Information Technology Systems at Airports--A Primer

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 59

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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FOREWORD

By Michael R. Salamone
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ACRP Report 59: Information Technology Systems at Airports—A Primer provides insights and advice to help airport executives and information technology (IT) professionals plan for and communicate about information technology at airports. The report offers techniques for both groups to identify critical issues and thereby communicate effectively, articulates sound IT principles for implementing new IT systems using a standard IT system lifecycle process for their airport, describes the benefits and value of various IT systems when formulating airport strategic goals and making financial investment decisions, and helps clarify mutual understanding of the fundamental architecture concepts of IT systems as they relate to airport goals.

This primer is based on the knowledge, expertise, opinions, and recommendations of airport executives, IT professionals, and other airport industry practitioners collected through focus group discussions, online surveys, interviews, and case studies. In addition to proven techniques and tools applied at some airports, the primer provides innovative solutions for common IT issues.

Occasionally, airport executives do not fully understand how to place a value on information systems and technology when making resource allocation decisions, and likewise IT professionals frequently have a difficult time communicating and justifying the business benefits of newer technologies to executive management. This creates a dilemma of sorts, and as a result, airports tend to lag behind private industry in the strategic use of technology to improve business operations and financial performance.

Today, IT is a core component of nearly all processes at the airport. A change is occurring in business processes at airports, where the airport is becoming a fully involved service provider in the daily operation of all airport activities, including tenant activities. With IT applications, airports are offering more comprehensive services to their tenants and customers in the normal course of doing business. Notwithstanding, airports do not always know how to tailor information systems and technology to best support their own operations, let alone those of their tenants. Airports sometimes experience problems such as cost overruns, underperformance, implementation delays, internal disputes, poor reliability, unanticipated collateral impacts, and failure to consider integration when implementing new IT applications.

Through ACRP Project 01-12, Faith Group, LLC, developed a user-friendly management tool to facilitate airport executives' and IT professionals' mutual understanding and help them work together more effectively on IT projects, leading to better performance and reliability of IT systems and fewer cost overruns and delays during system implementation.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

CHAPTER 1

Introduction

ACRP Report 59: Information Technology Systems at Airports—A Primer (referred to throughout as "the primer"), provides insight and advice to help airport executives plan for and communicate about information technology (IT) at airports. This primer is based on the knowledge, expertise, opinions, and recommendations of airport executives and other airport industry professionals collected through focus group discussions, anonymous online surveys (the source for the quotations used throughout this primer), interviews, and case studies. In addition to proven techniques and tools applied at some airports, this primer provides innovative solutions for common IT issues.

1.1 Purpose of the Primer

In today's airports, IT is a core component of all systems. Airports are offering more comprehensive services to their tenants and customers in the normal course of doing business. This primer was developed as a user-friendly management tool to help airport executives and IT professionals:

- Identify and communicate effectively regarding common IT issues.
- Articulate sound IT principles for implementing IT systems.
- Implement a standard IT system lifecycle process for their airport.
- Effectively describe the benefits and value of IT systems when formulating airport strategic goals and making financial investment decisions.
- Understand the fundamental architecture concepts of IT systems.

Ultimately, the information in the primer should facilitate understanding among airport executives and help them work together more effectively on IT projects, leading to better performance and reliability of IT systems and fewer cost overruns and delays during system implementation.

1.2 The Communication Triangle

This primer has three audiences because three separate groups fall into the category of airport executives—the CEO, the CIO, and the stakeholder executive. Readers may not have these exact titles, but they are likely to fill one or more of the typical executive roles described in the following.

- **CEO**—The chief executive officer, typically called the airport director, is responsible for aligning the company, internally and externally, with his or her strategic vision.
- **CIO**—The chief information officer, or information technology manager, is responsible for the airport's computers and communications systems, including infrastructure, hardware, and software applications. The CIO implements IT projects and operates systems already in place.

Icons and other features are used throughout the Primer to help readers identify key tips and highlights. Look for the following:

The "helpful tip" icon, which offers suggestions for how to use a specific technique or solution.

The "Appendix A" icon, which alerts readers that a specific document mentioned in the text is described in more detail in Appendix A, which also presents sample outlines and templates.

The "Triangle of Communication" icon, which highlights to the reader the specific communication path being discussed in the text.

- **Stakeholder executive**—A stakeholder is anyone who uses technology systems and cares about the systems' performance. For the purposes of this primer, the term *stakeholder executive* refers to senior airport managers who report to the CEO and represent users who depend on IT systems, including those in charge of property management, operations, maintenance, security, finance, and human resources.

The three-point relationship between these executive roles can be described as a triangle of communication, as shown in Figure 1-1. The triangle shape is appropriate because all legs of a triangle depend on each other for structural support, just as the three executives in the airport communication triangle must communicate effectively to implement complex technology.

The IT communication process is continual, not a one-time effort. For example, when a CIO and stakeholder executive work together to get a new system approved, that step is not the end

Figure 1-1. Triangle of communication

of the communication process. Collaboration and communication must continue through the implementation phase so that all parties understand system functions, benefits, and operational requirements. Chapter 2 is focused on facilitating a mutual understanding between airport executives regarding IT. The chapter highlights the perspectives of each of these executives and what they would like the others to understand. Common challenges that these executives face are discussed and solutions are suggested.

1.3 Guiding IT Principles

Given the critical importance of IT infrastructure to the airport's successful operations, airports must establish a set of IT principles to guide IT investments and implementations. These principles, intended to be enduring and seldom changed, help make the IT environment as productive and cost-effective as possible. They should be developed jointly by the CIO, CEO, and stakeholder executives to align with airport strategic goals and visions. Chapter 3 contains a more detailed explanation of IT principles and provides sample principles that have been found useful by many organizations.

1.4 IT System Lifecycle

One way of improving communication about IT is for all executives to understand and follow a common IT system lifecycle for managing a system from conception through design, implementation, and ongoing operations until the system is removed or replaced. Adhering to a deliberate, structured, and methodical process integrates people, data, and business systems from all areas of the airport. The result is a high-quality system that:

- Meets or exceeds customer expectations.
- Reaches completion within time and cost estimates.
- Works effectively and efficiently within established IT principles and infrastructure.
- Is cost-effective to operate and maintain.

This primer organizes the IT system lifecycle into four key phases to make it easy for readers to grasp:

1. Strategic planning
2. Planning
3. Implementation
4. Operations and maintenance

Chapter 4 describes the activities performed and the outputs of each phase in the IT system lifecycle. Sample outlines of recommended system lifecycle documentation are provided in Appendix A.

