. Each element should make a contribution to the exposition of the site contents that balances any increase in site download time. The use of consistent page layout throughout the site can help the user register the unique information on each page and facilitate navigation. By placing a graphic of a star next to an item on an alphabetical list, a web author can communicate that item's prominence to the user. The graphic can be designed for quick loading. But, the diversity of users' equipment types and browsers should be considered in the selection of graphic and other special design elements.

Step Three: Location and Access

Step 3, "Location and Access," covers both the discovery of the sources and finding useful information within the sources. Site promotion can include listserv announcements alerting Web audiences to the site's release and subsequent developments. Web designers should register their sites with major indexing and search engine utilities. This has not been done for the PAM site. Metadata tags (information about information) have the potential for improving the resource discovery, and schemes such as the Dublin Core may improve search precision in the future (Lynch 1998). Librarians will want to monitor these developments and explore their implementation. Currently, specialized search utilities, such as WAIS, Excite, Swish, etc., can be customized to search the entire site, or, using devices such as buttons, forms, and pull-down menus, specific parts of it. Search utilities should support both known-item searches and browsing. And, it must be remembered, they don't always work consistently across platforms.

A new grouping of products, sometimes called middleware, offers the option of publishing web databases. Also called dynamic web pages, these applications connect a database of elements in tagged fields and a search interface that can take the user's query (often submitted on a fill-in form), convert it to SQL (Standard Query Language), poll the database, convert the response to HTML, and deliver it to the user's browser. There are several areas of the PAM web site that would benefit from a web database application. For instance, publishers are active in multiple subject areas.

It is probable that Elsevier will be listed on our web site in the publisher sections of several of the disciplines. If the Elsevier URL changes, a volunteer responsible for one discipline might notice and update the link on one page, while the older outdated link lurks on the other sections. In a database configuration, the URLs of all publishers linked to the site would be entered into a database. The information would need to be corrected in only one location, more efficient than updating occurrences in several segments of the site.

The addition of specialized databases to the web site might impact the structure of the web committee. Rather than a discipline-based division of responsibility, a committee member might take responsibility for updating the database of the web site's publishers' links. There are a wide variety of types and prices among the middleware offerings (King 1997). Some require a knowledge of HTML, while others assume familiarity with scripting languages. They range from CGI scripts, through add-ons to familiar packages (like Lasso working under FileMaker Pro), to elaborate commercial packages that support "shopping carts" and secure credit card transactions. It is currently SLA policy not to provide any proprietary web software, but the efficacy of dynamic data provision may eventually lead to the Association-wide adoption of a web database product. (A similar situation is SLA's selection of Quicken for use by all chapter and division treasurers.)

Step Four: Use of Information

"Use of Information," step 4, follows step 3 with no sharp delineation. To make the site contents most useful, the arrangement and presentation of the material must be logical. Design guides promote "... the idea of 'chunking,' which advocates grouping limited bits of information into similar categories so that the user can more easily process the overall information" (Stover & Zink 1996). Several disciplines have thesauri to help select appropriate terms and synonyms. There is no reason to assume that various disciplines will have the same "chunks." Technical reports are a prominent document type in computer science; several specialized sites provide access.

There is no exactly parallel category in astronomy. Astronomy has many sites of archived observational data, for which there are no close parallels in mathematics. And the section of web resources for librarians has its own singular pattern. Each section will require some unique categories, while many will share common types, such as dictionaries, journals, and directories. A "Reference Shelf" section linking to the best tools for each discipline would enrich the PAM site. Relevant web sites must be sought out and evaluated, then grouped for ease of use. Past experience with printed "Pathfinders" can combine with the wide access offered by the web to produce topic specific guides (Sloan 1996). Providing scope notes, dates, and source information will give links context. Any restrictions on the reproduction and distribution of site contents should be made clear to the users. Several Dublin Core elements can hold information on copyright ownership and use restrictions.

Step Five: Synthesis

"Synthesis," defined as the organization and presentation of information from a variety of sources, is the fifth step in this model. In the context of the web, this includes both the total site design, and the currency of all links. Sites are never finished. Eternal vigilance is the price of freedom from dead links. Link rot, like rust, never sleeps. Kevin Hunt views the activity of site making as the Internet community's form of "gift-giving." He states "... in science, gift-giving takes the form of contributing journal articles for the sake of contributing to the growth of the community's knowledge base and with the expectation of receiving recognition from the community in the form of citations and professional respect... This spirit of reciprocal gift-giving is central to the construction of 'special interest' sites" (Hunt 1996).

The ongoing development of the PAM site will require the coordinated efforts of enthusiastic volunteers. New resources must be discovered for each section. Established links must be monitored and updated. The presence of outdated links was the most common complaint about the site reported in the *PAM Division Strategic Planning Survey—February 1998.* Prior to the 1997 SLA Conference, it was decided that the site was too large for a single web manager. The PAM web committee was struck, with responsibilities distributed along discipline lines. Like the PAM web committee, members of the web development team of the Association for Educational Communication and Technology (AECT) discovered the difficulties of distributed web design and management. The AECT team reported, "While the ability to work with team members across a continent was exciting, the team also found this could cause delays in the development process... Lack of face-to-face contact proved to be particularly challenging. Misreading of intent resulted in miscommunications in e-mail messages... the transfer of information continues to be problematic.

Currently the team is relying on a combination of FTP (file transfer protocol) and surface mail... with all updates completed via FTP." The authors recommend a number of steps to facilitate web design by a dispersed group: establishing a time frame for the overall project and deadlines for reviewing documents. And they caution, "Be prepared to devote extra time for distance management" (Hill et al. 1997).

The PAM web committee will be considering a thoroughgoing revision of the existing web site. But their enthusiasm for the newest web bells and whistles might be dampened by the important admonition to design to the lowest common denominator, that is, to design for those with the oldest flavour of browsers. Darcy DiNucci has identified three types of web users. The first group consists of those who seek out the newest options and will have installed the latest edition of their browser and the full range of plug-ins; the second group is made up of those who control their web browsers by customizing font settings, turning off graphics, etc.; and the third group is only interested in the content of the sites and will probably have older browsers. DiNucci suggests that only the first group is interested in design.

The web designer's efforts to include appropriate amounts of white space, to add killer animation or a new sound resource will only be appreciated by the first group. The other groups will prefer simpler or text-only options. Yet, the site must meet the needs of all three groups of users. By offering different paths through the same site, the needs of each group can be met (DiNucci 1997). Rather than trashing the earlier version, the site can grow by accretion. A splash sheet at the top of the web site can offer the user the choice of the text-only path or other routes, enhanced by frames, style sheets, and whatever is next. This approach allows more scope for innovative "early adaptors," the most likely to volunteer for the web committee who want to test the newest features. A plug-in page should be maintained, with links to all extras needed to fully access the site. This page would include links to the browsers' update sites, Adobe's PDF download sites, and any other plug-ins that have been used in the site's design.

Step Six: Evaluation

The last step of the "Big Six" is "Evaluation," to judge the product and the efficiency of the information problem-solving process. In web design, this suggests the provision of feedback mechanisms, such as "mail to" links that facilitate communicating questions, comments, etc., to the web manager. A feedback form is another option, one often preferred by those whose browsers aren't configured for email. With the right kind of publicity and the provision of an easy communications option, it may be possible to enlist all regular site users into the hunt for lapsed links. Counters can be added to a site to track usage numbers. Cookies are used by some sites to gather information on visitors, as are guest books and visitor registries, both less intrusive than cookies.

In the *PAM Division Strategic Planning Survey—February 1998*, members were asked to rate the PAM web site on a scale of 1-5, where 1 = good, 2 = pretty good, 3 = marginal, 4 = poor, and 5 = don't know. One quarter of the respondents chose "don't know" (5). They had not sampled the site enough to form an opinion. This survey was an excellent feedback mechanism. I hope that the PAM site will grow, change, and develop to the point that the next time such a survey is taken, the vast majority will select 1! Right now, the site is suffering from the "launch it & leave it" syndrome.

If we want the PAM site to be a dynamic trove for astronomy librarians, the web site committee must accept the charge of not only keeping the links live, but prospecting for and evaluating new links. All PAM members ought be encouraged to post interesting links to the listserv. The web committee should investigate and appraise posted links, and they should maintain a "link watch," quarrying search engines for new offerings and posting them. A recent NEC Research Institute study reported that HotBot, the most comprehensive search engine, only covered 34% of indexable pages. Alta Vista covered 28%, Northern Light 20%, Excite 14%, and Lycos 3% (Edupage 5 April 1998), so multiple search engine sites must be regularly polled to ensure coverage. (It would be interesting to identify the proportion of overlap.) New links that meet the "web collection development policy" for the site can be permanently added. The others can be added to the site's searchable "link watch" archive. This type of current awareness service provides a "value-added" leaven to the site and encourages repeat visits.

Conclusions

At this time, sixteen of the 37 SLA divisions and caucuses have web sites. In preparation for this presentation, I visited the web sites of the others. I was pleased to see that the PAM site was one of the more ambitious offerings. The PAM site essays to offer quality links in five areas: four scientific disciplines and library/information services, as well as supplying divisional and association connections. We share the discipline-specific links with our researchers, while the library/information links cluster, currently called "Web Workbench" is targeted at us as professional librarians. Here should be gathered links to help us maximize the benefits of the web, links to sites such as the UKOLN Metadata page (www.ukoln.ac.uk/metadata/), with the "DC dot" utility that automatically generates Dublin Core <META> tags. Like the other sections, the Workbench will need updating and enrichment to remain useful over time.

The PAM web site is over two years old. The start-up phase has concluded. Now, the potential of the medium must be more deeply explored and exploited, and a pattern of maintenance and renewal must be established to guarantee the site's continuing value. The next edition is overdue. It behooves us to develop the organizational constructs to get the job done.

We're lucky this is a web site, not an architectural building site; it is much easier to refurbish. With the proper underpinning of member support and using the "Big Six" as a blueprint for addressing user groups' information-seeking patterns, the PAM web site can function as a clearinghouse for astronomy librarians until web sites follow the gophers over the edge of the event horizon.

Open Forum on Optimizing Communication

The final session of the conference was introduced by a list of topics (statements and questions) distributed to participants on the first day of the conference and posted on Astrolib, which was unfortunately delayed due to some unexpected technical problems. A copy of the distributed list of topics can be found as an appendix. The following summary is not only from the conference discussion, but also includes responses from four participants who submitted their suggestions in writing at the conference and 10 responses that were received by email. Three of the latter were from Chinese librarians who also sent messages of support to the conference.

Topic 1

The response of the audience was definitely in favour of traditionally published proceedings rather than exclusively electronic format. The reasons given were:

- LISA conference proceedings have been published on paper in the past. This factor is appreciated by both scientists and our peers and so helps us to be recognized by them.
- Finding a funding source for LISA III was very difficult as the International Astronomical Union did not offer the support it had provided in the past. We are fortunate to have the support of the European Union this time but there is no guarantee for future support. It is important to have the proceedings published for future reference.
- Books are still more accessible, easier to use and to read than works on computer screens.
- At this stage electronic archiving is too uncertain and a paper copy is still the most permanent format.
- For an academic librarian, a hard copy carries more weight and a paper publication is better for inclusion in a resume. Also, people like to see their names in print.
- Hard copy requires a more finished presentation and this is worthwhile.

The question was asked as to how many of the audience had referred to previous LISA proceedings recently. A large number of the audience raised their hands.

Topic 2

Who will be the safe keepers of information and knowledge in the global astronomical community?

The topic was not discussed during the Open Forum because it had been fully discussed during the conference, although with no definite answers. The views of a number of delegates are expressed with the following extracts from written contributions:

- Today's students are the future knowledge holders. Information/knowledge sources will become even more varied, but the needs of the users will still determine how we manage these sources. Flexibility is all important-in how organisations work, manage their information and the role of the librarian within these premises. If flexibility is not retained, then it can lead to the demise of whole institutions.
- The safe keeping of information requires uniform standards for the information sources, otherwise control will be lost in the processing of the information.
- Ideally, libraries in every country would provide the print backup of one copy for each paper item pertinent to their geographic area. Items of global "value" would be housed in the larger repositories of the world as well. Problems of future accessibility still remain with the use of other formats, especially electronic formats. The question still remains of who would co-ordinate the listings of any international holdings.

Topic 3

All participants and written responses were very much in favour of future LISA meetings, with a consensus of a three or four year interval between meetings and a suggestion to hold LISA IV in the Pacific area.

The development of discussion groups initiated with papers or comments posted on the Web was more controversial. All written responses commended this suggestion on either an annual or biannual basis. These views are summarised by the following statement.

- Interpersonal contact is very important for all human endeavours. In such a small community as ours, chance encounters are quite rare and exceptional. (In the USA and UK this may be easier.) LISA meetings should occur about every four years with a virtual meeting approximately one year later to serve as a forum to follow-up on action taken or action pending. I think that alternative forms of communication only work well between established contacts.

However, this was not the general opinion expressed by those who were able to attend the conference and so a summary of their responses now follows.

- It seems that some people are not ready for virtual meetings which are taken less seriously and are subject to distractions and interruptions. The difference in time zones was seen as an almost impossible problem by some delegates.
- The mixture of astronomers, librarians, computer people and publishers is perceived as a positive attribute, adding to the depth of experience and understanding gained. The interactions at these meetings are rewarding and encourage further communication, but this lessens over time, especially if there is not the necessary impetus provided by further meetings.
- If Astrolib is used as the forum for "virtual meetings" there is concern that people will not take as much time to write papers for it as they do for LISA conferences and so the quality may be lost. Many librarians are too busy with their daily tasks to take the time to read Web postings, newsletters or other information. However, "meeting in person" enhances the opportunities for closer cooperation. In this regard, LISA I was exceptional as it was held at the time e-mail began and so boosted our ability to communicate in a fast and effective method.

The session was closed with applause for the last comment made by an astronomer: "I see this as a very useful conference because it establishes more cooperation.

At other conferences, it is mostly competition; here, it is mostly collaboration. This is a good conference and it would be a pity to see it substituted."

Appendix

Open forum on optimizing communication amongst astronomy librarians in the digital age:

Chairs: Jeanette Regan and Suzanne Laloe

Discussion Topics

Direct Publishing on the Web: Most people agree that "proceedings" are not "real" books and that the ratios information/price and information/shelf-space are rather low. The short time that proceedings remain current is also of concern.

a) Why should we publish future LISA proceedings in the form of a book?

b) Would a posting on the Web not be sufficient?

c) Should librarians not give the good example?

Who will be the safe keepers of information and knowledge in the global astronomical community?

a) What is the raison d'etre of a librarian in this digital age, given that we also have pre-digital information (books, journals, etc.)? Is it only the free circulation of hard copy material, facilitated no doubt by electronic communications, or will it be the use of electronic communications to direct people to digital sources?

   Research institutions are attempting to exist within the confines of smaller budgets and changing political regimes. These, and other factors, have lead to dramatic changes in institutions in Eastern European countries and also the closure of renowned institutions such as RGO.

b) How can we ensure the safe keeping of information sources?

c) Do we need to ensure that there are copies of all paper items within defined regions world wide?

d) How should these be managed?

e) It would require an enormous level of cooperation. Is it feasible?

f) Can we, or should we, also rely on deposit sets held in National Libraries?

Communication amongst Astronomy Librarians: The changes in international communication channels that have been made since LISA I have been astounding. Astrolib and other relevant discussion lists assist most of us with our daily tasks. However, the overall costs of holding conferences are high-too high for some institutions.

a) In this isolated subject area of astronomy, how important is face-to-face contact?

b) Other organisations are organising regular Internet meetings. Could we also use this as an alternative method?

c) If so, how often should 'virtual' meetings be held, and how often face-to-face meetings, *e.g.* annually, or every 2, 3 or 5 years?

d) Are there other methods of communication we should be developing?

The VLT/HST Archive Research Facility

The initial archive requirements for the HST science archive were derived from the need to store and retrieve the data taken by the Hubble Space Telescope (HST). However, in the near future the driver for the ESO Science Data Archive will be the Very Large Telescope (VLT): with four large Unit Telescopes, numerous smaller telescopes, large format detectors, and high sample rates, the data volume will be over 70 Gigabytes per day.

Given the rapid evolution of the World Wide Web the Archive is accessible to a growing community of users, who have become accustomed to rapid response and to the multitude of options and functions provided by large commercial services (*e.g.* the different search engines). In particular the Archive must evolve from a mere repository of data to a research facility which is capable of optimizing the scientific return from the telescopes. Therefore the development goals of the ESO archive have two main thrusts: the support of the VLT and of the HST; and the development of additional functionality to discover all information contained in the archive, either explicitly, or implied.