1.5 Evaluating IT Systems

Chapter 5 outlines a four-step methodology for evaluating IT systems and making IT investment decisions. The four steps are:

1. Documenting system benefits
2. Determining total lifecycle costs (TLC)
3. Performing a cost–benefit analysis
4. Scoring system values objectively

Chapter 5 also provides a simple scorecard that can be used to determine the value of a proposed IT system. It takes into account both financial and nonfinancial benefits when valuing the system. This scorecard helps in evaluating a single system or comparing multiple systems when budgets are limited and choices must be made.

1.6 IT Systems Architecture

Airport IT systems can be very complex. They are often grouped into four conceptual categories and depicted in a layered fashion, as shown in Figure 1-2. The layered architecture exemplifies how the systems of one layer act as building blocks for the systems in the next layer. A more detailed explanation of these categories and of other aspects of IT systems architecture appears in Chapter 6. In addition, a list of airport IT systems and brief descriptions are included in Appendix B.

1.7 Checklists—A Common Management Tool

Checklists are useful management tools for ensuring consistency and completeness—an example from a related field is the checklist of safety precautions that pilots go through before every flight. When used consistently, checklists are very effective at ensuring that activities are completed in accordance with standard practices. Table 1-1 is an IT system lifecycle checklist useful for ensuring that the IT system lifecycle process described in Chapter 4 has been implemented completely.

1.8 IT Vocabulary

The airport industry is full of acronyms and abbreviations that are not readily understood by others outside the specialized world of airports. Information technology also has its own unique vocabulary. To help airport executives sort out the terminology, Appendix C provides a list of airport and IT acronyms and abbreviations along with expansions and brief descriptions.

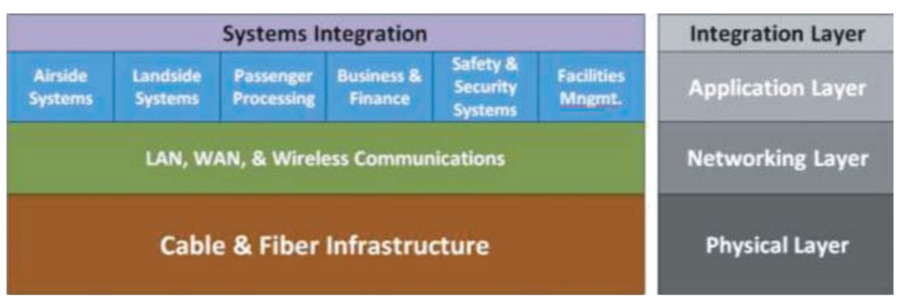


Figure 1-2. Systems architecture.

Table 1-1. IT system lifecycle checklist.

ITEM	QUESTIONS FOR PLANNING PHASE	☑
1	Does the project support airport strategic goals?	
2	Does project fit into airport master plan?	
3	Have a *system definition* and *concept of operations* been written?	
4	Have project responsibilities for funding, implementing, and operating been assigned?	
5	Have all stakeholders been identified and coordinated with?	
6	Have potential impacts been identified (e.g., other systems, projects, staffing, contracts)?	
7	Has the *value proposition* been presented [budget, return on investment (ROI), benefits]?	
8	Have funding sources been identified?	
ITEM	**QUESTIONS FOR IMPLEMENTATION PHASE**	☑
9	Has a project manager been named and given a project charter?	
10	Has a *project management plan* (with required cost, schedule, and resources) been approved by the stakeholders?	
11	Are regular project reviews scheduled with stakeholders that discuss scope, schedule, cost, risks, issues, accomplishments, and goals?	
12	Has a *system specification* been approved by all stakeholders?	
13	Is source selection committee representative of key stakeholders?	
14	Has sufficient training and transition planning for the new system been completed?	
15	Have operational procedures been coordinated with stakeholders?	
ITEM	**QUESTIONS FOR OPERATIONS AND MAINTENANCE PHASE**	☑
16	Are performance metrics defined, measurable, and monitored regularly?	
17	Are stakeholder/user feedback mechanisms in place?	
18	Are operations and maintenance (O&M) budgets as predicted in planning phase?	
19	Does IT department have the proper staff and outside expertise to do the job?	
20	Is there a disaster recovery plan dovetailed to airport continuity of operations plan (COOP)	

CHAPTER 2

The IT Communication Triangle—Solving IT Issues

2.1 The Challenges of Communicating About IT

In the last 20 years, IT has emerged from a discipline that is primarily focused on financial and administrative tasks to become a core underpinning of all aspects of airport operations. At the same time, the role of the IT professional has expanded and become highly visible, and the work done by IT staff has become an essential part of most business operations of all sizes and complexity.

The growing dependence of airports on their IT infrastructure, applications, and data has caused all organizations to have a vested interest in that infrastructure's reliability and functionality. Good communications among airport executives, stakeholders, and the IT organization are critical to the successful operation of airports.

The three-point relationship between these parties (CEO, executive stakeholder, and CIO) can be described as a triangle of communication, as shown in Figure 2-1.

The diagram puts the CEO at the top, in a simplified version of the airport organizational hierarchy. However, the triangle is about communication; it is not an organizational chart. Regardless of the organizational structure, the triangle of communication remains the same.

This chapter examines commonly occurring IT communication challenges among the three parties in the communication triangle. As each challenge is discussed, the chapter provides insight into the problem, identifies why it exists, and offers suggestions for improvement. Table 2-1 summarizes the common challenges.

It is important to recognize the three distinct executive roles and understand that, especially in smaller airports, the roles may be consolidated and performed by one or two staff members who have competing interests.

This chapter facilitates the mutual understanding of each executive's perspective in regard to the fundamental considerations of IT at airports. Each section focuses on one leg of the communications triangle. For each leg, a table of each executive's expectations and perspectives about the other is provided. The associated communication challenges and suggested solutions are then discussed in more detail.

2.2 CEO–CIO Communication

Setting clear goals, delegating authority with responsibility, and assigning accountability for actions are all appropriate activities between the CEO and CIO. Because IT permeates all departments in an airport, the interaction between CEOs and CIOs is extremely important yet uniquely different from that of other executives who report to the CEO. Table 2-2 portrays perspectives that each of these executives feel it is important for the other to understand.

Figure 2-1. IT triangle of communication.

Table 2-1. Common IT challenges at airports.

AREA OF COMMUNICATION TRIANGLE	CHALLENGE
CEO–CIO	IT systems have a short life span.
	Governance complexities are difficult to manage.
	A quality IT staff must be established and retained.
	Cost overruns must be avoided.
	The value proposition of IT systems must be created.
CIO–Stakeholder	IT terminology confuses non-IT people.
	CIOs and stakeholders must communicate early and often.
	IT projects are inherently complex.
	IT security must be maintained.
	Training needs are not fully met.
	Projects are not well managed.
	IT department roles and responsibilities are often unclear.
	New system benefits are not measured.
CEO–Stakeholder	Competition for limited capital resources.
	Managing impacts of IT projects on stakeholder staff.
	IT affects stakeholder budgets.
	Airport language is not always well understood.
	The CIO must be positioned effectively in the organization.