Added Value Products: On-the fly Recalibration, WFPC Associations

New calibration reference data and new calibration procedures, based on improved operational experience allow improved calibration of archive data. Together with the Canadian Astronomical Data Centre the ST-ECF pioneered the on-the-fly calibration concept: as the data are being retrieved from the archive they are calibrated using the best available calibration reference files and the best available calibration algorithms (Crabtree et al. 1997). This also allows to store ONLY the raw data. These are usually signed integers which compress well and fit on CD-ROMs or DVDs, keeping the data volume low and the hardware cost down. The ultimate goal is to perform both de-compression and re-calibration at the client site, using Web-compatible distributed software.

Associations are sets of logically linked observations, *e.g.* CR-split observations, long HST exposures interrupted by Earth occultations, or, ultimately, the Hubble Deep Field. The first goal is to identify suitable candidates and to perform the combination and re-calibration upon retrieval of the data from the Archive (Micol et al. 1998). It soon became evident that it was vital to assess the suitability of the data for re-combination on the basis of the jitter of the HST during the observations: only if the jitter is within the nominal limit of 7 milli arc seconds can the data be recombined.

A project to retrieve the jitter information for all WFPC2 observations was initiated and Java software to perform jitter analysis is available. It also turned out that the centre of gravity of the "jitter ball" shifts between observations on a subpixel scale. This effect can be utilized to improve the resolution of the combined images using the "drizzling" technique developed for the combination of images of the Hubble Deep Field.

Data Mining

In view of the very large amounts of data generated by state-of-the-art observing facilities, the selection of data for a particular archive research project quickly becomes an unmanagable task. Even though the catalogue of observations gives a precise description of the conditions under which the observations were made, it does not contain any information about the scientific contents of the data.

Hence, archive researchers first have to do a pre-selection of the possibly interesting data sets on the basis of the catalogue, then assess each observation by visually examining it (preview) and/or running an automated task to determine its suitability. Such procedures are currently used for archive research with the HST Science Archive. This is acceptable as long as the data volume is limited. However, already after the first year of Unit Telescope 1 operations, the VLT will be delivering data in quantities which do not make it feasible to follow the same procedures.

The ESO/CDS Data Mining Project aims at closing the gap and develop methods and techniques that will allow a thorough exploitation of the VLT Science Archive. The basic concept is not to have to ask for individual data sets, but instead to be able to ask for all information pertaining to a set of search criteria. In addition to parameters contained in the observation catalogue, the criteria should include parameters which pertain to the science content of the observations. This implies that science parameters have to be generated after the observations, either by performing science processing on the data, or by linking science-related information from other sources. The proper time is during the ingest of the data into the archive.

These parameters can then be correlated with other information. The concept is to create an environment that contains both extracted parametric information from the data plus references to existing data bases and catalogues. The environment then establishes a link between the raw data and the published knowledge with the immediate result of having the possibility to derive classification and other statistical samples.

Data mining as described above is a step in the process of Knowledge Discovery in Data Bases (KDD): application of specific algorithm(s) to produce a particular enumeration of patterns over the data base. Knowledge Discovery in Data Bases is the extraction of implicit, previously unknown, and potentially useful knowledge from data bases.

Determination of Science-related Parameters

The aim of parametrization must be the enumeration of statistically relevant and physically meaningful parameters. Examples are: integrated energy fluxes of objects, colours, morphology, distribution. This will lead to data archives which are organized by objects rather than by data sets (Albrecht et al. 1994)

A promising beginning are tools like Sextractor. This software package allows the extraction and parametrization of objects on large image frames (Bertin & Arnouts 1995). Electronic links will be used to collect parameters on the objects thus extracted from other sources, for instance data bases from other wavelength regions. These parameters will either be physically imported and added, or they will be attached to the objects through hyperlinks.

The most useful science processing consists of classification. The challenge of classification is to select the minimum number of classes such that objects in the same cluster are as similar as possible and objects in different classes are as dissimilar as possible. However, this has to be done in such a way that membership of an object in a particular class is meaningful in terms of the physical processes which are responsible for the condition of the object.

This is not always the case for traditional classification systems in astronomy: the binning criteria were determined by the characteristics of the detector and the physiology of the human classifier. This is also not necessarily the case for statistical approaches (clustering, pattern recognition, neural network), because no physics is involved in establishing the classes. The current emphasis is on automatic classification, and on the data base access mechanisms to mine terabyte-sized data bases.

The Archive Research Environment

It is evident that the optimum exploitation of the above concepts will require a special computational infrastructure (Albrecht et al. 1998). Given the large data volumes, the need to access heterogeneous data bases, and to execute different software packages we need an environment tailored to these requirements. The goal is to offer the Science Archive as an additional instrument with the capability of feature extraction from raw data and a data mining environment on both data and extracted parameters.

Archive Research Programmes are either user-defined or standard processing chains that are applied to the raw data. Each of the processing steps is called a Reduction Block. Typically the first reduction block would be the re-calibration of data according to a standard calibration pipeline. A reduction block consists of one or more processes which are treated by the system as 'black boxes', *i.e.*, without any knowledge of its implementation.

However, the reduction block interface does comply to a well-defined specification, which allows any reduction module to become part of the chain. In fact, this flexible architecture also allows the research programme to analyze different kinds of data from images and spectra to catalogues and tables of physical quantities. The output of an archive research programme will be derived parameters that are fed into an object-oriented data mining database (Objectivity).

Additional parameters for the data mining database will be fed in by a cross-correlation interface to the CDS and thus linking the ESO Science Archive to the published knowledge database of the CDS. The first step will be an interface to the parameters of catalogues of astronomical objects, the next step will also include means to extract information from published papers.

This interface may be used from either side, CDS or ESO-SARE (Science Archive Research Environment) to fill the data mining database with relevant parameters for a KDD project. The implementation of this system will be a first step to realize an astronomical data mining approach as described above.

Data Used in Library Systems

While the Library places an understandable emphasis on cataloguing and other standards for the description of library materials, there are a number of underlying standards which are also of major importance in ensuring the interchange of library data.

Character Sets

The data which describes library materials or electronic information resources is, in the final analysis, composed of characters which belong to the world's scripts. There are a number of standards which govern these character sets, including the international standard ISO 10646 which is functionally identical to the UNICODE standard, and code sets for East Asian languages such as the US standard Z39.64 (East Asian Character Code for Bibliographic Use).

The Library has a low level of participation in the development of these standards. It monitors developments through its participation in Standards Australia Committee IT/19. It also monitors the use of East Asian character codes in products used by its National CJK Service.

Responsibility for this area rests with the Information Technology Division.

Data Elements

The International Organization for Standardization (ISO), through its Technical Committee 46, Subcommittee 4, has developed a range of library automation standards. One of the working groups of Subcommittee 4 (Working Group 7) has developed a family of data element standards (ISO

8459) which can be used as a data dictionary to support the automation of library technical services. Data element standards have been defined for Interloan, Acquisitions, Information retrieval, Circulation, and Cataloguing & metadata. Further work will concentrate on a consolidation of all the parts into a unified data dictionary standard.

As discussed below, the Library has recently developed a draft data dictionary, based on the international standard ISO 2146 (Directories of libraries, archives, information and documentation centres, and their data bases), to support the future development of its directory services. The Library is leading a review of ISO 2146, which commenced in May 2000, under the auspices of Working Group 7.

The Library has also been active in the identification of data elements for preservation purposes. These activities are discussed in the section on Preservation Standards.

The Library also notes the existence of a framework standard, ISO 11179 (Specification and standardization of data elements) which it will observe, along with ISO 8459, in the construction of data dictionaries to support its own automated services.

Responsibility for this area is shared as follows:

- Resource Sharing Division: monitoring of the ISO 8459 family of standards;
- Collections Management Division: maintenance of the preservation metadata element set;
- Information Technology Division: monitoring of the ISO 11179 standard.

Item Identifiers

A key type of data element is a unique number which identifies a book, serial, journal article, electronic resource, or other type of information resource. Most of the standards applicable to this area have been developed within Subcommittee 9 of ISO Technical Committee 46. Examples include ISBN, ISSN, ISMN, Serial Item Contribution Identifier (SICI), Book Item and Component Identifier (BICI), and Digital Object Identifier (DOI).

The Library has historically had a strong interest in item identifiers, and it has endeavoured to ensure that processes are in place for the routine assignment of several of the above identifier types to Australian information resources.

The Library has relinquished the Australian ISBN agency role, but remains the national centre for ISSN and ISMN.

In the United States, a national standard has been developed for the identification of journal articles and other individual serial contributions. This standard is known as the Serial Item Contribution Identifier, or SICI. A similar standard for non-serial items, the Book Item and Component Identifier (BICI) has been released as a Draft Standard for trial use.

The Library will continue to monitor the development of the SICI and BICI standards, and it will work through Standards Australia and ISO committees to seek their endorsement as international standards. The Library will encourage their implementation in Australian citation databases and related services.

The Library has a strong interest in current developments aimed at providing authoritative and persistent identification of digital information resources. In April 2000 the Library engaged a consultant to examine and report on existing standards and processes for persistent identifiers, and a report of the consultant was released in June 2001.

The Library has implemented the recommendations of this report and is now allocating persistent identifiers to the digital objects in its care, according to the guidelines in Appendix 1 of the report. It is managing persistence of its resources through a combination of managed URLs and a resolver system based on directing query strings to our application delivery mechanisms for digital materials detailed in Appendix 2 of the report.

In collaboration with the CASL Digital Issues Working Group and the State Library of Tasmania, the Library is looking at the feasibility of an Australian Digital Resource Identifier (ADRI) and a national agency for its implementation and allocation.

In 2001 the Library released a statement on Managing Web Resources for Persistent Access.

The Library is also an active member of an international working group (the Persistent Identifiers Task Force) which was formed to develop standards and guidelines for national libraries in the use of persistent identifiers. This Group has met twice, in April 1999 and March 2000.

The Library has agreed to participate in a pilot project with the ISSN International Centre to explore the concept of an Electronic Archive Registry and its possible role as part of a resolution system.

Responsibility for this area is shared as follows:

- Collections Management Division, Technical Services Branch: oversight of the ISBN, ISSN, SICI and BICI standards, monitoring of persistent identifier standards, evaluation of test beds;

- Information Technology Division: monitoring of technical aspects of persistent identifier standards, technical support for test beds;
- Resource Sharing Division: delivery of the Library's PURL service.

Full Text Markup

Text markup is of critical importance in the provision of online access to documents. This process involves the insertion of markers which clearly delineate the logical components of a document, such as the author information, title information, abstract, executive summary, chapter headings, and bibliographic references. Markup facilitates the browsing of documents through the Web. It also facilitates search access and the extraction of metadata. The wide scale adoption of standard markup schemes by publishers could greatly facilitate the efficient construction of digital libraries.

The framework standard for document markup is known as the Standard Generalised Markup Language or SGML. Within this framework, there is a multitude of specific standards for the markup of particular types of documents, such as books, journal articles, law reports, theses, or manuscript finding aids. Each of these standards is known as a Document Type Definition.

Examples of the application of SGML are the HyperText Markup Language (HTML, the original basis for browsing documents on the World Wide Web), the Extensible Markup Language (XML, designed as an improvement on the HTML standard in the separation of content from presentation), the Text Encoding Initiative (TEI) and the Encoded Archival Description (EAD).

The Library will give increased attention to these standards, because of their importance in the management of digital information resources. The Library is trialling the use of XML and EAD (mentioned above under Special Collection Descriptions) for its collection guides, manuscript finding aids and other appropriate web publications.

Responsibility for this area rests with the Information Technology Division.

System Interconnection

The development of library networks over the next decade will be based on the interconnection of distributed library systems, and the use of client/server technology. The implementation of certain key technical standards will allow particular applications such as searching and interlibrary loan to be managed cooperatively between two computer systems.. The three key standards are Z39.50, the international Interlibrary Loan Protocol, and the Open Archives Initiative Metadata Harvesting Protocol.

Z39.50 (ISO 23950)

The Z39.50 standard specifies the structures and rules which allow a client machine (such as a personal computer or workstation) to search a database on a server machine (such as a library catalogue) and retrieve records that are identified as a result of such a search. The rather arcane designation for this standard derives from the fact that it was the 50th standard developed by a committee known as "Z39", the committee of the American National Standards Institute that has the responsibility for library automation standards. While technically a US national standard (Version 3 of which was adopted in 1995), Z39.50 has also been copied or "cloned" as an international standard, known as ISO 23950. The standard has been of major importance in supporting access to distributed library databases and catalogues. The Library of Congress undertakes the role of maintenance agency for the standard. Through its participation in Standards Australia Committee IT/19 and related bodies, the Library has been active in monitoring the development of the Z39.50 standard and in ensuring that it became an official Australian standard. The Library continues to participate as resources permit in meetings of the Z39.50 Implementors Group, an international body which works by consensus to approve the development of the standard.

From 1998 the Library participated in a group, convened by the National Library of Canada, which developed what is now known as the Bath Profile. This Z39.50 profile was drafted in August 1999 at a meeting held in Bath, UK. The profile builds on the work of earlier profiling projects and defines a range of author, title, subject, keyword, date of publication and standard identifier searches which should be supported, the exact combination of attributes required to specify each search type and the expected behaviours. The profile addresses the range of functionality which users expect to be supported by library catalogues. In addition the profile defines levels of conformance for cross-domain searching.

The Library has implemented the Z39.50 standard in its key bibliographic services: Kinetica; the National CJK Service and its catalogue. The Library also maintains a national directory of Z39.50 targets.

Libraries will add holdings and original cataloguing data to the national union catalogue, through Kinetica, as part of the process of obtaining records for their local systems. The Library recognises that, while union catalogues are of great benefit to library communities, more flexibility is required in the process of updating them. For this reason, the Library has taken a strong role in supporting the concept of the Union Catalogue Profile. This Profile is intended for use with the Z39.50 standard to allow a cataloguer to update a database in a distributed environment, effectively supporting the simultaneous update of local and union catalogue systems. The National Library, in collaboration with others, has discussed this profile with the Z39.50 Implementors Group, and it hosts the Profile on its web site.

Work on the Z39.50 standard is a priority activity for the Library, because of the importance of the standard to the development of the open, distributed library network. The Library will continue its high level of involvement in the monitoring of the standard, in contribution to the maintenance of the Union Catalogue Profile and the Bath profile, in support for the standard in the Library's own systems, and in collaborative projects which are based on the standard.

Responsibility for this area is shared as follows:

- Resource Sharing Division: implementation of the standards.
- Information Technology Division: input into the development of the standards.

Interlibrary Loan Protocol and Related Standards

The Interlibrary Loan Protocol is designed to support the interconnection of separate computer systems which are managing the interlibrary loan process. It supports the control and management of ILL transactions for both lending and borrowing activities. The Library has not taken an active role in the development of the Protocol. However, it has cooperated closely with the Australian Vice Chancellors Committee through the JEDDS and LIDDAS projects, which are based on the Protocol. The AVCC, through its project manager for JEDDS and LIDDAS, represented Australia at recent international meetings of the ILL Protocol Implementors Group. The Library's Kinetica Service is using the Fretwell Downing VDX software, which supports the Protocol.

Related to the Interlibrary Loan Protocol are standards which support electronic document delivery services, such as the "header information" standard developed by the Group on Electronic Document Interchange (GEDI), and the Multitype Internet Mail Extensions (MIME) standards which support transmission of a document image over electronic mail. These are important areas of activity for the National Library, because these standards will underpin the development of a national and global distributed interlibrary loan network. The Library will continue to monitor the development of these standards, partly in cooperation with others through the LIDDAS Steering Committee.

Responsibility for this area rests with the Resource Sharing Division.

Open Archives Initiative (OAI) Metadata Harvesting Protocol

The National Library has embarked on an exploration of the use of the Metadata Harvesting Protocol in its proof-of-concept to support resource discovery of digital Australiana. Metadata will be gathered from a wide range of information managers according to the OAI protocol and the proof-of-concept will also become a target for similar initiative being conducted by the University of Michigan's OAIster project. The National Library has also become a signatory to the Budapest Open Archive Initiative which 'aims to accelerate progress in the international effort to make research articles in all academic fields freely available on the Internet.'.

Responsibility for this area rests with the Coordination Support Branch.

Directory Services

Directory services provide a critical underpinning to the library and information infrastructure, allowing the discovery of relevant information suppliers, and providing access to information about the methods and conditions of supply. The Library has created and published a number of directories of Australian library collections and services. It has developed the Australian Libraries Gateway and the Directory of Australia's Oral History Collections to provide a single web interface to these directory services. The Library has recently developed a draft data dictionary, based on the international standard ISO 2146 (Directories of libraries, archives, information and documentation centres, and their data bases), to support the future development of these services. As this standard is now over 10 years old, the Library is leading a review of the standard through Committee IT/19.

Directory services play a significant role in supporting interlibrary loan services. The Library has developed the Australian Interlibrary Resource Sharing Directory, which includes a national register of library symbols. The Library is also participating in ISO Technical Committee 46, Subcommittee 4, Working Group 8, which is developing a standard for an internationally accepted system of library codes or symbols. A recent paper sets out relevant standards initiatives and projects related to directory services to be undertaken by the Library and by Committee IT/19.

The Library is conscious that directories will increasingly be based on distributed services, rather than on centralised directory databases. For this reason, international directory service standards such as X.500

are likely to become more important in the cooperative development of library directories. X.500 is actually a series of ISO standards which define a global directory service that is independent of any computing application or network platform. An X.500 service will utilise a collection of directory servers, each holding a portion of a global directory information base. Because the X.500 standard is quite complex, the Internet community has defined a standard called the Lightweight Directory Access Protocol, which conforms to the X.500 model and is becoming widely used.

The Library will aim to develop its technical expertise in these directory protocols, and it will consider how to apply these standards to the future development of the Australian Libraries Gateway and the national interlibrary loan network. The Library is cooperating with Macquarie University in relation to the international project known as PRIDE (People and Resources in a Distributed Environment) which will develop services based on the X.500 standard. In particular, the Library is working with Macquarie University to develop a draft directory schema. The Library is also trialling the Open Directory software (which supports X.500) with the aim of migrating the Interlibrary Resource Sharing Directory to this platform in the medium term.

Responsibility for this area is shared as follows:

- Information Technology Division: monitoring of the X.500 standard, participation in the development of a draft directory schema, monitoring of data dictionary standards, leadership of the review of ISO 2146, implementation of the Open Directory software;
- Resource Sharing Division: support for the Australian Libraries Gateway, participation in the PRIDE Project, monitoring of standard library codes.

Preservation Standards

Preservation of Physical Collections

Despite the growth in digital collections, the Library will continue to be responsible for its very large, important and growing non-digital collections. Preserving these collections draws on a range of best practice approaches. The Library takes an active role in monitoring and contributing to developments, especially in the areas of conservation treatment, storage environments and strategies for dealing with intrinsically unstable information carriers such as cellulose acetate photographic materials and acidic newspapers.

The Library played an especially active part in the development of an Australian standard for "permanent" paper, through Standards Australia

Committee MS/48 (AS 4003-1996)-see Australian National Permanent Paper Campaign for further details. The Library will continue to support the use of such standards by publishers, as a way of reducing the potential costs of preserving future additions to the Library's book collections. Responsibility for this area rests with the Collection Management Division: Preservation Services Branch.

Reformatting Standards

The Library accepts reformatting or copying as a legitimate tool in support of its preservation programmes. Identifying and using appropriate standards is a key foundation of the Library's approach to reformatting, whether using analogue or digital technologies.

Preservation Microfilming

In the area of preservation microfilming, the Library has gained extensive experience and played a leadership role in standards development in Australia. It was the main instigator in re-shaping the Standards Australia Committee MS/4 to focus on preservation issues, and actively contributed to the development of draft preservation microfilming standards through that Committee. In addition, the Library published in 1998 Guidelines for preservation microfilming in Australia & New Zealand to assist in the adoption of best practices. More recently, the Library is collaborating with the State Library of South Australia to develop training materials in preservation microfilming, suitable for use in the South East Asia and Pacific regions (in which the Library has special responsibilities as a Regional Centre of the IFLA Preservation and Conservation Programme). Improved knowledge of and compliance with standards and best practices for preservation microfilming have been identified as important goals for these regions.

Digital Reformatting

While microfilm has been a very useful preservation reformatting methodology, digital imaging technology has opened up the possibility of greatly enhanced access to the content of collection materials.

The Library makes digital copies of physical collection items in order to enhance access and to support preservation programmes. Standards play an important part in ensuring widespread accessibility, and in defining formats and methods capable of surviving a number of technology changes. The Library is also seeking best practices that will minimise the risk to material being digitally copied.

Currently, a standards approach to digital imaging applies mainly to image file formats. The Library takes account of a range of graphic interchange standards including TIFF (Tagged Image File Format), JPEG (Joint Photographic Experts Group), and GIF (Graphic Interchange Format) standards. The Library has also used some proprietary standards such as Kodak PhotoCD for processing and storage of images, Adobe PDF (Portable Document Format) for delivery of multi-page documents, DigiMarc watermarking to protect the intellectual property of creators and distributors of digital images, and Lizard Technologies MrSid wavelet compression tools to make large images such as maps deliverable over networks.

Recently, the Library has trialled the use of Ebind, a method of binding digital images together using an SGML document type definition. Ebind supports management and display of digital copies needing to reflect the hierarchical and sequential structure of documents such as books.

The Library seeks to use open, non-proprietary standards wherever they can deliver the functionality the Library requires.

Other elements of digitisation programmes such as selection and preparation of materials, digital capture, and management of digital collections, are currently less standardised, although many forums are attempting to prepare best practice guidelines in these areas.

The Library has been an active member of the Corporate Management Forum Information Technology Working Group Digitisation Subgroup, which produced some basic guidelines for national institutions in Australia.

The Library also participates in the RLG PRESERV programme, which has prepared a number of digital imaging guidance documents, and the NISO Committee AU on Technical Metadata for Digital Still Images.

The Library has developed its own Digitisation Policy, which sets out many of its own intentions, and is engaged in a major digitisation programme which will build on experience gained in a number of its own previous projects, as well as that of others such as the Library of Congress' American Memory and the Making of America project.

Over the course of its initial integrated digitisation programme in 2001-2002, the Library expects to clarify and report on the standards it finds most useful in all areas of digital imaging, and to clarify its intentions regarding the roles of digital imaging and preservation microfilming.

Responsibility for these areas rests with:

- Collection Management Division: Preservation Services Branch
- Corporate Services Division: Coordination Support Branch, and IT Division.

Preservation of Digital Collections

The Library is involved in developing digital archiving and preservation procedures to support both its own digital collections (including digital surrogates and Australian digital publications), and a distributed national collection of electronic publications. These collections include both online and physical format digital resources. The Library shares relevant information freely with a number of other national libraries, consortia such as RLG, and digital archiving projects overseas, as well as with other Australian libraries and institutions, with a view to developing standards and best practices that will ensure the ongoing accessibility of digital collections.

In particular, the Library closely monitors the development of archiving models such as the Reference Model for an Open Archival Information System (OAIS). This emerging standard is being developed by the Consultative Committee for Space Data Systems on behalf of ISO Technical Committee 20, Subcommittee 13 (Space data and information transfer systems).

The Library is also working to develop best practice guidelines with an RLG/OCLC Digital Archive Working Group defining the attributes of a reliable digital archive, and with a special committee of the Council of Directors of National Libraries (CDNL) on digital archiving issues.

The emergence of standards is likely to be slow in the area of strategies intended to maintain access to large collections of digital resources, such as migration and emulation. The Library monitors and when appropriate seeks to contribute to international research leading to a better understanding of these and other strategies. As best practices emerge, the Library plays a role in publicising them and encouraging their use, both through its PADI website, and through published guidelines such as Safeguarding Australia's web resources: guidelines for creators and publishers and First steps in preserving digital publications.

Responsibility for this area rests with:

- Collection Management Division: Preservation Services Branch
- Technical Services Branch.

Preservation of Audio Resources

The Library takes an active role in developing informal standard procedures for sound archiving through the International Association of Sound and Audiovisual Archives (IASA), and applies best practice approaches in managing its analogue and digital audio collections. It monitors the activities of the RLG Working Group on Preserving Magnetic

Media, and closely monitors the impact of Digital Video Disc technology on Compact Disc standards. However, as the Library moves its audio collections to mass storage systems over the next few years, CD standards are expected to become less important to the Library.

Responsibility for this area rests with Collection Management Division: Preservation Services Branch.

Metadata for Recording Preservation Information

The Library is developing systems for recording preservation information required to manage both its digital and non-digital collections.

The Library developed a draft set of preservation metadata requirements for managing all of its digital collections, designed to complement resource discovery, rights management and other administrative metadata. Building on this, the Library is a member of an OCLC/RLG Preservation Metadata Working Group developing international guidelines and recommendations which will be available for public comment by mid 2002. Responsibility for this area rests with Collection Management Division: Preservation Services Branch. The Library monitors standards in these areas but is not actively involved in their use at this stage. Responsibility for this area rests with Corporate Services Division.

The National Library has been active in the development and promotion of a large and complex array of standards which facilitate access to distributed information resources, and which support the inter-working of library systems and services. Other Australian libraries have given strong support for the National Library to exercise a leadership role in standards work. The Library is committed to continuing to invest in this area, with an emphasis on those standards which have the most impact in supporting the distributed library network, and in supporting the preservation of digital information.

The Digital Services Project is a long-term initiative of the Library begun in 1998 as a strategy for ensuring effective management of its digital collections and their preservation for future access as technologies change. The aim of the project is to:

- Provide the infrastructure for long-term management of digital material in the Library's collection through provision of hardware and software systems supporting integrated collection management in a digital environment.
- Provide the Library with cost-effective technical solutions for efficient development and delivery of digital services to provide enhanced access to the Library's collections and other documentary

resources, and provide shared access to digital collections in cooperation with other institutions.

The Library defines digital services to mean services exploiting digital technologies to provide access to traditional documentary resources and to ensure the long-term preservation of, and access to, documents available only in digital form.

Summary of Achievements

As a first deliverable, a Systems Architecture was developed that has been tested and modified over time to provide a framework for a wide set of IT development and procurement activities. This framework embraces all of the key library processes of selection, acquisition, storage, resource discovery, delivery, access control and preservation. It also covers both digitised and born-digital information resources. The Library then tested the market to identify and acquire the infrastructure components needed to meet the aims of the project. At almost every stage the requirements proved to be specialised or leading edge. This resulted in the need to build some elements of the infrastructure in-house. The Library has used open source software whenever this has provided a functional and robust solution, and has also started to look at ways of sharing the software it has developed in-house through open source licencing arrangements.

Metadata Repository and Search System

The capability to separate resource discovery from resource management and delivery was a key element of the Digital Services framework from the start. The Library had a requirement to build resource discovery services based on a combination of metadata harvested from a variety of sources and databases accessed through standard search and retrieval protocols. From 1999-2002 the Library used the MetaStar Enterprise software from BlueAngel Technologies for this purpose.

In July 2002 the Library signed a contract with InQuirion Pty Ltd for the TeraText software which is now being used to provide federated, metadata-based resource discovery services such as PictureAustralia, MusicAustralia, LibrariesAustralia. and the ARROW National Discovery Service. Through TeraText, the Library also provides the 16 million record National Bibliographic Database (NBD) as a search target for other metasearch services.

In 2006, the Library selected the open-soure software product Lucene as a full text search engine for PANDORA (Australia's Web Archive). Recently, it has also been experimenting with Lucene as a metadata search engine in a laboratory environment, using a copy of the NBD to prototype relevance ranking and clustering of result sets and the use of FRBR to group related items.

Digital Object Storage System

One of the lessons learnt through testing the market was that the digital object storage requirement could be effectively separated from the digital object management requirement. In 2001 the Library took delivery of a Digital Object Storage System (DOSS) to handle the Library's digital object storage requirements for the period 2001 to 2006. The system consists of a Sun E450 server, a CLARiiON FC4700 disk array, a StorageTek Tape Library connected via a SAN switching infrastructure. The new system which became operational in July 2001 had been upgraded by 2005 to a capacity of 14 TB of disk and 60 TB of offline tape storage.

Digital Collections Manager

The Library also recognised at an early stage in the project that, while the underlying storage systems and information model might be the same, different workflow systems were needed to support the digitisation of documentary heritage collections and the capture and archiving of websites. A Digital Collections Manager (DCM) was developed in-house, replacing a number of existing in-house systems and providing for the acquisition, storage and long-term management by the Library of the products of digitisation and born digital collection items.

The current version of this software supports the digitisation of still images and audio material and stores descriptions of the source copy and structural, technical and preservation information about the resulting digital objects. It is also used to manage born digital collection items and to store information about the Library's analogue audio material that has yet to be digitised. The functional specifications for this system are still a good indicator of the gap between existing digital object management systems in the marketplace and the level of workflow support required for the digitisation of documentary heritage materials as an operational task.

Work has now begun on a system to support the recording of intellectual property rights and the Library is also working with the Australian Partnership for Sustainable Repositories (APSR) to develop systems to support the management of the preservation of the Library's digital collections and management of the preservation of physical format collection materials.

Pandas-pandora Digital Archiving System

To support the separate need to capture and archive websites in an efficient and cost-effective manner, in 2001 the Library replaced an antiquated gathering system based on Harvest for the PANDORA Archive with the PANDAS system. A second version issued in 2002 provided improved workflow efficiencies and enabled archived material to be distributed nationally rather than being controlled centrally at the National Library. In 2005 the UK Web Archiving Consortium began using PANDAS for its a test-bed for selective archiving of UK websites.

The software is currently being redeveloped to position it better to meet the needs of other agencies as a website curation tool, to take into account emerging web archiving standards and to meet future requirements such as support for deposit workflows and preservation management.

Digital Collections, Persistent Identifiers and Web Delivery Systems

In July 2001, the Library embarked on a major digitisation programme to provide greater access to its collections through digitisation of traditional format library materials. This resulted in a new focus on the need for systems to support citation and delivery of digital collections.

In September 2001 the Library implemented a resolver service for digital collection items. The resolver accepts web requests which refer to a digital collection item by its persistent identifier and redirects them to the current storage location of that item. The service was implemented following the recommendations of a consultancy on Persistent Identifier Systems. Persistent Identifiers are now included at the bottom of every image (except thumbnails) delivered by the library's digital services.

The Library has also substantially implemented a generic web delivery framework and access architecture for its digital collections based on the Digital Collections Manager Database. Delivery systems for printed music and maps were released in July and September 2002 and for manuscripts, serials and monographs in 2003-2004. Delivery systems for audio material and pictures are currently under development. The manuscripts delivery system is based on the Encoded Archival Description.. The audio delivery system will also provide access to summaries and transcripts based on the Text Encoding Initiative guidelines.

The delivery framework is currently limited to material without access restrictions. The delivery system will be further developed to support access by authorised users to restricted material once systems to record rights management information are in place.

Metadata Harvesting

An Open Archives Initiative (OAI) gateway has been implemented to enable metadata describing the Library's digitised collection items to be harvested by other agencies.

Future Directions

Through its involvement in ARROW (Australian Research Repositories Online to the World) and APSR (Australian Project for Sustainable Repositories), the Library is currently investigating D-Space and Fedora as two alternative initiatives that may inform the ongoing development of its digital services framework. In particular, it is interested in aligning the information model and backend processes required to manage the digital objects under its care regardless of format, while continuing to support separate workflow systems for their creation and/or acquisition and ingest.

The Library has been monitoring developments in software and business models to support the digitisation of historical newspapers and the whole-of-domain capture of websites. This may require new software components to be incorporated into the Library's digital services framework and will certainly place new demands on the capacity of the Digital Object Storage System.

The Library is also investigating search engine software that will enhance the resource discovery process by providing access to the content of digital objects in Australian collections or federated metadata repositories and by enabling users to view different versions of an object over time.

Stop Press

In October 2006 the Library commissioned a project team to review the achievements of the Digital Services Project and to define the IT architecture that will be needed to support the management, discovery and delivery of the National Library of Australia's collections over the next three years.

The IT Architecture Project Report (pdf file, 627 kb) recommends three changes to the Library's current approach to building digital library services:

- to implement a service-oriented architecture;
- to adopt a single business approach; and
- to consider open-source solutions where these are functional and robust.

24

The Digital Library as a Community

A library is more than books and bricks. If it is successful, it supports a sense of community among its users, as an archive of its collective knowledge and as a resource for its future. Yet digital libraries thus far have tended to be digitised versions of card catalogues, books and journals, and as such do not evoke a sense of community. But digital libraries might well be designed to do so.

First of all, it seems that digital places can evoke emotional and intellectual engagement. In *Life on the Screen* Sherry Turkle has described the way that software and network communications are transforming psychology. As a sociologist and psychoanalyst she concludes that 'virtual life' is emotionally and intellectually part of 'real life', but simulations of virtual life with their anonymous role-playing are capable of supporting emotional experimentation and growth.