Table 2-2. CEO–CIO perspectives.

WHAT THE CEO WANTS THE CIO TO UNDERSTAND
The CEO wants IT master plans and IT goals to map to airport strategic plans.
The CEO wants the CIO to understand the governance structure of the airport and to work efficiently within that structure.
IT system cost estimates need to be accurate and complete. Hidden indirect costs associated with implementing and operating IT systems need to be included in budget estimates.
IT personnel should not use excessive technical jargon. They need to discuss IT systems in terms of user benefits.
The IT department (with stakeholders) needs to follow a standard process for managing projects that takes into account interdepartmental coordination and budgets.
Capital requests for IT systems should have both financial and nonfinancial benefits specified and should be coordinated with all affected stakeholders before they are presented to the CEO.
WHAT THE CIO WANTS THE CEO TO UNDERSTAND
IT permeates systems across all departments. The IT department needs to be involved in all system acquisitions/additions/modifications even if the system is not owned by IT.
IT systems have a shorter life span than other airport systems and need technology refresh and upgrades more frequently to keep them from becoming obsolete.
IT professionals have specialized skills that cross industry boundaries. Acquiring and retaining IT staff is a difficult challenge and different from hiring airport industry professionals.
Maintaining IT security is complex and costly but is a necessity due to the potential impacts of a breach. IT security guidelines and policies must be enforced across all departments.
The CIO wants the CEO to clearly define roles and responsibilities for implementing systems containing elements of IT to both IT and stakeholder departments throughout all phases of the system lifecycle (e.g., user, financer, acquirer, implementer, administrator, operator, and maintainer). Budget responsibilities for each phase also need to be specified.
Because IT systems and infrastructure are critical to successful airport operations, the CIO should have an appropriate level of authority and access to the CEO and other members of the executive team.

The perspectives discussed in Table 2-2 lead to common communication challenges between the CEO and CIO. These challenges and suggested solutions are discussed in more detail in the following.

2.2.1 Challenge: IT Systems Have a Short Life Span

It is difficult for many disciplines and industries, including IT, to perfectly foresee advances and growth and to project all costs over the near and long term. IT's fast pace and expense can be a source of concern and frustration for airport CEOs and stakeholders. As IT expands throughout airports, it requires a larger share of capital and operational funds, and unlike terminal buildings and runways, which have lives measured in decades, many IT systems are effectively obsolete in as few as 5 years.

Establishing IT systems with longevity presents a significant challenge to airports. Information technology's very nature involves frequent innovation and change. Over the past two decades, computers and software have become more powerful by orders of magnitude. Network speeds and capacity now extend into ranges over 100 times greater than they were just 10 years ago. Nothing indicates that these increases in performance are slowing down or that the appetite of users for improvement is diminishing. This rate of change causes IT systems to have short life spans, given that users demand new IT features and capabilities on a frequent basis.

The problem is how to future-proof the IT investment to the greatest degree possible, such that upgrade and replacement costs, while not eliminated, are at least reduced and managed.

Solution: Plan Strategically

Airport management is skilled at master planning. Typically, on a regular cycle, the airport staff and planning experts meet to review the existing master plan and revise and adjust it in light of a range of conditions, from traffic forecasts to changes in airline requirements or the need for additional parking. These periodic strategic planning sessions provide executive stakeholders and the CEO with long-term guidance for organizing and funding the capital projects of the airport. By tying the goals of the IT master plan to those of the airport master plan, the usefulness and longevity of the IT infrastructure can be expanded.

Over 50% of CEOs believe that IT goals are not mapped to airport goals, and only 18% indicate that an IT master plan is produced.

> ***Helpful Tip #1***
> *Developing an IT master plan is part of the strategic planning process. Use the template in Appendix A as a guide for IT master plan contents.*

These numbers indicate less than half of the airports are developing an IT master plan, which is a significant problem.

An IT master plan does not have to be complex or cumbersome. Its size, scale, and detail will depend on the size of the airport and the airport's need for IT. Regardless, long-term planning for IT is essential and must be performed. When it is performed, it is incumbent on the CIO to normalize that plan to the airport master plan and relay the future vision for IT technology to the CEO and stakeholders.

IT master planning includes assessing the existing conditions of all IT systems and highlighting systems that are near their end of life or are otherwise unsustainable. A 360-degree analysis of user perceptions of the IT systems and department will identify both technology and management areas that require attention. By looking outward at the industry, IT can identify technology trends that may be applicable at the airport. When the research is completed and lessons are extracted, IT projects can be prioritized and organized into a road map that is aligned with the airport master plan. (Although this will not eliminate IT costs and the cycle of innovation, it will help identify economies, ensure that all parties understand the costs and benefits, and allow for more effective planning overall.)

CEOs need IT master plans so they can understand what funding the IT department needs and what IT projects are critical to accomplishing the airport master plan. Here is a real-world story from an airport, obtained, as with all of these quotations throughout the primer, through an anonymous survey:

> We worked with a third-party consulting team to create an IT master plan. This project allowed us to assess our IT needs from a systemic viewpoint and to build out in a sensible manner. Frankly, it also allowed us to curtail some of the more random selections of system software and hardware peripherals, as well. The greatest benefit was the ability to rationalize our purchasing, set out multi-year small sum purchase plans for individual PCs, peripherals, and software upgrades, and to get better control of our various service agreements.

Helpful Tip #2
Avoid organizational conflicts by forming an airport IT committee to coordinate and collaborate with the owner on airport IT systems.

As this example suggests, the CIO can use the IT master plan to check the implementation of technology against the airport's needs and to solicit input and ideas from the stakeholder community, helping to ensure that the projects are necessary. These actions help ease the funding of these projects by giving them visibility and support. Once the IT master plan is completed and supported by stakeholders, the CIO can use it as a touchstone for future dialog with the CEO.

Important things to remember about IT master plans include:

- IT systems change much more rapidly than airports. Therefore, IT master plans will usually become obsolete faster than the airport master plans from which they were derived. IT master planning should be done at least every 24 to 36 months.
- Capital expenditures in IT master plans should be categorized as near-term and long-term. Near-term expenses should be forecast with some accuracy, but long-term expenses will need to be reviewed and adjusted as their planned implementation grows closer.
- IT master plans provide an opportunity for the CIO to receive constructive criticism and peer review of the IT master plan, which in turn will improve the plan.