And secondly, it seems that digital places can support a sense of community. The term 'virtual community' describes the feelings of social solidarity made possible by interactive network software. The strong case for virtual community is made by journalists Howard Rheingold, describing 'The Well', a San Francisco Bay Area based chat group (IRC), and Julian Dibble, describing Lambda Moo, an experimental Xerox PARC MOO designed as a virtual rooming house. Social scientists Barry Wellman and Milena Gulia argue that social networks on the Web are not very different from social networks experienced anywhere else. Deep feelings of community are rare in modern life, they argue, and virtual communities are more like the relationships most people have with casual acquaintances than with intimate friends.

Virnoche and Marx agree that 'virtual communities' and 'real life' are not opposites, and that the strongest sense of virtual community comes when network communications are reinforced with face to face meetings. There are three kinds of virtual communities, they argue, each connecting physical and virtual senses of place, called community networks, virtual extensions and virtual communities.

Community Networks

Community networks are based upon geographical proximity, but participation in a sense of place and community is extended by network communication, such as electronic mail, Internet relay chat, bulletin boards and Web pages.

Examples of community networks include municipal governments using the network to involve citizens in political deliberation, or corporations using electronic mail and teleconferencing. Clearly any traditional sense of community is dependent upon frequent personal interaction, but community networks reinforce a sense of membership by making information or communication more accessible. Many libraries use Web pages, email and lists in precisely this way to extend a sense of access into their communities; thus digital libraries should be designed as an extension of a physical library, not their replacements.

Virtual Extensions

Virtual extensions sustain a sense of community among a group of people separated by geographical distance but who have intermittent personal contact. Virtual extensions typically create a sense of place by collaborative work on a shared problem, requiring occasional face-to-face meetings, but sustained by a sense of shared culture and profession. Many classrooms use Web pages and electronic mail as virtual extensions, to encourage discussion outside classroom hours. Professions and academic disciplines use Web pages, email and lists in this manner, to reinforce professional values and trade information on skilled practice; librarians are exemplars of this.

Virtual Communities

Virtual communities in this strict sense, then, are groups of strangers separated by geographical distance, but sharing a common interest, expressed by participation in computer-mediated communication. Virtual communities in this specific sense may have relatively little stability over time, and relatively more listeners than speakers.

And yet they are of great interest because they may be robust even if the members have never met and are separated by great distances. They are, in essence, a sustained conversation on a (usually) narrow topic of mutual interest or shared problems rather than physical proximity.

Thus many of the most successful sites provide scarce information and advice about very specialised topics, such as political movements or the treatment of rare diseases, or perhaps simply a place to talk about a controversial topic without risk. For example, SeniorNet is an organisation using digital network services to link together elderly people, many of whom live alone, into a vibrant online community. Studies of the use of SeniorNet services suggest that it is not online information (*e.g.* databases) that sustains a sense of community, but rather the interactive services (such as electronic mail and online chat groups) that SeniorNet provides.

How, then, do network communications create and sustain a sense of community, when they do? According to Wellman and Gulia, social relations in cyberspace have the following characteristics: topics tend to be specialised, not general; social structure is based upon a sense of reciprocity, and social status is gained by giving good answers; anonymity fosters communication among a wider diversity of people than most face to face communities; and they tend to be quick to respond to questions. On the other hand, unlike traditional communities, they are not intimate, nor long-term, do not require frequent contact, and do not have depth over many social contexts or concerns.

A true virtual community, in this sense, might enable the creation of a virtual library, in which users around the globe interested in some specialised field could work together. These, of course, already exist, particularly among specialised scholars, or people who share a very rare disease; but librarians, who might bring order and quality to the information involved, rarely mediate them.

Each of these kinds of digital community is consistent with the idea of the library, and each uses commonplace technologies, such as Web pages, electronic mail and lists. But of course far more sophisticated technologies are emerging that might be used. Anonymous communication in online environments might be used to provide or support mentoring, or role-playing that enables users to participate in educational experiences not otherwise accessible. Anonymous role-playing might complement learning in educational places, by encouraging participation in learning by those traditionally silenced by the hidden currents of power and authority in the classroom.

Thus far, Internet communication has been far more successful as a tool for games than for learning; indeed, investment in computer games is far greater than investment in computer learning. But the spontaneous development of learning technologies on the Web, in parallel with far more sophisticated MOO technologies (which go beyond text and numbers to multimedia representations of information), have led to increased investment in these technologies for business training and development. Pensare, for example, is a Silicon Valley start-up that uses MOO technologies to teach business skills, including video mentoring by experts, simulations of business situations, and links to online discussion groups; when they become successful they hope to support experiments with libraries and schools using these technologies.

The premises of this paper are straightforward. First, it is too soon to make intellectual property policy because we lack even elementary knowledge of the dynamics of an information economy, a term which is still a slogan more than a social fact. Hence we live in a world with parallel systems of intellectual property, with parallel kinds of digital libraries. This in itself is not alarming, but it is rather complex, since each of the three libraries is, in one way or another, problematic. Second, information technology is not changing libraries alone; so too are publishers in change, and authors.

The transformation of authorship, and thereby information and knowledge, and the ownership thereof, is the most fundamental of all. Third, having stated that it is more important to envision the digital library we would like to build than the one we may be forced to accept, I accepted my own invitation and began to imagine how virtual community technology might be joined to digital library technology. Australia is the best place in the world to build this kind of a digital library, for obvious reasons.

Digital Library

A digital library is a library in which collections are stored in digital formats (as opposed to print, microform, or other media) and accessible by computers. The digital content may be stored locally, or accessed remotely via computer networks.

The first use of the term *digital library* in print may have been in a 1988 report to the Corporation for National Research Initiatives The term *digital libraries* was first popularized by the NSF/DARPA/NASA Digital Libraries Initiative in 1994. The older names electronic library or virtual library are also occasionally used, though *electronic library* nowadays more often refers to portals, often provided by government agencies, as in the case of the Florida Electronic Library.

Digitization

Digitization is the process of representing an object, an image, or a signal (usually an analog signal) by a discrete set of its points or samples.

The result is called "digital representation" or, more specifically, a "digital image", for the object, and "digital form", for the signal.

Analog signals are continuously variable, both in the number of possible values of the signal at a given time, as well as in the number of points in the signal in a given period of time. However, digital signals are discrete in both of those respects, and so a digitization can only ever be an approximation of the signal it represents. The digital representation does not necessarily lose information in this transformation since the analog signal usually contains both information and noise.

A digital signal may be represented by a sequence of integers. Digitization is performed by reading an analog signal A, and, at regular time intervals (sampling frequency), representing the value of A at that point by an integer. Each such reading is called a sample. A series of integers can be transformed back into an analog signal that approximates the original analog signal. Such a transformation is called DA conversion. There are two factors determining how close such an approximation to an analog signal A a digitization D can be, namely the sampling rate and the number of bits used to represent the integers.

In the past few years, procedures for digitizing books at high speed and comparatively low cost have improved considerably with the result that it is now possible to plan the digitization of millions of books per year for creating digital libraries.

Types of Digital Libraries

The term *digital library* is diffuse enough to be applied to a wide range of collections and organizations, but, to be considered a digital library, an online collection of information must be managed by and made accessible to a community of users. Thus, some web sites can be considered digital libraries, but far from all.

Many of the best known digital libraries are older than the web including Project Perseus, Project Gutenberg, and ibiblio. Nevertheless, as a result of the development of the internet and its search potential, digital libraries such as the European Library and the Library of Congress are now developing in a Web-based environment.

A distinction is often made between content that was created in a digital format, known as *born digital*, and information that has been converted from a physical medium, *e.g.*, paper, by digitizing. The term *hybrid library* is sometimes used for libraries that have both physical collections and digital collections. For example, American Memory is a digital library within the Library of Congress. Some important digital libraries also serve as long term archives, for example, the ePrint arXiv, and the Internet Archive.

Collaborative Digitization Projects

There are many collaborative digitization projects throughout the United States and in Europe, Australia and Asia. Two of the earliest projects were the Collaborative Digitization Project in Colorado and NC ECHO-North Carolina Exploring Cultural Heritage Online, based at the State Library of North Carolina. These projects helped to establish and publish best practices for digitization and work with regional partners to digitize cultural heritage materials. Additional criteria for best practice have more recently been established in the UK, Australia and the European Union.

Advantages

The advantages of digital libraries as a means of easily and rapidly accessing books, archives and images of various types are now widely recognized by commercial interests and public bodies alike. Traditional libraries are limited by storage space; digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain it. As such, the cost of maintaining a digital library is much lower than that of a traditional library. A traditional library must spend large sums of money paying for staff, book maintenance, rent, and additional books. Digital libraries do away with these fees.

Digital libraries can immediately adopt innovations in technology providing users with improvements in electronic and audio book technology as well as presenting new forms of communication such as wikis and blogs.

- *No Physical Boundary*. The user of a digital library need not to go to the library physically; people from all over the world can gain access to the same information, as long as an Internet connection is available.
- *Round the Clock Availability*. A major advantage of digital libraries is that people can gain access to the information at any time, night or day.
- *Multiple Accesses*. The same resources can be used at the same time by a number of users.
- *Structured Approach*. Digital libraries provide access to much richer content in a more structured manner, *i.e.* we can easily move from the catalogue to the particular book then to a particular chapter and so on.

- *Information Retrieval*. The user is able to use any search term (word, phrase, title, name, subject) to search the entire collection. Digital libraries can provide very user-friendly interfaces, giving clickable access to its resources.
- *Preservation and Conservation*. An exact copy of the original can be made any number of times without any degradation in quality.
- *Space*. Whereas traditional libraries are limited by storage space, digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain them. When a library has no space for extension digitization is the only solution.
- *Networking*. A particular digital library can provide a link to any other resources of other digital libraries very easily; thus a seamlessly integrated resource sharing can be achieved.
- *Cost*. In theory, the cost of maintaining a digital library is lower than that of a traditional library. A traditional library must spend large sums of money paying for staff, book maintenance, rent, and additional books. Although digital libraries do away with these fees, it has since been found that digital libraries can be no less expensive in their own way to operate. Digital libraries can and do incur large costs for the conversion of print materials into digital format, for the technical skills of staff to maintain them, and for the costs of maintaining online access (*i.e.* servers, bandwidth costs, etc.). Also, the information in a digital library must often be "migrated" every few years to the latest digital media. This process can incur very large costs in hardware and skilled personnel.

Problems

Some people have criticized that digital libraries are hampered by copyright law, because works cannot be shared over different periods of time in the manner of a traditional library. The content is, in many cases, public domain or self-generated content only. Some digital libraries, such as Project Gutenberg, work to digitize out-of-copyright works and make them freely available to the public. An estimate of the number of distinct books still existent in library catalogues from 2000BC to 1960, has been made.

Other digital libraries accommodate copyright concerns by licensing content and distributing it on a commercial basis, which allows for better management of the content's reproduction and the payment (if required) of royalties. Access to digital libraries and their collections is dependent upon a stable information technology infrastructure (power, computers, communications links etc.). Hence, despite the egalitarian potential of the digital library, many of those who could most benefit from its global reach (for instance in the Third World) are not able to do so.

Academic Repositories

Many academic libraries are actively involved in building institutional repositories of the institution's books, papers, theses, and other works which can be digitized or were 'born digital'. Many of these repositories are made available to the general public with few restrictions, in accordance with the goals of open access. Institutional, truly free, and corporate repositories are often referred to as digital libraries.

Digital Archives

Archives differ from libraries in several ways. Traditionally, archives were defined as:

1. Containing primary sources of information (typically letters and papers directly produced by an individual or organization) rather than the secondary sources found in a library (books, etc.);
2. Having their contents organized in groups rather than individual items. Whereas books in a library are catalogued individually, items in an archive are typically grouped by provenance (the individual or organization who created them) and original order (the order in which the materials were kept by the creator);
3. Having unique contents. Whereas a book may be found at many different libraries, depending on its rarity, the records in an archive are usually one-of-a-kind, and cannot be found or consulted at any other location except at the archive that holds them.

The technology used to create digital libraries has been even more revolutionary for archives since it breaks down the second and third of these general rules.

The use of search engines, Optical Character Recognition and metadata allow digital copies of individual items (*i.e.* letters) to be catalogued, and the ability to remotely access digital copies has removed the necessity of physically going to a particular archive to find a particular set of records. The Oxford Text Archive is generally considered to be the oldest digital archive of academic primary source materials.

Project Gutenberg, Google Book Search, Windows Live Search Books, Internet Archive, Cornell University, The Library of Congress World Digital Library, The Digital Library at the University of Michigan, and CMU's

Universal Library are considered leaders in the field of digital archive creation and management. There are hundreds of regionals such as the Wisconsin Historical Society.

The Vatican maintains an extensive digital library inventory and associated technology. The entire works of Martin Luther are held at Emory University and are being digitized under an $8M Grant from Coca-Cola heirs, and the Packard Foundation maintains digitization facilities near the Acropolis in Athens, Greece, as examples.

Searching

Most digital libraries provide a search interface which allows resources to be found. These resources are typically deep web (or invisible web) resources since they frequently cannot be located by search engine crawlers. Some digital libraries create special pages or sitemaps to allow search engines to find all their resources. Digital libraries frequently use the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) to expose their metadata to other digital libraries, and search engines like Google Scholar, Google, Yahoo! and Scirus can also use OAI-PMH to find these deep web resources.

There are two general strategies for searching a federation of digital libraries:

1. distributed searching, and
2. searching previously harvested metadata.

Distributed searching typically involves a client sending multiple search requests in parallel to a number of servers in the federation. The results are gathered, duplicates are eliminated or clustered, and the remaining items are sorted and presented back to the client. Protocols like Z39.50 are frequently used in distributed searching. A benefit to this approach is that the resource-intensive tasks of indexing and storage are left to the respective servers in the federation. A drawback to this approach is that the search mechanism is limited by the different indexing and ranking capabilities of each database, making it difficult to assemble a combined result consisting of the most relevant found items.

Searching over previously harvested metadata involves searching a locally stored index of information that has previously been collected from the libraries in the federation. When a search is performed, the search mechanism does not need to make connections with the digital libraries it is searching-it already has a local representation of the information.

This approach requires the creation of an indexing and harvesting mechanism which operates regularly, connecting to all the digital libraries and querying the whole collection in order to discover new and updated resources. OAI-PMH is frequently used by digital libraries for allowing metadata to be harvested. A benefit to this approach is that the search mechanism has full control over indexing and ranking algorithms, possibly allowing more consistent results. A drawback is that harvesting and indexing systems are more resource-intensive and therefore expensive.

Framework

A digital library can be built around specific repository software. The best known examples of this are DSpace, Eprints, Fedora, dLibra, and Greenstone Digital Library Software.

The Future

Large scale digitization projects are underway at Google, the Million Book Project, MSN, and Yahoo!. With continued improvements in book handling and presentation technologies such as optical character recognition and ebooks, and development of alternative depositories and business models, digital libraries are rapidly growing in popularity as demonstrated by Google, Yahoo!, and MSN's efforts. Just as libraries have ventured into audio and video collections, so have digital libraries such as the Internet Archive.

In 1997, the Library initiated the American Memory Fellows Programme, which brought together 25 two-person teams of K-12 educators to explore the collections and to develop sample lesson plans, teaching activities, and Web sites that could be used in their local communities. Throughout the 1997-1998 school year, these educators will participate in an online forum as they test and evaluate their materials under development. The Library continued the American Memory Fellows Programme in the summer of 1998 with the goal of building champions for their collections in schools across the country.

Digital Preservation

Digital preservation refers to the management of digital information over time. Preservation of digital information is widely considered to require more constant and ongoing attention than preservation of other media. This constant input of effort, time, and money to handle rapid technological and organisational advance is considered the main stumbling block for preserving digital information. Indeed, while we are still able to read our written heritage from several thousand years ago, the digital information created merely a decade ago is in serious danger of being lost. Digital preservation can therefore be seen as the set of processes and activities that ensure the continued access to information and all kinds of records, scientific and cultural heritage existing in digital formats. In the language of digital imaging and electronic resources, preservation is no longer just the product of a programme but an ongoing process. In this regard the way digital information is stored is important in ensuring their longevity.

Digital preservation is defined as: long-term, error-free storage of digital information, with means for retrieval and interpretation, for all the time span that the information is required for. "Retrieval" means obtaining needed digital files from the long-term, error-free digital storage, without possibility of corrupting the continued error-free storage of the digital files. "Interpretation" means that the retrieved digital files, files that, for example, are of texts, charts, images or sounds, are decoded and transformed into usable representations. This is often interpreted as "rendering", *i.e.* making it available for a human to access. However, in many cases it will mean able to be processed by computational means.