2.2.2 Challenge: Governance Complexities Are Difficult to Manage

Many airports are owned by a city, county, or state, most of which have their own CIOs and policies and procedures related to IT. One of the major management challenges that CEOs encounter involves differences of opinion between the airport CIO and the CIO of the owning entity. (This is less true when the airport is an authority.)

This situation can cause several different types of conflicts. The owning entity may insist that the airport share in cost pools for networks and for applications, such as financial accounting systems, which are not necessarily the preferred or optimal solutions for the airport. Airports may prefer to have independent control of these assets and may argue that their special nature warrants independent investment. Airport CIOs often feel that their city, county, or state counterpart doesn't understand aviation and the unique aspects of the industry. Here is an example directly from an airport:

> Our biggest problem at the [airport] is when procurements have to be approved by our downtown IT department. Our downtown purchasing department will not approve any computer procurements unless downtown IT has approved the project. Any time downtown gets involved it will delay a project anywhere from 3 to 6 months.

Solution: Establish Governance Working Group

Governance—who owns the airport and how IT is managed relative to the type of governing body—is an important consideration for IT systems.

When the governance is external and causes delays or problems for the airport, two general actions can be pursued:

1. Adapt to the governance structure. The airport CIO needs to be fully aware of the practices and policies of the governing entity and must integrate these into his or her practices, policies, and procedures, which may mean incorporating specific procurement practices or allowing added time for external reviews or budgeting.
2. Establish an airport IT working group that includes representatives from both the airport and the governing body. The working group should provide a forum for regular communication, advanced planning, and opportunities to address governance issues and influence the process. An airport IT working group should have a clear charter that includes coordinating planning, standardizing specifications and technical requirements, funding, procurement, and installing IT systems. The working group should include representatives from IT management, airport stakeholders, budget, procurement, and the governing entity.

2.2.3 Challenge: Quality IT Staff Must Be Acquired and Retained

Acquiring and retaining the right staff is a difficult challenge for airport CIOs, who must compete with other airports and private industry for talented staff with very specialized skills. For example, certified information systems security professionals (CISSPs) are currently in demand across all industries, and airports are often shocked by and unwilling to pay the salaries garnered by these leading-edge technology professionals.

Also, IT staff members who have been internally developed within the CIO's organization may be recruited to another organization or may choose to leave for a variety of reasons.

Solution: Augment IT Staff Through Outsourcing

The CEO must recognize that skilled individuals in the IT department have other opportunities outside of aviation—which is simply the nature of the competitive landscape for IT professionals. Although the cost of some IT professionals may be high, especially in an industry that is particularly sensitive to the current economic downturn, it is important to weigh their skills and value in the overall IT market, not just in the airport community.

Helpful Tip #3
Ensure that IT specialists are available on demand by augmenting staff with outsourced resources.

For example, consider the cost of a data security breach. Credit card companies are currently transferring risk of loss to the merchants whose systems store and transport sensitive credit card information. Liability for an airport whose network exposes credit card information from parking transactions is currently about $500,000. Liabilities and/or loss of revenue for delaying aircraft or shutting down piers may carry similar consequential costs that justify the skills offered by IT security professionals.

Retaining qualified staff through fair salaries and good working conditions is important, but not always practical. In these cases, or as a response to a variable work load, some airports have turned to outsourcing. Outsourcing technology functions typically makes sense when:

- The outsourcer has specialized skills that allow the outsourcer to operate more efficiently than an airport can with its own staff and systems.
- The outsourcer has a stable of skilled specialists who can be used when needed but do not have to be carried full time by the airport.

If the IT function is outsourced, develop a solid service level agreement, and review tasks and projects routinely with airport management. A weak service level agreement will make life for the CIO very challenging for a long period of time.

Outsourcing also gives the airport access to a pool of part-time experts with specialized skill sets, without having to pay for them full time. Figure 2-2 shows how an airport is able to meet staffing demands through outsourcing and only hire when sustained demands warrant it.

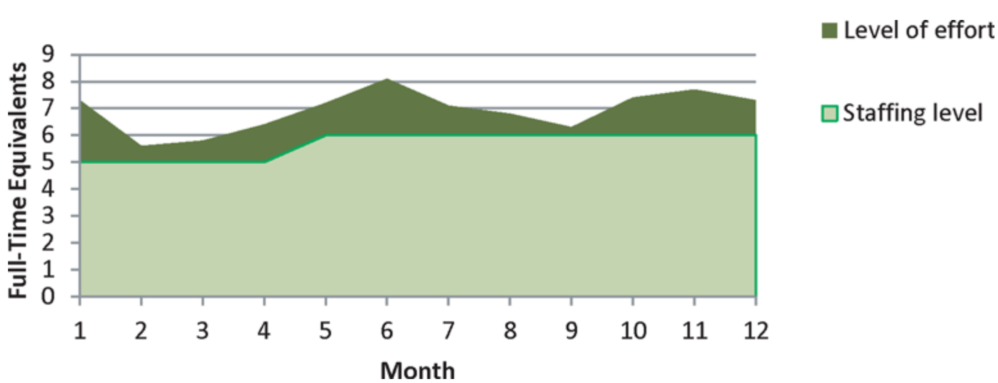


Figure 2-2. Example of meeting staffing demands through outsourcing.

2.2.4 Challenge: Cost Overruns Must Be Avoided

A frequent complaint of CEOs (and CFOs) is that an IT system that had been approved based on a specific capital cost later became much more expensive because of unforeseen issues. The following story provides an example:

> We funded over $1M to implement a geographic information system (GIS). We hired a consultant, wrote a specification, put it out for bid, and selected the best provider for the task. The project plan from the vendor was very thorough and we felt this was going to go well. Two months in, however, we discovered that the room identifications in the floor plans didn't mean the same thing as was expressed in the lease or in the property management system. A third of my staff spent 5 weeks straightening out the mess so that the system would work right. If we actually counted the cost of their time and the impacts to operations, the costs would have been much higher. Instead we just burnt everybody out.

Solution: Include Hidden Costs in Budget Estimates

IT systems have an extensive set of direct and indirect costs. Direct costs are those that are typically tracked in the financial system, while indirect costs are the hidden costs that exist but aren't easily associated with the system. These costs are frequently overlooked when planning and estimating IT systems.

As Table 2-3 shows, many of the costs of an IT project, especially indirect costs, are incurred by the stakeholder as well as by IT. Whether planning a project or planning an operational budget, the CIO and stakeholder need to share an honest, mutual understanding of the costs involved.

Table 2-3. Cost implications of an IT system.

	Direct Costs	Indirect Costs
One-Time Project Costs (Cap-X)	Capital cost of hardware	IT labor to run the project
	Capital cost of software	Stakeholder labor to prepare data for conversion to the new system
	Vendor labor cost to design, test, and cut over to the system	Costs for disposal of old system components
	Travel costs incurred by IT and stakeholders during the project	Stakeholder labor cost to support system testing and acceptance
	Installation costs of telecommunications channels	Stakeholder labor for training
		Cost of airport facilities required or made unavailable for project staging and deployment
		Security badges for vendor's workers
Recurring Expenses (Op-X)	Costs for telecommunications channels required by the system	Stakeholder labor to operate the system
	Preventative hardware maintenance	IT labor cost to operate the system
	Restorative hardware maintenance	Travel and labor costs to attend user group meetings
	Vendor help desk support	Membership costs of user groups
	Software maintenance	Ongoing training costs
	Consumables	Ongoing labor for training and retraining

Far too often, projects are presented to the board with only the hardware and software capital costs documented in a vendor quote. Without considering the total picture of direct and indirect costs for both operating expenses and capital expenses, the stage is set for cost surprises and cost overruns.

Complete planning of projects early in the lifecycle is essential. Experience shows that when teams collaborate that are well-versed in a particular type of project, they will identify external issues, indirect costs, and other items that will influence the final cost of the system. Therefore, many IT professionals and consultants insist on a longer conceptual phase when developing a project's cost.

Chapter 5 provides a more detailed discussion of capturing a system's TLC.

> ***Helpful Tip #4***
> *Avoid cost surprises by ensuring that all costs are considered when developing the total lifecycle cost estimates in the system planning phases (Section 3.3).*

2.2.5 Challenge: The Value Proposition of IT Systems Must Be Created

One of the trickier parts of the project planning and funding process is valuation of system benefits. Projects are presented for capital funding in a variety of formats and may not include all the evaluation criteria necessary for proper decision making. Some project proposals state the capital costs but omit the operational costs. Others talk about strategic value but fail to clarify any operational cost reductions or revenue gains.

For the CEO to make sound investment decisions, the valuation must be realistic and based on clear statements of goals, benefits, and costs, with measurable results.

Solution: Develop a Standard Process for Valuation of Capital Requests

The solution to this problem is to develop a consistent valuation methodology, which allows side-by-side comparison of projects and a better means of justifying decisions to fund projects. Valuation supports and leads to the development of metrics, provides a useful benchmark for determining if the project has met all of its goals, and helps identify areas where corrective steps need to be taken.

Chapter 5 provides a detailed methodology for valuing IT systems and a means of comparison to make informed investment decisions. The result of the methodology is a documented value proposition. The contents of this value proposition should include the following information:

- Description of the system.
- Benefits statement (justification).
- Financial evaluation, including:
  - The total direct capital costs, including expenses for performing the project.
  - Indirect capital costs of labor (both inside and outside the IT department).
  - The net impact to direct and indirect (labor) operating costs, which includes:
    - New operating costs incurred by commissioning a new system.
    - Eliminated or reduced operating costs achieved by decommissioning the old system.
    - Addition and/or reduction of staffing due to the new system.
    - Net revenue generated by the new system.
    - Return on investment (ROI) analysis over a consistent term.
- Regulatory compliance achieved.
- Intangibles such as:
  - Customer service benefit.
  - Increased security.
  - Increased safety.
  - Improved environmental position.

> ***Helpful Tip #5***
> *Make the return-on-investment calculations in Chapter 5 part of your value proposition and track both the costs and benefits all the way through operations and maintenance.*

- Risk assessment.
  - Project risks.
  - Risks created by having the system.
  - Risks avoided by having the system.
- Proposed project schedule.
- Funding sources [Airport Improvement Program (AIP), passenger facility charge (PFC) eligibility, etc.].
- Strategic value (alignment with airport or IT master plans).

This valuation should be developed by both the CIO and the vested stakeholder organizations. For example, an expansion of the airport will likely require added space, power, and HVAC services. The CIO must confer with the appropriate parties at the airport to understand the effects this will have on overall operation and costs.

Figure 2-3 is a scoring template that captures tangible and intangible benefits and provides a simple, objective scoring system. The template can be used for assessing the relative value of individual systems or for comparing the investment value of multiple systems.

Project Name	Sample Project
Advocate(s) Name	CIO and stakeholder
Project Description	Describe the project here
Expected Benefits	Describe benefits here
Risks	Describe risks here

		Evaluation Norms			Score	Weight
Nonfinancial Evaluation	**2.6**	a **1** means:	a **3** means:	a **5** means:		
Is this a regulatory necessity?		Not really	It could become a problem	Imminent danger of being shut down	**2**	25
Does this support the airport master plan?		No	Somewhat	Yes	**1**	0
Was this in the IT master plan?		No	Somewhat	Yes	**2**	10
Is there community goodwill to be gained?		None	Somewhat	Lots	**1**	15
Is this a green initiative?		Spends significant energy	Neutral	Saves significant energy	**3**	15
Is customer service improved?		No	Somewhat	Yes	**4**	15
Does it increase airport capacity?		It decreases it a little	Somewhat	Significantly	**3**	10
Does it attract air carriers to operate here?		Unlikely	May factor into their decision	Significant draw potential	**2**	10
Will it reduce errors and improve efficiency?		No	Somewhat	Yes	**3**	10
Will it make the airport safer?		Less safe	A little safer	Much more safe	**2**	15
Will it make the airport more secure?		Less secure	A little more secure	Much more secure	**2**	15
Does it diversify revenue sources?		All revenue comes from air carriers	Mixed revenue sources	No air carrier revenue expected	**5**	10
Will implementation disrupt operations?		No effect on operations	Some impact, but it won't be big.	Affects tenants & operations a lot.	**4**	10
How risky is the project?		Very risky	There is risk, but it is manageable	No risks	**2**	10
Financial Evaluation	**4.5**					
Internal rate of return	**8.8%**	Below 3%	Around 6%	Above 8%	**5**	50
Net present value	**$ 9,799**	Negative	Near zero	Positive	**4**	30
Breakeven point (years)	**3.8**	Above 5	Around 4	Below 3	**4**	20

Figure 2-3. System valuation scoring sheet.

2.3 CIO–Stakeholder Communication

The relationships between the CIO and other stakeholder executives are as important as their relationships with the CEO. Their perspectives are represented in Table 2-4.

The perspectives discussed in Table 2-4 lead to common communication challenges between the CIO and stakeholder executives. These challenges and suggested solutions are discussed in more detail in the following.

2.3.1 Challenge: IT Terminology Confuses Non-IT People

During the research for this primer, the communication issue that brought the strongest reaction was that technical experts, specifically CIOs and IT professionals, speak and write in a technical language that is not commonly understood by the CEO or stakeholders. Over 70% of

Table 2-4. CIO–stakeholder perspectives.