Strategies

There are several strategies which individuals and organizations may use to combat the loss of digital information.

Refreshing

Refreshing is the copying of data onto newer media or systems. For example, transferring census data from an old tape to a new one or transferring an MP3 from a hard drive to CD. This strategy may need to be combined with migration when the software or hardware required to read the data is no longer available or is unable to understand the format of the data. Refreshing will likely always be necessary due to the deterioration of physical media.

Migration

Migration is the transferring of data to newer system environments (Garrett et al., 1996). This may include conversion of resources from one format to another (*e.g.*, conversion of Microsoft Word to PDF or OpenDocument), from one operating system to another (*e.g.*, Solaris to Linux) or from one programming language to another (*e.g.*, C to Java) so the resource remains fully accessible and functional. Resources that are migrated run the risk of losing some type of functionality since newer formats may be incapable of capturing all the functionality of the original format, or the converter itself may be unable to interpret all the nuances of the original format. The latter is often a concern with proprietary data formats.

Replication

Creating duplicate copies of data on one or more systems is called *replication*. Data that exists as a single copy in only one location is highly vulnerable to software or hardware failure, intentional or accidental alteration, and environmental catastrophes like fire, flooding, etc. Digital data is more likely to survive if it is replicated in several locations. Replicated data may introduce difficulties in refreshing, migration, versioning, and access control since the data is located in multiple places.

Emulation

Emulation is the replicating of functionality of an obsolete system (Rothenberg, 1998). For example, emulating an Atari 2600 on a Windows system or emulating WordPerfect 1.0 on a Macintosh. Emulators may be built for applications, operating systems, or hardware platforms. Emulation has been a popular strategy for retaining the functionality of old video game systems. The feasibility of emulation as a catch-all solution has been debated in the academic community (Granger, 2000).

Raymond A. Lorie has suggested a Universal Virtual Computer (UVC) could be used to run any software in the future on a yet unknown platform (Lorie, 2001). The UVC strategy uses a combination of emulation and migration. The UVC strategy has not yet been widely adopted by the digital preservation community.

Trustworthy Digital Objects

Digital objects that can speak to their own authenticity are called *trustworthy digital objects* (TDOs). TDOs were proposed by Henry M. Gladney to enable digital objects to maintain a record of their change history so future users can know with certainty that the contents of the object are authentic (Gladney, 2004). Other preservation strategies like replication and migration are necessary for the long-term preservation of TDOs.

Data Format Management

Data Format Management (DFM) is the application of a systematic approach to the selection and use of the data formats used to encode information for storage on a computer.

In practical terms Data Format Management is the analysis of data formats and their associated technical, legal or economic attributes which can either enhance or detract from the ability of a digital asset or a given information systems to meet specified objectives. Data Format Management is necessary as the amount of information and number of people creating it grows. This is especially the case as the information with which users are working is difficult to generate, store, costly to acquire, or to be shared.

Data Format Management as an analytic tool or approach is data format neutral.

Historically individuals, organization and businesses have been categorized by their type of computer or their operating system. Today, however, it is primarily productivity software, such as spreadsheet or word processor programmes, and the way these programmes store information that also defines an entity. For instance, when browsing the web it is not important which kind of computer is responsible for hosting a site, only that the information it publishes is in a format that is readable by the viewing browser. In this instance the data format of the published information has more to do with defining compatibilities than the underlying hardware or operating system.

Digital Curation

Digital curation, broadly interpreted, is about maintaining and adding value to a trusted body of digital information for current and future use.

Digital curation encompasses all of the actions needed to maintain digitised and born-digital objects and data over their entire life-cycle and over time for current and future generations of users. Implicit in this definition are the processes of digital archiving and digital preservation but it also includes all the processes needed for good data creation and management, and the capacity to add value to data to generate new sources of information and knowledge.

As an example that digital curation is more than and potentially very different from digital preservation, consider the curation of e-mails. Intrinsically easy to preserve over a long period (attachments aside) because of their well-defined structure (RFC2822) and in-built metadata, the issues of curating e-mails relate much more to managing their place as corporate records, or their assured destruction, than to their preservation.

Digital curation, then, is a medium to long term process where resources are managed, cleaned and corrected, associated with metadata that shows their context, meaning and value, annotated and discussed, and where appropriate preserved or reliably disposed of.

Long-term curation and preservation of digital resources is seen as a challenge which is difficult if not impossible for individual organisations to resolve on their own, due to the complexity and scale of the challenges involved. Curation and long-term preservation of digital resources is of increasing importance for many different sectors, such as education, research, business and government. Digital resources from these sectors are growing in volume, type, and complexity at a staggering rate. The investment made in producing these resources must be protected, for re-creating data is not simply expensive; in many cases (such as climatology) it can be impossible.

Digital curation is the key to the sustainability, reproducibility, and re-use of reliable and trusted digital resources.

Digital Obsolescence

Digital obsolescence is a situation where a digital resource is no longer readable because the physical media, the reader required to read the media, the hardware, or the software that runs on it, is no longer available. A prime example of this is the BBC Domesday Project.

The rapid evolution and proliferation of different kinds of computer hardware, modes of digital encoding, operating systems and general or specialized software ensures that digital obsolescence will become a problem in the future. Many versions of word-processing programmes, data-storage media, standards for encoding images and films are considered "standards" for some time, but in the end are always replaced by new versions of the software or completely new hardware. Files meant to be read or edited with a certain programme (for example Microsoft Word, Winamp, or OpenOffice) will be unreadable in other programmes, and as operating systems and hardware move on, even old versions of programmes developed by the same company become impossible to use on the new platform (for instance, older versions of Microsoft Works, before Works 4.5, cannot be run under Windows 2000 or later).

The problem was brought to the attention of libraries and archives during the 1990s, and has been discussed among professionals in those branches, though so far without any obvious solutions other than continual forward-migration of files and information to the latest data-storage standards.

In some cases, obsolete technologies are used in a deliberate attempt to avoid data intrusion in a strategy known as "security through obsolescence".

Digital Libraries: A National Library Perspective

National Library of Australia

A digital library, like any library, is a service which is based on principles of selection, acquisition, access, management and preservation, related to a specific client community. This paper examines some of the key challenges which these processes encounter when dealing with digital collections, with particular attention to the issues which are raised for national libraries. Examples are the challenge of selecting significant national digital publications, the challenge of how to acquire efficiently those digital publications which are selected, the challenge of integrating access to digital and traditional information resources, the challenge of ensuring reliable delivery of digital publications given their changeable physical location, and the enormous challenge of how to preserve digital publications.

The paper refers to the National Library of Australia's Digital Services Project, which has developed system requirements in the light of these issues and challenges. The term "digital library" began to be heard in the early 1990s, as universities and other institutions began to build discipline-based collections of information resources in digital form, and to provide access to these collections through local and wide area networks.

Today, hundreds of services which might qualify for the description "digital library" have been developed, and it is possible to survey what has been achieved by such services and what challenges have been identified.

Definition of "Digital Library"

The Digital Library Federation has proposed the following definition:

> *Digital libraries are organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use a by a defined community or set of communities.*

This definition emphasises that a digital library, like any library, is more than a mere aggregation of information resources: it is a service which is based on principles of selection, acquisition, access, management and preservation, related to a specific client community. All of these principles are relevant when we consider the meaning of a digital library and the practical issues involved in service delivery.

A digital library collection may include two types of information resource. One type comprises the "digital original" resources, which are sometimes referred to as resources which are "born digitally". The other type comprises "digital surrogates", which are created from traditional information resources through format conversion. While both types of resource have the same access and management requirements, they raise different issues of selection and acquisition, and their preservation imperatives are also different.

Some definitions of "digital library" are broad enough to embrace services which integrate access to digital and traditional (*e.g.* print) materials. In the interests of clarity of terminology, the use of the term "digital library" in this paper will be confined to services which are based on digital materials. On the other hand, it would be appropriate to use the term "digital services" to encompass the use of electronic services designed to improve access to traditional library collections as well as digital collections.

Integration of Access and Delivery

We should bear in mind that the library community has a responsibility to collect and deliver information resources regardless of format, and indeed to strive to put in place mechanisms which will promote integrated access to all formats. This will become more important as an increasing proportion of information resources are available only in digital form. As Lynch and Garcia-Molina have observed: The objective is to develop information systems providing access to a coherent collection of material, more and more of which will be in digital format as time goes on, and to fully exploit the opportunities that are offered by the materials that are in digital formats.... There is, in reality, a very strong continuity between traditional library roles and missions and the objectives of digital library systems. Integrated access to diverse materials is usually accomplished through services which allow the relevant metadata for all materials to be searched simultaneously.

Integration can also be realised in the delivery process which follows discovery and access of the information resources. For example, it is now possible to deliver, in digital form, information resources from traditional library collections to remote users, using document delivery services such as Ariel. In this case the key difference to the user between a digital service based on a digital collection, and one based on a traditional collection, is the length of the delay that occurs before the collection item is delivered.

The Development of Digital Libraries

The emergence of the World Wide Web in 1993, and its rapid development thereafter, has allowed developers to provide universal access to digital libraries. Previously, access to digital collections was supported by proprietary networks or by local or campus-wide networks. These services also depended on a variety of end user software and hardware.

By contrast, access through the Web is based on open standards (such as the HyperText Transmission Protocol) and on widely available browser software which can be used from anyone's desktop computer. Because of the Web, place is not a barrier to access to digital libraries.

Amongst the earliest examples of pre-Web digital collections, we should recognise the construction in the 1970s of databases of full-text documents, supported by software such as STAIRS. These collections were single format, and access was limited by proprietary communication protocols and rudimentary interfaces. A relatively ambitious pre-Web attempt to build a digital library was Project Mercury (1989-1992), a joint development of Carnegie Mellon University and OCLC. It developed software for uniform access to textual and image databases, including page images of journal articles. Access was to be confined to the university campus, with X Window interfaces.

The TULIP Project (1993-1995), which was planned prior to the emergence of the Web, facilitated access to materials science journals. Each of eight US universities developed their own solutions for access to the electronic versions of these journals. The project revealed a host of practical problems with content delivery, content storage, lack of integration with other services, printing, and authentication.

Any examination of digital libraries must recognise the achievements of the National Digital Library Programme (NDLP) of the Library of Congress and its predecessor, the American Memory Project (1990-1994). This Project aims to make five million collection items accessible online by the year 2000, through digitisation of materials in the collections of the Library of Congress and other cooperating institutions. Key features of the NDLP are the attention given to selection, the quality of presentation of the digital surrogates, the use of quality cataloguing data, the standards and facilities which have been developed to support discovery and access, and the depth of the technical documentation made available on the project site. The NDLP was one of the first examples of a publicly accessible, Web-based digital library service.

Some of the key digital library possibilities and challenges are being explored by the Digital Libraries Initiative (1994-1998), which comprises six research projects funded by the National Science Foundation, in partnership with the US defence and space communities. These projects will build testbeds of digital collections in a range of disciplines, evaluate their use, test various indexing and searching techniques, explore interoperability standards, and examine authentication and security issues. The research results are being shared within the group and are being progressively reported to the public.

The Technical Framework

While the development of digital libraries is motivated by the imperative of improved information delivery for users, most of these projects also have a research aspect, as we have observed with the Digital Libraries Initiative projects. Alongside these pilot projects, research is also proceeding to develop conceptual models of the digital library, and to clarify the technical framework. In one of the key early research papers, Kahn and Wilensky described a framework for digital libraries, and for "distributed digital object services" in general. This paper established some basic definitions and terminology which are used to describe digital library services. The framework takes account of the fact that while content in a digital library takes a wide variety of forms, it is possible to define a "digital object" which applies to all such forms. The digital object is conceptually contained within an envelope which informs the access software how to unpack it, what standards it conforms to, and so on. Furthermore, a digital object consists of digital material plus a unique identifier for this material, sometimes called a "handle", and access to the objects is supported by a distributed system which supports the discovery of these "handles".

A paper by Arms, Blanchi and Overly provides an excellent summary of the issues relating to the information architecture for digital libraries, including the Kahn/Wilensky framework. The framework has been extended by others, including Payette and Lagoze, who have described an architecture for storing and disseminating digital library content. This architecture provides a more complex model, for example by recognising the ability to have a range of different interfaces to the same digital object, and the ability to associate rights management schemes with the dissemination of the object. The architecture is being applied to specific projects such as "The Making of America II", a Digital Library Federation project which is assembling digital information resources concerned with transport in the United States between 1869 and 1900.

Digital Libraries and National Libraries

This paper is particularly concerned with the issues raised for national libraries in the delivery of digital information resources. What is the role of a national library in the digital age? And how should a national library facilitate the delivery of national digital services?

The role of national libraries involves:

- collecting and preserving significant national information resources;
- cooperating with other institutions to ensure the most comprehensive possible collection and preservation of these resources; and

- cooperating with other institutions to ensure that there is an effective national infrastructure for the registration, discovery, access and delivery of information resources.

In the context of these roles, the following are amongst the challenges for national libraries which arise from the rapidly expanding world of digital publications:

- the challenge of selecting significant national digital publications, given the large volume and variable quality of these publications;
- the challenge of how to acquire efficiently those digital publications which are selected;
- the challenge of integrating access to digitised and non-digitised collections of original heritage materials;
- the challenge of constructing metadata infrastructures to support access to nationally distributed digital collections;
- the challenge of ensuring reliable delivery of digital publications in a distributed environment, given their changeable physical location;
- the challenge of reaching agreement with publishers on reasonable access conditions for digital publications received on deposit;
- the challenge of managing and controlling these access conditions; and
- the enormous challenge of how to preserve digital publications, which is of particular importance for those publications "born digitally".

These challenges will be examined in the context of the key library processes of selection, acquisition, bibliographic control, access control and preservation. It is recognised that a number of these challenges (particularly those of acquisition and access control) are not ones for national libraries exclusively.

The National Library of Australia has previously identified these challenges in a number of discussion papers. It is continuing to discuss these issues with other libraries, particularly the Australian state libraries and other national libraries.

The Selection Process

National libraries have a responsibility to collect and preserve the nation's information resources, in all formats. In doing this, they must take account of the expanding world of digital publications, particularly given the rapid development of the World Wide Web since 1993. The fact that the Web has allowed large volumes of digital material to be published creates a particular problem for national libraries. The high cost of publishing in traditional formats has meant that publishers have effectively undertaken a filtering role, selecting only quality works, or those with high market appeal, from the many manuscripts submitted by authors. However, the Web has allowed many authors to find an alternative, lower cost, publishing channel. For national libraries, this presents a significant challenge in identifying and selecting the publications to be preserved, and in identifying these in the absence of traditional selection tools and legal deposit provisions.

A statutory deposit system is often used to support the building of a comprehensive or highly intensive collection of resources relating to the country or jurisdiction concerned. In Australia, at the national level, the Copyright Act does not mandate legal deposit for digital publications, but the National Library is pursuing the development of amendments to the legal deposit section of the Copyright Act which will make electronic publications, both physical format and online, subject to legal deposit. Of course, even when these amendments to the Act are made, the Library will not wish to retain all Australian electronic publications, just as it does not retain more than a small sample of printed ephemera.

It is also necessary to distinguish between selection for current access (including online reference services and licensed information services) and preservation for future access. In the first case (and unlike the traditional library) the library does not need to collect the object, but only provide the means for discovery and access. In the latter case, the library must either collect the object and take responsibility for its ongoing access through technological change, or make sure that some other institution has taken responsibility for this. In Australia, through its PANDORA Project, the National Library has created, and is continuing to develop, an operational proof-of-concept archive of selected Australian Web publications. The Library has developed a set of guidelines for its selection of online Australian publications. These guidelines take account of issues such as: Australian content, Australian authorship, the "authoritative status" of the author, research value, whether the publication exists in hardcopy form, whether there has been any "quality control process" in the online publishing, public interest in the subject matter, and whether the publication is indexed by a recognised indexing service.

The Non-selective Alternative

One way of by-passing the selection problem is to collect and preserve everything published on the Web. In this context, national libraries have an interest in recent efforts to do just that. The Internet Archive is a well known project to archive the entire World Wide Web and some other components of the Internet, such as the Gopher hierarchy. The Archive was founded by Brewster Kahle in April 1996. In October 1998, the archive for the months of January and February 1997, containing two terabytes of data, was deposited with the Library of Congress.

In 1997 the Royal Library of Sweden initiated the Kulturarw Project, in order to archive the Swedish domain of the Web. To date, this project has made three comprehensive harvests of the Swedish web domain. The result is a file of about 200 gigabytes covering 31,000 Web sites. This attempt at a comprehensive collection of digital publications is consistent with the Royal Library's practice of collecting printed ephemera through a legal deposit framework under which printers, rather than publishers, deposit their product with the Library.

Both the Internet Archive and the Kulturarw projects have stated that they will attempt to use data migration to maintain the readability of the documents. However, there must be doubts about the costs of storage and migration involved in this non-selective process, given that it involves successive snapshots of a large and rapidly expanding volume of information. There must also be doubts about the practicality of supporting access to each snapshot through an appropriate index.

The Acquisition Process

A digital library collection may be built through either or both of the following processes (in addition to creation of content by the library itself):

- digital documents may be created by digital conversion of existing printed or other analogue materials; or
- existing digital documents may be gathered from the Web or from physical digital sources such as CD-ROMs.

Digital Conversion: In many cases, the materials selected for the digital library will consist of non-contemporary heritage materials, or other resources which exist only in non-digital form. In such cases a digital conversion process, such as imaging or OCR scanning, or a combination of both, must be used if it is desired to deliver the resource through a digital service.

The digital conversion process is a costly one because it is laborious both in processing time and in project management overheads. It is also a process which requires careful planning to ensure that the full informational value of the original material is preserved. Chapman and Kenney argue strongly for a strategy of "full informational capture", in which the conversion process is matched to the informational content of the original, in those cases where the digital conversion is undertaken primarily for preservation purposes.

The National Library of Australia has had direct experience of two major digital conversion projects in recent years. One of these projects has developed IMAGES1, which now contains more than 20,000 digital surrogates of items in the Library's pictorial collection. Access is delivered through the Web, through the Library's catalogue and in the future through the Kinetica Service. The digital collection is updated through a routine digital conversion process as new items are acquired for the pictorial collection.

The Australian Cooperative Digitisation Project, also known as the Ferguson Project, provides access to digital surrogates of printed materials published in the 1840s. This Project has proved to be significantly more complex than IMAGES1, for several reasons. Unlike IMAGES1, the Ferguson project had a preservation as well as an access objective. Microfilming was part of the preservation process, and this introduced complexities into the imaging process. There were stringent resolution requirements, because there needed to be sufficient resolution to enable the digital surrogates to be read comfortably while also being downloaded in a reasonable time. Finally, the use of OCR scanning, used to improve search access to the Ferguson materials, added to the complexity of the Project.

Collecting Digital Documents: the Markup Issue: Even where contemporary materials are involved, some digital library projects have created collections through a combination of imaging and OCR scanning from print originals, such as journal articles. On the surface this appears to be unnecessarily costly and inefficient, given that these contemporary resources, during their preparation, existed as machine readable text. Moreover, the process of OCR scanning re-introduces errors, violating authors' moral rights unless they are painstakingly corrected.

The builders of digital libraries would benefit greatly if they could obtain the authoritative version of any document in machine-readable form, complete with structural markup. By flagging the logical components of a document, structural markup allows descriptive metadata (author, title, abstract and so on) to be extracted efficiently from the document text. The processes of structural markup have been defined by the international standard framework known as SGML (Standard Generalised Markup Language). Use of this standard during the complete publishing process would support the more efficient integration of documents from various publishers into the digital library. It would also support more powerful and precise searching of the contents of the digital library, by allowing searches to be focussed on the descriptive metadata, the abstract, executive summary or other appropriate parts of the document.

There has been limited success in pursuit of this goal. One example is provided by the role of SGML markup in the Illinois Digital Library Project. This project has constructed a multiple-publisher testbed containing tens of thousands of full text journal articles in the disciplines of physics, engineering and computer science. The project has been able to utilise SGML markup provided by the publishers, although it has converted this into a standard SGML format for federated searching. The Illinois Project has been fortunate to obtain, from publishers, the authoritative texts with structural markup already in place.

Most publishers perceive it to be too costly to treat their publications in this manner, and the prospects for adoption of SGML in the publishing community appear to be limited to specialised areas (such as the markup of case reports by legal publishers) or situations where it might be mandated (such as university theses). Web documents already possess a weak form of structural markup in the HyperText Markup Language (HTML). The recently developed Extended Markup Language (XML) will increase the extent of structural markup for documents published on the Web. Some observers have expressed the hope that XML will be taken up by the commercial publishing community, helping to deliver "all the power of SGML without all the complications".

Gathering Resources from the Web: Another method of acquiring documents which are already in digital form is to harvest or "gather" them from the Web, with their limited HTML markup. There is no need to undertake this process unless you wish to ensure the preservation of the materials concerned, since you need only to link to the resource to support current access. Since national libraries have a strong preservation mandate, gathering from the Web has been the approach which the National Library of Australia has used in its PANDORA Project. The gathering process itself raises a number of challenges.

To preserve fidelity to the original resource, it is necessary that the archive copy should replicate the directory structure, file names and internal links of the original resource, in parallel form. On the other hand, links to external resources will need to be disabled and replaced by a suitable message, unless these external resources have also been archived or continue to exist unmodified with permanent names. For efficiency reasons, it is desirable that the gathering software should automate these processes, while also collecting administrative metadata associated with the resource.

Needless to say, gathering software with all these features does not yet exist.

The Control And Access Process

It was noted above that the world of digital publications has created challenges, for national libraries and others, such as:

- how to integrate access to digitised and non-digitised collections of original heritage materials;
- how to support navigation through levels of information resource in a collection, or within a collection item;
- how to construct metadata infrastructures to support access to nationally distributed digital collections; and
- how to ensure reliable delivery of digital publications given their changeable physical location.

Metadata and Integrated Access: Bibliographic data (or metadata) is the key to integrating access to digital and traditional collections. A searcher often needs to discover information resources in all formats relating to a given subject, or which have been created by a given author. Services such as "subject gateways", which have been developed primarily to support access to quality information resources on the Web, have the potential to support browse and search access to distributed collections of both digital and traditional materials.

Integrated access can be a particularly desirable goal when only part of a collection has been digitised, which will usually be the case for any library with a large collection of original materials. For example, a national or state library with a large pictorial collection may offer a service which allows a searcher to discover a digitised image of a picture or photograph which meets a particular information need, if the library has digitised this picture. But what if the picture that meets this need is one of the majority in the collection that have not been digitised?

The answer to this question is to offer a digital service which supports access to all of the library's pictorial collection. The elements of this service might be (a) the original collection items, (b) the digitised images, (c) the metadata about the entire collection, and (d) a "digitisation on demand" service which supports the progressive digitisation of the collection in response to user requests for access to collection items.

One potential barrier to integrated access is the divergence of metadata standards between the world of traditional publications (based mainly on the AACR2 and MARC standards) and the world of digital publications (which may be based on Dublin Core or other non-MARC standards). The

Dublin Core metadata standard has been developed during the past few years, with two main purposes. One has been to support "simple resource discovery" for digital collections. The second has been to provide a kind of "lingua franca", with the potential to integrate access to the digital services of libraries with those of institutions such as museums and archives, and with access to the wider universe of Web based resources.

The development of this standard continues to be beset by debate within the community of implementors over the degree of structure and rigour which the standard requires. This discussion intensified at the most recent Dublin Core Workshop in Washington in November 1998, where the key debate focussed on the question of a more rigorous data model which might guide the development of a Dublin Core Version 2. Representatives of the commercial Web publishing community argued that the development of such a model would encourage the widescale implementation of the standard in the publishing and rights owner communities. However, others argued that development of a new version at this stage would undermine confidence in the standard, and would not be necessary given the basic purposes of the standard.

As well as being a "lingua franca" across the sectors, the Dublin Core standard may be useful in supporting search access across various collection levels. For example, the experience of the library and information industry has exhibited a divergence of standards between those used to describe and support access to the whole item, on the one hand, and those used to describe and support access to part of the item, on the other. This traditional dichotomy between the cataloguing community and the abstracting and indexing community has the potential to create access barriers. The Dublin Core standard may assist in bridging these barriers, by providing a basic set of descriptive elements to which the cataloguing and indexing data elements can be mapped.

Navigation Through Collection Levels: For both traditional and digital collections, users have a need to navigate up or down through the levels of a collection. This may apply, for example, to items within a manuscript collection, articles in a journal, photographs in a collection, or individual pages within a book. In the physical environment it is straightforward enough for the user to manage this browsing process. However, in the digital environment the linkages between the components of the collection (or collection item) must be made explicitly.

There is no clear consensus on a preferred or standard method of supporting navigation through collection levels, given the wide variety of published and original materials which the digital collection might need to support. While the use of the Dublin Core "Relation" element is one possibility, another is a generalisation of the system of component part identifiers which has so far produced the Serial Item Contribution Identifier (SICI) and Book Item Contribution Identifier (BICI). These identifiers, while uniquely naming a component part of a serial or book, are structured so as to carry information about the serial issue, serial title or book. A more generalised standard might be able to carry similar relationship information for any multi-level resource, including collections of original materials.

At the lowest level, the part-of-item level, structural document markup also has a role to play in supporting access to text-based resources. For various purposes, searchers may wish to confine their searches to the abstract, the methods section of a scientific article, the citations, and so on. Research by the Illinois Digital Library Project has drawn attention to the potential for this kind of markup to support the disaggregation of journal articles into separate components.

Distributed and Centralised Metadata Infrastructures

The Digital Library is likely to consist of a distributed set of digital objects. But is distributed metadata the best way to provide access to the objects? There is no simple answer to this question, and existing projects reveal a continuum from:

- services which have no central metadata component (such as those which rely on the Z39.50 protocol); through to
- services which use a distributed index architecture (such as the Whois++ index service used by the ROADS software); through to
- services which use a single central index to distributed metadata (whether this metadata is embedded in the resources or stored in multiple repositories); through to
- totally centralised metadata repositories such as the Australian National Bibliographic Database.

A digital service may attempt to support integrated access to diverse categories of information resource, or to resources from diverse sources. The more diverse these categories or sources, the more likely it is that a centralised model (based on a uniform metadata standard) will be required, because the less likely it is that there will be sufficient alignment of the entire set of protocols that are needed to support the fully distributed approach. This issue was discussed last year in the context of government information by the Search Engine Working Group, which was charged with developing a model for metadata based access to Australian government information in digital form. As the Working Group commented:

> *The distributed approach would rely on significant standards and software development. It is essentially a parallel searching mechanism that is able take a user query in a single query syntax, translate it to multiple syntaxes of the underlying (agency) search engines in question, and translate the results (and the relevance rank values) back into a coherent result set. This demands that query and result syntaxes, and the ranking algorithms of each individual search engine, be made known to the whole-of-government search facility.*

In this case, the Working Group was dealing with a relatively uniform collection of information resources-Australian government documents-but still judged it more practical to rely on a single central index to the distributed metadata until standards and the software were available to support a more fully distributed approach.

Permanent Naming and Resource Registration

It was noted above that the Kahn/Wilensky Framework assumes a highly reliable system of unique identifiers, called "handles", to support basic universal access to digital information resources. The "handle" and its supporting infrastructure would ensure that a resource can still be accessed even if it changes its location. The standard for Uniform Resource Names (URNs) as proposed by the Internet Engineering Task Force, together with a network of URN resolver services, are compatible with the requirements for a universal system of "handles".

In a 1996 paper, James Miller drew attention to the important role of national libraries, as institutions of long standing, in relation to "handles" or permanent names:

> *There must be one or more entities that take institutional charge of the issuing and resolving of unique names, and a mechanism that will allow this entire set of names to be moved forward as the technology progresses..... The Digital Library community must identify institutions of long standing that will take the responsibility for resolving institutionalized names into current names for the forseeable future.... I propose that a small consortium of well-known (perhaps national) libraries could work to provide the computing infrastructure.*

The National Library of Australia has indicated that it favours the use of Universal Resource Names (URNs) in any national registration system. Consequently, the Library is exploring the implementation of a national mechanism enabling publishers of digital publications to register them, and in the process to apply for Uniform Resource Names. Publishers would contribute metadata as part of the registration process, and the metadata repository would be maintained as an Australian URN resolver service.

Controlling the Use of The Collection

As commercial publishers increasingly make use of the Web as a publishing medium, important issues are raised in the relationship between publishers and libraries, including national libraries. Publishers have been comfortable with the role of libraries in relation to traditional publications (including the legal deposit system), knowing that the physical format provided natural limitations on access to the publication. However, there would be a threat to the remuneration of publishers and copyright owners if unlimited access to commercial digital publications were provided by libraries.

For these reasons, libraries must deal with the challenge of reaching agreement with publishers on reasonable access conditions for digital publications, including those received on deposit. They must also deal with the challenge of managing and controlling these access conditions. Because of the difficulties posed by these challenges, many digital library projects have concentrated on the digitisation of original materials which are not subject to copyright or which have little commercial value.

The access conditions could theoretically involve a wide range of options such as:

- the digital item is accessible only within the library building or campus (this is very limiting for a public, state or national library with a mandate to serve a widely dispersed community);
- the digital item can be accessed by only one reader at a time;
- a licence fee is paid which permits a given number of readers to access the digital item at the same time;
- a royalty fee is paid each time a work is printed or copied, or possibly even each time it is viewed; or
- one of the above limitations applies initially, but is relaxed over time once the publisher has received adequate remuneration, or once the resource has lost its commercial value.

There has been insufficient dialogue between publishers and libraries for agreement to have been reached on the above options. For their part, libraries in Australia will not wish to see any agreement which weakens the "fair dealing" principles, especially given the recent report of the Copyright Law Review Committee on the Simplification of the Copyright

Act. The Committee recommended that the Copyright Act be amended to consolidate the fair dealing provisions into a single, technology neutral provision which would, amongst other things, uphold the place of fair dealing in the digital environment.

If a satisfactory agreement were negotiated, there would remain the issue of managing and controlling the agreed access conditions. Currently, some major projects are underway to better define this management process, and to develop clearer models for commercial traffic in digital information resources. The recently commenced INDECS (Interoperability of Data in E-Commerce Systems) Project will attempt "to create a genre-neutral framework among rights-holders for electronic [Intellectual Property Rights] trading so that companies [such as] record companies, film companies, book and music publishers can trade their creations in a coherent single marketplace". INDECS is funded by the European Commission, and the trade associations of almost all the major rights sectors are participating.

The control process demands the availability of software which can allow or deny access to a digital object depending on the rights conditions associated with the object, and possibly also depending on the category of user. The software should also notify potential users of conditions of use applying to an object, and support the online payment of copyright, reproduction or delivery fees. There is also a need to log usage of each object and report this to a designated copyright collection agency where applicable.

The process of controlling the use of the digital collection includes the requirement to recognise and authorise users, either as individuals or as members of a category. The issues involved in user authentication and authorisation have spawned some major projects. An example is the CNI Programme on Authentication, Authorization and Access Management, which issued a key discussion paper in April 1998. This paper is the focus of continuing discussion amongst information providers and institutions, who wish to see an efficient process through which end users can gain access to registered information resources.

In the United Kingdom the ATHENS Project, which is based on a central database of authorisation information, is providing what some observers have judged to be a satisfactory interim solution. The Web has become a powerful information tool despite its chaos, partly because its open, standards-based system of hypertext links has given it a genuine universality. Many of the existing digital library services, and those under development, are based on free and unfettered access to the collections. As these services are joined by digital libraries which impose user charges or other access conditions, the universality provided by the Web is weakened. To quote from Clifford Lynch:

> *As long as all resources are free, the move from one sphere of control to another is not so important to the user. But as transfer from one system, which may be free, to another, which charges for use, becomes commonplace, the notifications of these transitions may weaken the sense of a coherent information space. Indeed, the user may want a less coherent presentation to make cost implications more visible.*

For institutionally based users, this problem can be addressed in part through the use of licence arrangements for access to the commercial services, so that the user could effectively search these services and free Web resources through a common subject gateway, with no metered charging applied to either. However, this option is not available to the independent scholar or the casual user, and its implementation for institutional users depends on solutions to the challenges of authentication and authorisation.

The Preservation Process

This paper has surveyed many of the challenges which are involved in building and managing a digital library. These challenges are all the subject of continuing research or standards development. But none of them is as serious or as potentially intractable as the problem of digital preservation.

It takes an effort to recall that the personal computer is barely 20 years old. Computer technology is changing so rapidly that the design, the interfaces, the technical standards and the file structures of the computers of 2020 are very likely to be quite different from those used today. For national libraries and other research libraries, which have a tradition of building collections to meet the needs of scholars many decades or even centuries into the future, this presents a very formidable challenge. The ability to access and read digital information in the future will depend on strategies such as migration (in which the data is migrated, if technically feasible, to new operating systems and data structures) or emulation (in which modern computers emulate the operating systems and data structures of previous eras).