WHAT THE CIO WANTS THE STAKEHOLDER TO UNDERSTAND
The IT department needs to be involved from the beginning of stakeholder projects to determine impacts to existing IT infrastructure or needs for new IT to support the stakeholder requirements.
Performance metrics need to be defined and collected. Metrics are used to determine if service level agreements are being met, to measure the benefits of new system implementations, and to help define new requirements or improvements that need to be implemented.
IT systems are complex. IT principles and guidelines must be adhered to in order to maintain stability and security across the IT infrastructure and to maintain cost control. Proprietary systems should be avoided.
Roles and responsibilities for implementing systems containing elements of IT need to be made clear to both IT and stakeholder departments throughout all phases of the system lifecycle (e.g., user, financer, acquirer, implementer, administrator, operator, and maintainer). Budget responsibilities for each phase also need to be specified.
There are many hidden costs associated with implementing IT systems (e.g., new staff, data transfer, training). Interdepartmental coordination is required when developing total lifecycle cost estimates.
WHAT THE STAKEHOLDER WANTS THE CIO TO UNDERSTAND
IT personnel should not use excessive technical jargon. They need to discuss IT systems in terms of user benefits and how IT will improve stakeholder operations.
Stakeholders need to be involved from the beginning of IT projects to ensure that their requirements are being incorporated and to determine what impacts the new system will have on their operations.
Adequate training on new IT systems must be provided prior to system cutover.
Adequate planning for transitioning to new systems must be performed to ensure that there is no loss of data and that adequate resources are available to operate the new system.
CIOs should coordinate with stakeholders and get their buy in of the benefits and justification for new IT systems prior to funding requests.

stakeholders rated IT terminology as somewhat of a communication obstacle; the rest rated it as a major obstacle. This means it is a problem for nearly every stakeholder.

A further complication is that 37% of CIOs did not perceive IT terminology as an obstacle. In other words, more than a third of CIOs are unaware that communication barriers exist when IT is being discussed.

Clearly, the use of specific technical language or jargon causes communication problems between the parties.

Solution: Speak in Terms of User Needs and Benefits

A good approach is to use a common language that conveys how the technology works in terms of how it benefits the stakeholder and helps improve his or her operation. Whenever individuals or organizations present information about something that is specific to their function and operation, they are responsible for communicating in language that is easily understood by the listener.

In the case of CEO, CIO, and stakeholder communication, this requirement applies to all parties involved. Specific ways to achieve clarity when communicating about IT systems include:

Helpful Tip #6
In the strategic planning (Section 3.2) and system planning (Section 3.3) phases, focus on the benefits. Defining the benefits, using airport terminology, will allow CIOs to return to those reference points during implementation and operations.

- The CIO must recognize that terminology unique to IT, so-called "geek speak," is not familiar to the CEO and stakeholders. Overuse of technical language and acronyms causes the listener to lose track of the content and diminishes the value of the communication. The CIO should couch discussions in clear language that addresses the listener's needs and concerns.
- The CEO and stakeholders should make an effort to learn the basics of IT systems and how they work, as well as to educate the CIO on unique terminology and acronyms commonly used to describe airport operations and activities. Likewise, the CIO should endeavor to understand airport business.
- In any discussion among the parties, user needs and solutions must be a priority. Develop a common foundation for all discussions that involves solving problems and bringing benefits to the airport. Over time, as regular discussions focus on benefits, the clarity and quality of communication should improve.

As noted, the responsibility for efficient and clear communication rests with all parties involved. Everyone must be aware of the audience and the audience's frame of reference and must be committed to conveying clear messages and avoiding excessive use of jargon.

2.3.2 Challenge: CIOs and Stakeholders Must Communicate Early and Often

A weakness on both sides is that CIOs and stakeholders often don't communicate early enough in the system lifecycle. For example:

- CIOs complain of being excluded from stakeholder-driven projects until late in the process, forcing the CIO to respond reactively and without adequate time or planning.
- Stakeholders procure proprietary software or services that are not easily supported. With proper CIO involvement, an equally effective solution may have been found that was easier to support.

One airport CIO shared such a situation:

> The Planning Department and the business stakeholder planned out an IT project without IT organization input, got it authorized, and began implementing a solution our current IT infrastructure was not equipped to handle. This project went through multiple change orders and cost overruns to make it operate.

Stakeholders, on the other hand, frequently state that CIOs don't engage them in defining requirements for projects the CIOs are driving. Because the needs of the stakeholder are not addressed early, it is not uncommon for the procured system to have deficiencies relative to the stakeholder's needs.

Solution: Collaborate as a Multidisciplinary Team

As with any other project at an airport, involving the right people from the start is critical to success. For example, a common and highly successful practice when carrying out building projects is to engage architects and electrical and mechanical engineers from the conceptual stage through construction, which allows a full complement of experts to ensure a high-quality outcome. This approach should also apply to IT projects, whether they are initiated by the CIO or the stakeholder.

Although doing this may seem obvious, for a variety of reasons, such as time constraints, schedule demands, and unintentional oversight, it often doesn't happen.

Stakeholder-Led Projects

Examples of stakeholder-led projects are terminal renovations, security upgrades, and new parking structures. Almost any construction job falls into the category of a stakeholder-led project. It is rare for these projects to not have an IT component. For example:

- Terminal renovations typically include work on networks, telephone systems, IT infrastructure (rooms, cabling, and raceways), flight information display systems, and common use systems, all of which rely on IT design and services.
- Security, which is increasingly reliant on computers and electronic storage systems, requires network support, servers, switching systems, cameras, and electronic file storage, all of which rely to some degree on IT.
- Parking structures typically require a wide range of IT-based systems, including security and specialized parking management and revenue management systems.

> ***Helpful Tip #7***
> *The IT systems list in Appendix B is a useful reference to help stakeholders understand which IT systems to include in a given project. Reviewing this list at concept design and again at schematic design will ensure meaningful communications with the CIO.*

Executing the projects in these examples calls for IT to understand and support the facilities' requirements and needs. Also, design and planning must take IT requirements into account from the start. In other words, space, power, environmental conditioning, and implementation of IT upgrades must be part of the project from start to finish.

Often in the planning and design phases a dollar allowance is included for IT. An allowance is just an estimate. Failing to identify accurate IT impacts early can lead to rework and cost overruns down the line. Involving the CIO at the start of the project, similar to the way electrical or mechanical engineers are engaged, helps to clearly define costs.