A National Library of Australia position paper on electronic publications observed:

> *There are unresolved technical issues to be confronted. These include the necessity to reformat material involving conversion from one format or medium to another.... Details*

of how a continuous programme of updating, through migration or refreshment, as a digital preservation strategy might work remain to be developed. For multimedia publications it may not be possible to keep the "look and feel", and interactive or dynamic aspects of these publications may be lost.

The many aspects of this challenge have been documented on the PADI (Preserving Access to Digital Information) web site which is maintained by the National Library of Australia, and the interested reader is urged to explore that site thoroughly. The issues were also explored in depth by a key report commissioned by the Commission on Preservation and Access and the Research Libraries Group.

Another report from the Commission on Preservation and Access has discussed the importance of structural markup, using SGML standards, to the long term accessibility of digital materials:

When viewed from the perspectives of the preservation community and the digital librarian, SGML appears to be the best choice for archival document storage. SGML is standardized, portable, flexible, modular, and supported by the market. [Its] vendor neutrality, extensibility … and ability to manage large information repositories make it an attractive choice for both archival and retrieval purposes.

Some less optimistic observers have questioned whether, given our short experience with digital information formats compared to that of paper, the quest for digital preservation has any realistic chance of success. Michael Gorman presses this point:

I would suggest that we should work out collective schemes to make copies of such documents on acid-free paper, catalogue them, and add the resulting records to local, national, and international databases. I insist on saying that the only practical manner in which we can preserve our present for posterity is to create print on paper archives and to create an enduring bibliographic structure to sustain those archives. All suggestions of massive electronic archives are confronted with insuperable economic, technological, and practical problems.

Peter Graham has also expressed serious doubts about the practicality of digital preservation:

The investment necessary to migrate files of data will involve skilled labour, complex record-keeping, physical piece

> *management, checking for successful outcomes, space and equipment. A comparable library [project for] data migration cost and complexity at approximately this order of magnitude would be the orderly photocopying of books in the collection every five years.*

These remarks rightly warn us of the depth of the challenge that this issue presents. However, it would be premature to assume now that the problem is incapable of a solution. Many international research efforts (including the CEDARS Project in the UK, the work of Jeff Rothenberg on emulation, and the work of the Digital Library Federation) are actively pursuing the digital preservation question from a wide range of perspectives. There is a great imperative to find a solution, or a combination of solutions.

The Nla's Digital Services Project

Since it began to deliver information through the Web, the National Library of Australia has developed digital library services through projects such as IMAGES1, the Ferguson Project and PANDORA. The Library now needs to find better systems tools to enable it to meet the twin challenges of managing its present and future digital collections, and of supporting shared access to digital collections. To this end, it has commenced a project which it is calling the Digital Services Project.

The Library expects that the system resulting from the Digital Services Project will enable it to collect, organise and preserve its digital materials, and to support access to them which is integrated with access to its traditional collections. These services will apply to items that are "born digital" and those which are reformatted from non-digital originals. The system would enable the Library to manage, in a robust, high performance systems environment, collections such as:

- its collection of significant Australian electronic publications (in a re-vamped PANDORA archive);
- its IMAGES1 collection of pictorial images;
- its collection of digitised oral history recordings; and
- its collection of digitised journal articles indexed by the Library (through the Australian Public Affairs Information Service and the Australian Medical Index).

The Library also expects that the system will enhance the "national digital infrastructure" by enabling the Library to:

- implement a national registration service (using a permanent naming system such as Uniform Resource Names) for Australian digital publications; and

- support shared access to other nationally significant digital collections, in cooperation with state libraries and other Australian cultural institutions.

Theoretically, Kinetica could be enhanced to support the second of these goals, and this remains a possibility. However, Kinetica is limited in terms of the types of metadata that it can support. Consequently, the Library may decide to support the cooperative access services outside Kinetica. In any case, the Library has stipulated a number of technical standards, to ensure that the resulting systems can interoperate with other national and National Library systems such as Kinetica and the Library's web catalogue, and also to ensure that the Library is able to load, store and search a wide range of structured digital documents, representing formats including text, sound and image.

The Library has allocated capital funding to initiate this project. In December 1998 it distributed an Information Paper setting out its detailed requirements for the Project, with the aim of encouraging comment from libraries and the IT industry. The Library is planning to release a Request for Tender in the second quarter of 1999, after taking account of the comments received in response to the Information Paper.

This paper has discussed key challenges faced by the developers and providers of digital library services, with emphasis on the challenges for national libraries. The challenges span the entire range of library functions: selection, acquisition, access, management and preservation. In many of these areas, research efforts are attempting to pilot possible solutions, develop better conceptual models, or formulate improved standards. However, the solutions to these challenges cannot be left only to the researchers. They will require a response by all of us who are attempting to build new or improved digital services.

This paper has identified some themes which might influence these responses. One theme has been the importance of standards to the processes involved in digital services. More effort is still required in the development and implementation of standards. For example:

- improved and more precise search access, including integrated access to resources in all formats, will depend on the adoption and further development of metadata standards such as Dublin Core;
- it is desirable to encourage the use of common standards for the storage of digital materials, and for the recording of preservation and other management information;
- standards are clearly needed to support navigation through the collection levels of materials in the digital collection; and

- widespread adoption of long term persistent names such as Uniform Resource Names is needed to support access to materials which change their location.

A standards issue which has been raised a number of times in this paper is the importance of structural markup of digital publications.

For example, structural markup can:

- support the more efficient capture of digital publications into the digital library, and the automatic extraction of metadata from documents;
- support more precise searching of digital library content, including searching of specified components of a document; and
- support the digital preservation process through the non-proprietary nature of the standards involved.

Another of the themes of this paper is that many of the responses to the challenges of digital services appear to require a more concerted dialogue with publishers, and with the rights owner community. For example:

- legal deposit libraries, in consultation with publishers, should work more urgently to secure legislation which mandates legal deposit for digital publications;
- the library community should establish better processes to attempt to reach agreement with publishers on reasonable access conditions for digital publications received on deposit;
- standards bodies, libraries and systems developers should work with publishers to improve their mutual understanding of the barriers to more widespread use of structural markup in the publishing process; and
- national libraries, in consultation with publishers, should begin to implement working registration and permanent naming services for digital publications.

The development of digital libraries has opened up an exciting new world of information delivery for the researchers and citizens of tomorrow. It is our responsibility to improve these services by addressing these challenges in concert with our colleagues around the world.

The Impacts of the Internet

The paper reports a study which assessed the benefits to and impacts of the Internet on Victorian business libraries and whether any of the benefits and impacts carry though to libraries' end-users and host organisations. Results from a mail survey of 34 questions to 139 Victorian business libraries strongly upheld a primary hypothesis that host organisations did benefit from their libraries providing value-added and timely information through Internet connections.

Business librarians have introduced many new electronic resources; respondents agreed that the most popular of these was the Internet, ranked above CD-ROM and online databases. It was also apparent that respondents did not fully understand the importance of value-added services, and did not do a cost—benefit analysis when marketing the benefits of new Internet services. Further, business librarians provided little input in formulating IT policies, which were controlled largely by the IT department.

In the title of this paper, the term *'impacts'* was extended to include both *impacts* and *benefits* of the Internet. This study examined the possible impacts and benefits that the Internet has brought already and will continue to do so for both the Victorian Business Library and the host organisation. Thirty-four questions in a mail-out survey to 139 Victorian business libraries were used to test a hypothesis and a series of assumptions.

Research Area Overview

The research undertaken for this paper was to be used in analysing how 139 Victorian business libraries managed the introduction of the Internet within their organisations, and to gauge the lasting impacts and benefits to all business library users. While some case studies had been reported from a special library perspective by two North American authors, little else had been documented either here or overseas concerning the experiences of the Internet in Australian business libraries. The fact that Australia appeared to be well ahead in the development of the latest Internet technologies did not imply that the benefits had been passed on to Australian business libraries and their organisations.

With the nature of increased work loads and higher productivity levels expected by corporate Australian employers, informal comments made by librarians over a period of time indicated that there were many business libraries which had implemented Internet connections, but probably had not documented their problems and/or results. It appears that there had been little time to devote to either pure or applied research and to document it for the larger Australian business library sector. There were two reasons which may explain what was really happening in business libraries.

Respondents would be asked to what degree they had been able to participate in decisions about initiating an Internet connection for their library. Many of the technology strategies appeared to be driven by the so-called 'information technologists' in IT departments of large companies, rather than by librarians.

The emphasis was often placed upon the technological advantages that would result from the introduction of Internet to business organisations. This came at the expense of value-added information, which previously might not have been easily accessible.

Some library professionals believed that the methods used in their libraries to implement the Internet may be so specialised that a short discussion would not do the topic any justice. Allied to the specialised nature of many Australian business libraries, some libraries might have felt in breach of their organisation's commercial code of practice if they were to reveal even the summary details.

Business libraries which might fall into this category included the banking and legal sectors. It was likely that either the library or the host organisation would have produced some form of internal documented evidence as either working papers or departmental policies and procedures. The intention was to verify whether this was a general trend.

Research Objectives

The objective of the mail-out survey questionnaire was to present evidence to either support or refute the proposition that the host organisation did benefit either directly or indirectly from its library providing value-added and timely information through an Internet connection.

Properly handled, Victorian business libraries could use the introduction of or expanded use of the Internet as a very powerful marketing tool to justify the existence of the library, offering new user services, maintenance of staffing and on-going funding.

Hypothesis and Assumptions

Hypothesis

That there are positive impacts and benefits for Victorian business libraries and their host organisations in the use of the Internet.

Assumptions

- Specific user requests for information are now easier since the introduction of the Internet.
- The intermediary in the business library is still important.
- There are specific search methodologies required when using World Wide Web search engines.

- There are now changes in the manner of delivering information to clientele.
- It is the business library's role to establish and maintain IT and security policies for Internet-related functions.
- There are positive impacts of the Internet on the business library and host organisation.
- There are positive impacts of the Internet within the business library.
- The Internet has caused or will cause changes to library services in the business library.
- The business library only is responsible for Internet access issues.
- Internet training is provided to both the business library staff and users.
- Technical and reference services are aided by the Internet.
- Cost–benefit analysis and marketing of Internet services are crucial.
- The Internet has placed more emphasis on value-added services in the business library.
- Potential benefits of the Internet fall into specific categories.
- Business libraries benefit from full-text resources available on the Internet.
- The business library has been able to advise its host organisation on the advantages of accessing information from the Internet.

Findings

Overview of the Business Library

Sixty-two business libraries responded out of a total number of 139 survey recipients, giving a return rate of 44.6 per cent. Fifty-eight organisations out of 62 provided library service to staff and 38 of the same gave access to 100 per cent of staff. The number of staff employed in each organisation ranged from two through to 65 000.

Providing Information and Reference Services

Examples of specific user requests for information since the introduction of the Internet were many and varied and were grouped into 14 specific categories. The concept of free 'intermediary' assistance was important in business libraries, with most not charging for their professional services (72 per cent) and network use by users (81 per cent). Only two said that they intended charging in the future.

Business libraries only provided dedicated reference staff in 20 per cent (nine out of 44) of cases for answering Internet-related searching queries. Eight of the nine supplied dedicated reference staff only on a part-time basis (average 21 per cent) to answer questions concerned with Internet searching. A majority (67 per cent) of reference staff spent more than five minutes in answering questions from Internet users. Typical questions asked by Internet users fell into the categories of client education, government sources, Internet access or connection, reference sources, search techniques, search tools, software issues and subject reference.

Business librarians still delivered information in the face-to-face interview, telephone interview and through printed reports, brochures and publications to the same extent as previously (72 per cent), despite recent electronic methods being now made available. The number of library staff employed remained the same.

Internet Connection and Responsibility for IT Policies

Forty-seven business libraries had an Internet connection and 33 of them also claimed that they had an IT policy. Yet the findings indicated that responsibility for establishing IT policies and security policies for use of and access to the Internet and intranet within the organisation largely rested with the IT department (75 per cent). However, when revising such policies, within the corporate library, the business library and IT department combined had slightly more input (47 per cent) than the IT department alone (42 per cent).

Impacts of the Internet on the Library and Organisation

Business librarians agreed (82 per cent) that there were already marked impacts of the Internet on the business library and organisational environment. While 83 per cent of respondents believed that the Internet would empower users and deliver positive financial impacts for both the library and organisation in 86 per cent of cases, it would not necessarily change every facet of library work (54 per cent), nor would it transform the business library into the 'virtual library' (62 per cent). Respondents saw the Internet as requiring new skills and new policies (95 per cent). Downloadable software tools from the Internet were considered one of these new skills (91 per cent).

Impacts of the Internet within the Business Library

Business librarians had mixed views about the impacts of the Internet within the business library. Slightly more than half (53 per cent) said that the provision of Internet services in the business library would not result in reduced spending on collection development. Fifty-eight percent of respondents accepted that the introduction of the Internet had seen the need for staff to become more familiar with content than purely technical issues. Numerous interpretations were given about the meanings of 'content', 'subject knowledge' and 'technical knowledge'.

Anticipated Changes to Library Services

Business librarians anticipated changes to library services over the next two years. Sixty percent said that they would add new resources, while only 17 per cent would withdraw services. Respondents concentrated most on acquiring CD-ROM databases (30 per cent) and then gaining access to the Internet (26 per cent). Deletion of specific library services were very small in number.

Internet Access to Users

Business libraries did not always provide Internet access to users on terminals both inside (67 per cent) and outside (69 per cent) of the business library. Internet access was mostly paid for by the company (42 per cent), but in some instances by the user's department (28 per cent), the IT department (20 per cent), or the corporate library (10 per cent). The percentage of computer terminals with Internet access varied considerably between organisations. Seven respondents' answers fell into the 25 per cent to 50 per cent category, nine into the 60 per cent to 100 per cent group and 13 went into the 1 per cent to 10 per cent region. Internet access was available to most users, regardless of their position in the organisation.

Benefits and Impacts of Internet Training

Internet training benefits were broken into two distinct groupings. Firstly, 65 per cent of librarians benefited from formal Internet training sessions being provided. However in 59 per cent of cases, the training provided was of the self-training type, that is of an informal nature. Sixty-one percent could not benefit from refresher Internet courses. Secondly, 48 per cent of librarians gave Internet training to their clientele, followed by 40 per cent who did not provide any and the IT department doing so only in 12 per cent of cases. Those libraries providing Internet training did so mostly at an introductory level (67 per cent) and tended to use the one-to-one instruction method (52 per cent). However, 30 librarians (75 per cent) disagreed that one of the negative impacts of the use of the Internet in business libraries was the continuous need for training of library staff and that the ongoing costs should be absorbed within the traditional budget.

Library Functions Aided by the Internet

Library functions that were aided by the use of the Internet brought some interesting results. Overwhelmingly respondents used the Internet for reference related work in the areas of ready reference questions from users (51 per cent) and email reference questions (28 per cent). However, the large majority (89 per cent) did not see the benefits of obtaining copy cataloguing records from the Internet.

Non-decisive Issues in Business Libraries

Cost–benefit analysis, marketing of Internet services and value-added services were not decisive issues. Most respondents (87 per cent) said they had not carried out a cost–benefit analysis of sourcing the information from the Internet.

Only a few had done so on an informal basis and were also responsible for setting up the terms of reference for the cost–benefit. However, when librarians were asked about marketing the benefits of the Internet in their library and organisation, 63 per cent said they had managed to do so. A large majority (86 per cent) said that there was no greater emphasis placed on value-added services, since the introduction of the Internet to business libraries. However some were able to give examples of value-added services.

Business Librarians' most Important Benefits of the Internet

Business librarians ranked reference enquiries, followed by online databases and electronic mail, respectively, as the three most important benefits of the Internet in a business library environment from a list of 11 items.

The three least-favoured benefits in order of rank were video conferencing, followed by electronic mailing lists and then serial publications.

Full-text Resources on the Internet

Obtaining subject-related full-text resources across the Internet was a popular option for a little over half of the respondents (52 per cent). Of those who did, the United States (41 per cent), followed by Australia (23 per cent) were the two most likely countries from where the full-text resources were acquired.

Passing on Useful Information to the Organisation

Business libraries were prepared to pass on useful advice to their organisations on the advantages of having access to timely and cost effective information available from the Internet. Respondents also provided a multitude of examples of the major benefits that the Internet had brought to their business library and organisation.

Outcomes

The outcomes for this paper were determined by three important factors. Firstly, whether the hypothesis and in turn the set of assumptions were upheld or dismissed in relation to the findings. Secondly, whether the main survey findings were upheld by a previous literature study. Finally, the literature might not had covered some or all of the topic areas raised in the survey findings.

Support of Hypothesis

Business librarians' responses to the survey indicated that there were positive impacts and benefits to Victorian corporate libraries and their host organisation of using the Internet. Therefore, the hypothesis advanced for this study was upheld. Some respondents did not discern many differences between whether it was a particular impact or a series of impacts which had resulted from the introduction of the Internet to their business libraries. The same situation was observed for the *benefits* of the Internet. Further, many respondents did not distinguish differences between the *impacts* and *benefits*. In some cases, particularly in the open-ended questions, librarians gave overlapping answers, which implied that some impacts were interchangeable with benefits.

The number of business libraries surveyed and the overall response rate achieved suggested that this study was overdue and that respondents were open in expressing their views. The figures gathered on the number of organisations providing a library service to staff, those that already had an Internet connection and at the same time an IT policy had not been researched beforehand.

Support of Assumptions

- Specific user requests for information are now easier since the introduction of the Internet: With the large number and varied examples provided by respondents' answers, this assumption was fully supported. Since Steele's article of 1996, in which she claimed that the librarian needed to carefully access if Internet technologies were beneficial in providing users with information which was of some value to them, the trend has changed noticeably. Users appeared to be pleased with the information that their business library was able to source from the Internet. They also returned to the business library with follow-up requests for more information or asked for specific information on other topics.
- The intermediary in the business library is still important: This assumption was verified as true and therefore strongly upheld.

Nicholas and Fenton had said that even allowing for the stronger link between information providers and users, the intermediary would still be necessary, but less visible. The intermediary's role was considered as very visible by the level of positive responses given to the three questions asked in the survey.

- There are specific search methodologies required when using World Wide Web search engines: The responses received from five questions concerning issues about search methodologies used by World Wide Web search engines all revealed a common theme. It emerged that it was necessary to spend more than five minutes in answering a multitude of different questions from Internet users. This highlighted the fact that reference staff had to clearly demonstrate specific search methodologies to users, even when doing a simple search. This assumption was therefore supported.

A warning must be added that business libraries seemed to be under the false belief that all the Internet queries could be easily answered briefly by perhaps only one dedicated reference staff person. King correctly hinted at this trend when he said that software tools on the Internet did not make the information well organised and easily accessible. The situation would not be resolved in the short term.

- There are now changes in the manner of delivering information to clientele: The series of three questions which tested this assumption was dismissed by respondents. Librarians said that they were delivering information in the same manner and to the same extent as previously, prior to the introduction of sources being made available across the Internet.

Ladner suggested that those business libraries which were members of resource sharing electronic networks could gain considerable benefits when delivering information to their clientele. These benefits could include consultation, courier-document delivery, email/electronic bulletin boards or reference assistance. The findings suggested that Victorian business librarians appeared not to have taken to using these electronic networks, including the Internet, in large numbers as many had believed to be the case.

- It is the business library's role to establish and maintain IT and security policies for Internet-related functions: This assumption was analysed in a group of three questions. The survey findings concluded that the assumption was invalid, as it was mostly the IT department who was responsible for IT and security policies. Of interest was that librarians said their business library had an

IT policy already in place. When they were questioned further, respondents gave a different answer about who was responsible for maintaining IT and security policies within the business library. The IT department and business library shared the responsibility equally.

Gilbert's concerns that business librarians were not able to set the information policy for both the business library and host organisation were still perfectly valid. Evidence produced by Shockley also was still correct for these findings. He queried how many librarians were asked by their organisation to develop Internet policies and procedures. It must also be noted that librarians should take the initial steps in making their ideas known to the organisation about such policies, rather then just waiting to be approached for any contribution. By implication an effective information policy could encompass Internet access, usage and security issues.

- There are positive impacts of the Internet on the business library and host organisation: The responses given to a group of seven questions only partially supported the above assumption. In five of the questions, respondents upheld the assumption, while in the other two it was dismissed. Librarians disagreed about the Internet changing every facet of library work and transforming the business library into the virtual library without walls.

Missingham said that special librarians had made good use of new technology, particularly the Internet, to deliver services and manage information for their host organisations. Contrary to Roby's belief that the Internet was definitely not the friendly empowering environment for users, the results suggested that this was not the case here. Also, respondents broadly supported Roby's comments that as users came to realise the pitfalls of surfing for information, business librarians could reinforce their position as mediators and specialists in finding information. Victorian business librarians accepted that there were positive financial impacts in delivering information for both the library and host organisation.

There are positive impacts of the Internet within the business library: The answers given to this assumption indicate that it was supported. By dismissing the suggestion of less spending on collection development in the business library with the advent of Internet services, librarians indicated that it was more a positive impact than a negative one. Likewise, respondents realised that it was more important and therefore a positive impact for them and their libraries to become more familiar with Internet content than being a technical master of electronic-derived information.

King realised the positive impacts of having an information professional who was not only a technical master of the Internet, but also familiar with the Internet's content. He said that what was most needed was someone who understood how to look — an information detective. Even companies with intelligent search agents were finding that by adding librarians' searching expertise to their projects could enhance search results noticeably. Librarians could integrate traditional database searches using other Internet resources as well as print and non-network, online resources, such as modem-accessible databases. By combining a command language and rich bibliographic resources, the result would be a stronger search tool.

- The Internet has caused or will cause changes to library services in the business library: Business librarians partially supported this assumption. The findings demonstrated anticipated changes in regard to additional services, but not concerning a reduction of services. However, setting up CD-ROM networks was slightly more favoured than coordinating access to the Internet. Contrary to expectations, respondents were very optimistic of retaining nearly all existing library services. This was in spite of increased accountability and tighter budgetary controls demanded by the corporate funding body. The five categories of services mentioned in the results appear not to have been considered collectively before, but only as individual items.
- The business library only is responsible for Internet access issues: In a series of questions, respondents were asked about Internet access issues relating to the *business library* and *host organisation*. The findings showed that largely the business library was not responsible for these types of issues. Responsibility appeared to be vested in other parts of the host organisation. This research did not attempt to find out where that may have been. Based on answers to other questions concerning responsibility for IT polices of the Internet, the IT department could also have dictated the requirements for Internet access. No such experiences were found in earlier studied literature which revealed an Australian business library view.
- Internet training is provided to both the business library staff and users: Business library staff and users only partially supported this assumption. The first of two sets of questions considered Internet training provided by the business library and host organisation to its librarians. Tillman and Ladner's figure of 35 per cent of respondents who underwent formal Internet training contrasted dramatically with 65 per cent of librarians in this survey. The same

authors found that 25 per cent were responsible for their own Internet training. Victorian business librarians were much more accountable for their training— self training — with a response rate of 59 per cent. This question had considered both formal and informal types of training. Tillman and Ladner did not provide any findings on refresher Internet courses.

The second group of questions addressed Internet training given by business librarians to their users. No direct evidence emerged of previous findings into whether librarians provided Internet training for their clientele. Tillman and Ladner only referred to the fact that their respondents considered the subdividing of training in larger organisations. The IT department could offer classes on the basics of the Internet, while the library could provide seminars on available network resources in specialised subject areas. This suggestion could go part of the way in explaining responses received from Victorian business librarians who gave Internet training and to a particular level.

- Technical and reference services are aided by the Internet: This assumption was tested in a set of four questions. The three questions which pertained to technical services asked respondents about the use of copy cataloguing records downloaded via the Internet. The fourth question asked whether business librarians used the Internet for reference-related work. The assumption was strongly dismissed on the technical services question, but strongly supported on reference services.
- Two contrasting opinions emerged in the literature concerning technical services being aided by the Internet. On the one hand, Missingham believed that the World Wide Web and Internet access could be used much more than reference services for clients. The author claimed that one of the uses which she had experienced in working in special libraries was reducing original cataloguing, and checking authority files from both local and overseas organisations. By implication, Missingham was probably referring to the downloading of copy cataloguing records and authority files via the Internet as occurring on a routine basis.

However, Ladner and Tillman maintained that special libraries in the corporate sector would not be able to use the Internet to the same extent. Corporate libraries tended to have small numbers of staff, sometimes only one professional, and therefore could spend only limited time in technical services functions, like copy cataloguing. Business librarians concentrated more on emphasising access to information than collection development and stressed current awareness functions more than other special librarians.

The findings from Victorian business librarians' use of the Internet for reference work were supported by Ladner and Tillman's research into the use of the Internet for reference. The authors said that 'as the Internet became a more integral tool of the information workplace, the almost instant responses to questions and other serendipities that occur on the Internet would become commonplace.' Special librarians were considered as the 'early adopters' of using the Internet.

- Cost–benefit analysis and marketing of Internet services are crucial: This assumption was only partially upheld, as respondents tended to not carry out any cost–benefit analysis. Yet it was supported on the importance of marketing Internet services. It seemed a little strange that business librarians were able to effectively market the benefits of the Internet, without having always done a cost–benefit analysis. It remains to be seen that if respondents had been more inclined to do cost–benefit analysis then their success in marketing Internet services could have been higher still. The contradictory findings from the two questions suggest that respondents may not have understood the significance or importance of a cost–benefit analysis in a business environment.

Cram did an extensive study into the importance of cost–benefit analysis and marketing of the Internet's potential benefits. She alleged the paradox of the Internet was that it could deliver improvements to the library's bottom line in terms of reduced or offset costs and improved productivity, and almost simultaneously, could increase costs and decrease productivity.

Cram indicated that the nature and range of costs pertaining to an individual business library must be known and answered according to a set criteria.

- The Internet has placed more emphasis on value-added services in the business library: The two questions which sought to verify this assumption was only partially supported. Since the introduction of the Internet, many respondents had placed little emphasis on the importance of value-added services. Despite this, some business librarians were able to give examples of value-added services.

The findings vindicated Matarazzo and Prusak's research in America which stated that business libraries could derive many more benefits from being a part of the growth in computing power and the expansion of network capabilities, including the Internet and World Wide Web. Corporate libraries could also become more involved in target-marketing of on-line products and services, to both end-users within and outside of the corporate organisation.

- Potential benefits of the Internet fall into specific categories: Undoubtedly survey respondents upheld this assumption. They were asked to order benefits in degree of importance from 1 through to 11. No recent studies could be found giving similar results from among business libraries both here in Australia and overseas. The only exception was some related research carried out by and Ladner into how special librarians used the Internet and the importance they attached to five Internet functions. Their findings, based on a set of 'functions' of the Internet, provided for some means of comparison with the eleven 'benefits' on which Victorian business librarians rated the Internet for their library and organisation. Where Tillman and Ladner's results were expressed in percentage terms, this survey used a factoring analysis to calculate the spread of the first benefit for each of the eleven listed library services.

Tillman and Ladner asked special librarians to briefly describe their use of the Internet. They organised the findings into seven umbrella categories. Eighty-nine percent of respondents selected 'work related communication and email', followed by 60 per cent for 'electronic forums, bulletin boards and e-journals', then 40 per cent for 'searching remote databases'. 'File transfer (FTP) and data exchange' followed 28 per cent, then research and publication on 28 per cent and nine percent for 'personal communication, leisure activities'. In last place was the 'other' category with six percent.

Tillman and Ladner also queried the same respondents about the importance of five Internet functions — email, searching remote databases, discussion lists, file transfer, and chat/talk, based on a five-point scale. The results of this analysis showed that email ranked first, followed by searching remote databases and discussion lists. Three out of four considered email to be essential or important in their work, two out of three believed searching remote databases to be essential or important. In comparison, less than half considered discussion lists to be essential or important, and only one out of four felt that way about FTP.

- Business libraries benefit from full-text resources available on the Internet: While business librarians upheld this assumption, no recently written articles could be located which specifically discussed the supply of full-text resources from the Internet in a business library environment. The survey findings suggested that those librarians who used the Internet for this purpose did so on an extensive basis. Many respondents took the option of choosing more than one country of origin for sourcing full-text materials. This would have accounted for the high number of countries or regions that respondents selected. If more respondents had indicated that they had benefited from the availability of full-text resources from the Internet, then the figures for the origin of full-text material would have been correspondingly higher. While it was not surprising that America was the most popular place for sourcing full-text materials, Australia was also regarded as a very good supplier of these resources in second place.

- The business library has been able to advise its host organisation on the advantages of accessing information from the Internet: The final assumption in this study was strongly supported. The quantity and quality of responses suggested that business librarians had been able to clearly define these benefits of the Internet and therefore inform their host organisations of the advantages which could be gained. In many cases respondents provided multiple examples, some of which were shared also by others. It remained a little unclear as to whether all of the advantages given had been achieved in practice or were considered from a theoretical perspective. Without carrying out further investigation, the evidence given pointed to these advantages as practical achievements.

Suggestions for Further Research

Further research needs to be carried out into how Victorian business librarians are delivering information to their users, both through the reference interview and document delivery. On the one hand, they delivered reference information via traditional methods, without always making use of the Internet as a search tool. At the same time, respondents said that they used the Internet to obtain full-text articles and reports for their users.

In future, how business librarians use the Internet to answer reference enquiries should take in the issue of also delivering full-text articles across the Internet. Also consideration should be given to examining the type of sources on the Internet that provide full-text documents and if there is much difference in charging policies between them. How would this compare then to taking out a journal subscription or purchasing of the monograph?

More investigation is strongly recommended into the reasons for business librarians not being more involved in the setting up and maintaining of IT and security policies for Internet related functions in both the *library* and their *organisation*. Until recently, this has been almost the sole domain of corporate IT departments. This could start with examining the type of information mounted on an internal Internet — intranet— through to the structure of information appearing in servers of other divisions of the parent organisation. Business librarians could also become involved in making selective internal information available to valued company clients across an 'extranet'.

Some questions to be raised on Internet policy include the following. What specific contributions has the *business library* been able to make in the setting and revising of overall Internet policy for the library and host organisation? Have librarians been trained sufficiently to understand the significance of information policy and its likely impacts throughout the organisation?

It could also ask if business librarians have been active in developing Internet training polices for both the library's clientele and throughout the whole organisation. Another aspect to be questioned is if, and how, business librarians have participated in developing policy and standards for the material that is posted to the organisation's Internet site.

Still more questions need to be asked about how librarians define 'content' and if they had been more involved with technical functions concerning the Internet than the quality of the information. These issues were reflected in optional written comments given to the main question. It proved necessary to categorise these comments into five categories. Further, there was a dividing line between 'content' and 'technical knowledge' for all respondents. Were there some respondents who could neatly combine information content with technical knowledge and therefore occupy the role of webmaster for both the business library and host organisation?

Cooper and Giles support the above trend by saying that special librarians need to become content coordinators as opposed to the technical Webmasters' or information technology role. Simultaneously, special librarians should acquire skills in developing Intranet content, *e.g.* Web pages, directories, subject guides, filters, intelligent agents, on-screen tutorials, and employee communications.

Internet training services in the *business library* context is another area in need of wider research. Cooper and Giles imply that not only could the business librarian have the role of Internet trainer, but also as educator and facilitator rather than just the information intermediary. They could acquire more technical skills such as 'train the trainer', information technology skills, including web publishing and setting up browser access. These aspects, if investigated, should help to identify why some business libraries have not only survived, but also diversified into a niche training area, which may not have been provided beforehand. It is crucial to ask why more business librarians cannot benefit from formal Internet training and refresher courses. Is it due to library staff not being spared the time to attend such courses, or to inadequate staff training budgets? The result is that business librarians have to train themselves about the Internet. That may explain why 40 per cent of library users are not provided with any Internet training.

The next area suggested for further investigation is cost–benefit analysis and marketing of Internet services. What is missing from the survey responses is the common link that should exist between effective marketing of Internet services to both library patrons and the host organisation and the cost–benefit analysis. As a first step in the justification process it is important to carry out a cost–benefit analysis before conducting any marketing exercise.

As Cooper and Giles tell us, there is a strong need to enhance the marketing role of selling Internet services, promoting access to information and information sharing and improving workflow and document management over an Intranet. However, the authors have failed to mention anything about the cost–benefit analysis. Further investigation in a business library environment is warranted of these enhanced marketing roles, in conjunction with cost–benefit analysis.

The question in the survey which asked respondents whether their *business library* had been able to benefit from more value-added services with the advent of Internet-based services gave a disappointing answer. More study is required on this topic to determine how business librarians define the term 'value-added' services.

The need to concentrate on value-added services, such as increased, faster document delivery, information analysis and commentary, Intranet input and serious information content would be other aspects that should be put to business librarians. As may be evident from the above suggestions for further research, there are other aspects from the current survey findings which could also be investigated. Those mentioned emerged as the most prominent and in need of more investigation in the near future.

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Index

D

E

F

G

I

P

R

S

T

U

V

W