> ***Helpful Tip #8***
> *Working with the stakeholders to complete a new concept of operations during the system planning phase (Section 3.3) of a new system will help ensure a mutual understanding of the requirements and benefits of a new system.*

When CIOs are involved throughout the project cycle, they can offer new ideas and suggest technologies that improve the project. Some ideas may result in minor changes to the project, but others may modify the basis of operations of airports and airlines. For example, common use self-service (CUSS) kiosks have not only changed the way in which passengers are ticketed and checked in, but they have also altered the design of airport ticket lobbies. Clearly, IT acts not only as a discipline supporting project development but also as a partner in advancing new approaches that improve efficiencies and reduce costs.

Here is a story a CIO told in which the stakeholder relationship started early and worked well:

> Our airport is currently installing a new inline baggage system in one of the terminals. I have been involved since the beginning, sitting in on every construction and stakeholder meeting. This has proven to be an advantage because IT is kept up to date and is able to quickly move on any IT issues encountered during construction and implementation.

CIO-Led Projects

Examples of IT-led projects are upgrading the network to a higher speed or implementing a new set of desktop tools for airport staff. While these are typically IT-specific, needing limited input from other departments or the stakeholder, they have the potential to have an effect, positive or negative, on the stakeholder. Effects may include outages in IT systems, a loss of productivity while a new software tool set is introduced, or stakeholder frustration due to a lack of training and preparation. An additional consequence can be estrangement between the CIO and stakeholder.

On the other hand, making an early effort to discover user requirements and impacts helps the CIO plan more effectively and address what stakeholders need, whether their needs are a particular set of tools or early training. The CIO may have to shift his or her notions about what should be included in the project and may expend more time and energy, but the benefits far outweigh the costs.

An operating department may find that assigning an IT department liaison helps improve information flow, or IT might assign a representative to the business unit. The base requirement is that the lead party engages with the other party early on to improve project communication, foster better progress, and properly allocate funding. Otherwise, the ramifications may include change orders, delays, and cost increases.

2.3.3 Challenge: IT Projects Are Inherently Complex

Aviation is one of the most technologically advanced industries. It has been an early and aggressive adopter of new technologies and solutions in an ongoing effort to increase efficiency and reduce costs. As a result, IT is part of almost every aspect of airport operations, from passenger experiences such as wayfinding and ticketing to back-of-house operations such as baggage handling and catering. This is a change from the time when IT was largely dedicated to management information systems (MIS) and finance.

Unintended consequences of introducing more technology have been the increased complexity of systems, the requirement for professional IT staff, and the continuing interdependence of stakeholders on the shared resources of IT and information.

The IT industry has undergone a major shift: delivering services through an open network architecture that allows the full range of information to be run across a common network, including data, voice, and video services. This change makes the technical side more complex but promises to simplify the stakeholder experience. An open network architecture allows services to be delivered to a wider range of users through computer workstations without needing special equipment or dedicated private networks.

As technology continues to advance, IT system capabilities expand, user expectations increase, and airport business practices change. The overall complexity of IT systems grows and systems become obsolete faster. The lifecycle of IT systems is much shorter than that of buildings or mechanical systems. Promoting an understanding of this quick rate of change helps control the perception that IT systems have high costs.

Solution: Stick to IT Principles and Guidelines

Helpful Tip #9
Implement guiding IT principles at your airport to provide a consistent framework for IT systems. Refer to Chapter 4 for sample principles.

Complexity is an inherent aspect of IT systems, so simplifying the technology isn't an option because intended benefits would be lost. However, managing, implementing, and maintaining IT projects can be greatly eased from the CEO and stakeholder perspectives by focusing on broader issues such as needs and benefits while keeping in mind that the work and systems involved are anything but simple.

Specific ways to deal with complexity include:

- Establish IT as a known entity within the airport's operations. The operational requirements of the IT department, including master planning, IT principles, and guidelines, should be published and available to the CEO and stakeholders. Publicize the IT department's approach and long-term plans for delivering service to avoid surprises down the road.

- Practice the concepts presented in this primer, communicate in terms the user understands, and work together as a team. Having regular conversations regarding IT will help acquaint everyone with the technologies involved and the IT professionals delivering them, thereby helping to reduce the mystery.
- Clearly state the goals, develop options based on those goals, and weigh the costs and benefits to arrive at the right solution. The specific means of delivering an end result is not the immediate concern of the CEO and stakeholder (barring cost and schedule issues), and their focus should be on high-level requirements. The most complex and technologically advanced solution is not always the best one, especially when viewed in light of the cost–benefit ratio.

In the case of the last item, the following story illustrates the point:

> Our airport needed a new building management system (BMS) to control lights and temperature. After all the sales pitches were done, we settled on a very advanced system that could tie into our airport resource management system (RMS) and automatically decrease power consumption and HVAC electricity demand based on our actual flight operations. On the surface everyone was enthusiastic about this green IT automation initiative. While there was a significant cost for the BMS–RMS integration, everyone felt it would save a lot of money over time. That was, until the night operations manager and one of the RMS guys in IT calculated that given our typical operations schedule, we only got the benefit for about 1 to 2 hours in the middle of the night. And that was when the air conditioner load was the lowest. So in the end we could select a less expensive BMS and save the cost and complexity of the RMS integration. The solution turned out to be both simpler and less expensive, yet we still got all the benefits.

2.3.4 Challenge: IT Security Must Be Maintained

Hacking, data theft, and other unethical or illegal acts become a greater threat as more people use IT systems and airports place more sensitive information on them, including financial and badging data. Over the past decade, the need to protect IT has greatly increased—a trend that is likely to grow. Unfortunately, increased security requirements can increase costs and hamper user access to needed information.

> ***Helpful Tip #10***
> *Following strict change and configuration management procedures during the operations and maintenance phase (Section 3.5) is key for maintaining security.*

Data security is a relatively new aspect of the IT industry. In many cases it is added as an upgrade feature to an existing system, which is not always the best solution, or is applied in the wrong manner.

The nature of data exchange and communication requires a degree of openness; this is one of the fundamental tenets of the Internet. Restricting access or imposing onerous security procedures without users understanding the reasons leads to violations and a lack of user-community support.

Security's effectiveness is difficult to measure unless an event occurs that exposes a flaw or weakness. Also, required security measures are difficult to explain and must be treated as sensitive information—restricted only to authorized personnel.

All of these factors make IT security a significant challenge for airports.

Solution: Centralize and Popularize Good IT Security Practices

Security, whether for data or for physical aspects of the airport, is not just a matter of implementing systems and equipment. It also requires buy-in and recognition of the need for good security practices. Encryption routines and passenger screening stations are tangible aspects of security, but these systems only work when human beings use them consistently and enforce the right practices and approaches.

Explaining security costs to stakeholders and the CEO is an important first step to gaining buy-in. A physical security issue such as a passenger screening breach can be measured in terms of

Table 2-5. Terminology translated from airport to IT security.

	Airport Security	IT Security
Perimeters	Airports have fences, gates, and secured doors to maintain a concentric set of security perimeters within the airport.	Information technology uses firewalls and access control lists to maintain perimeters within the network.
User authentications	Access control systems use codes, cards, and biometrics to authenticate users for access to secure areas.	IT systems use passwords, logon IDs, and biometrics to authenticate users' rights to use the system and access secure data storage areas.
Surveillance	Cameras and perimeter intrusion detection systems notify security when unauthorized access occurs.	System monitors look for unusual activity and unauthorized access attempts so that network managers can be notified when unauthorized access occurs.
Forensic data retention	Digital video recorders and access control systems retain records of access, which can be used to prosecute criminal acts.	Network switches and applications retain logs of system access, which can be used to prosecute criminal acts.

delayed travelers and flights and lost revenues—real numbers that demonstrate the system's value. Similarly, the benefits of IT security can be demonstrated by using real-world examples of lost revenues or increased costs due to breaches, such as the effects of a compromised badging system database or lost access card. By equating security breaches to financial and operational costs, the user can begin to understand the effect of these events on the organization and ultimately on each user. Money spent to clean up after a security breach is money that cannot be used on facilities, tools, salaries, and benefits.

It is useful to help airport staff and tenants understand the value of IT security in terms they are familiar with, such as those illustrated in Table 2-5.

As with airport security, IT security is a continuous operation of maintaining perimeters, authenticating users, watching operations, and retaining data logs. IT security also requires a centralized and specialized group with a charter to maintain vigilant surveillance of the network and applications. This group needs to be involved in the change management of every project to ensure that new holes in the perimeter are not accidentally opened.

Typically, the IT department contains the group tasked with data security management. Data security is one compelling reason for consolidating data system operations in the IT group. The IT department needs to partner with stakeholders to maintain an impenetrable data security perimeter that allows robust access to those with authorized access and swift denial of service to any unauthorized access attempts.

2.3.5 Challenge: Training Needs Are Not Fully Met

Compared with other airport systems and services (such as power or air conditioning), IT systems appear to have a disproportionately high need for training, which equates to time and cost. Higher training costs for IT systems are understandable when considering the number of users to be trained. Training on a new electrical system, for example, is generally confined to facilities and maintenance staff, whereas both the IT support staff and all users must be trained when a new email system or improved suite of desktop tools is added to users' computers. The training may not be as intense as for a new generator or facility management system, but it covers a much larger group with various levels of IT comfort and proficiency.

The value of training is often underestimated, partly because of the lack of understanding of the need, the associated costs, and the CIO's focus falling more on the system than the user. Providing quality training and supporting documentation are key concerns of the stakeholders.

Solution: Make Training Accessible and Meaningful to the User

There are a number of solutions to this problem.

- Employ professional trainers. Because IT staff are not necessarily the best when it comes to teaching a large, diverse group of users how to work with a new system, it's helpful to hire outside training professionals.
- Train a trainer. Training is often a one-time scheduled event, offered when the system is implemented. However, circumstances arise that prevent everyone who needs training from attending. Also, new employees joining the staff after training has been completed need to be trained. Therefore, a means is necessary for providing additional training after scheduled classes have been completed. A solution is training someone to be a trainer. Designating a representative from the user organization who can offer future training to those in need helps ensure the successful operation of new systems.
- Set realistic training-cost expectations. Every IT project will include some level of training (user, operations, maintenance, and administration). The CIO and others should begin to establish the training requirements from the beginning of the project, including cost, number of people, number of classes, and level of detail. Draw upon experience or benchmarking against similar projects or work done at other airports to establish these requirements.
- Provide good reference materials. As a standard practice, any new system should be delivered with a set of training manuals and user manuals well before the system goes live. These manuals should be reviewed by both the CIO and nontechnical users to identify any shortcomings before the material is disseminated.

Helpful Tip #11
Don't forget to include training time and costs of the stakeholder labor when developing total lifecycle costs (Section 5.3).

Helpful Tip #12
A comprehensive project management plan (PMP) is key to successful project execution. A PMP template can be found in Appendix A.

One airport discussed a particularly successful training session:

> The IT division provided ample training and screen shots of what to expect prior to the cutover. The change from one version of Microsoft Office to another was virtually seamless.

2.3.6 Challenge: Projects Are Not Well Managed

There are many sources of program management methodologies and best practices. The Program Management Institute is a well-respected source. Although most airports have project management procedures, research for this primer indicated that many problems occur because these procedures are not followed. In addition, the assigned project managers are often subject matter experts who are not trained in project management. These two issues combined result in projects with a poorly defined scope that fall behind schedule and run over the budgeted costs. This problem is not specific to IT systems, but the complexities of interdepartmental coordination and budgets make project management for IT systems that much harder.

Solution: Establish and Adhere to a Standard Project Management Process

The following activities can help ensure the implementation of successful projects:

- Take time to organize a repeatable, consistent, and routine project management methodology. This will enable the CIO, CEO, and stakeholders to execute projects in an even-handed, consistent way. Keeping the process simple and repeatable typically saves the project manager many hours of work. Having all organizations use the same process helps ensure an understanding of the tasks, achieve a common set of expectations for project managers, and establish a standard reporting methodology for multi-organizational projects.
- Use documented and structured review processes to manage projects. If the structured review process does not include an IT component, add it, and include the IT department as a regular participant in reviews and project management processes.

- Provide project management training for staff. In situations where IT must both manage projects and operate systems, train selected IT professionals in project management techniques. Establish a means for these IT professionals to be mentored by experienced project managers within the airport organization.

An adage says that the three most important rules of project management are to "communicate, communicate, and communicate." Proper project management techniques and practices, including regular reporting, achieve this goal, as demonstrated in the following story:

> The airport hired a consultant to evaluate the airport's existing IT system and to make recommendations for future expansion. One of the items discovered was the lack of redundancy due to the airport's fiber optic backbone not being connected to form a continuous loop. Another issue was that some of the fiber optic ends were not properly terminated. Although these were not a major concern, it was determined they needed correcting prior to a major upgrade of the airport's access control system planned for later in the year. Airport staff and contractors met to determine the best solution to solve these problems. The process was carefully planned, a schedule was developed, and the responsibility of each participant was determined. Coordination was established to allow for material and labor lead time and to have the project completed prior to the upgrade of the access control system. The project was completed on time and without any issues. This just shows how proper planning and coordination can expedite and simplify a project.

2.3.7 Challenge: IT Department Roles and Responsibilities Are Often Unclear

In airports today, so many systems include IT aspects that it's a huge challenge to determine roles and responsibilities throughout each phase of the system lifecycle, including which organization takes the lead on funding, planning, implementation, operations, and maintenance as the project progresses. Different approaches can be used depending on the airport or the project. In some cases the IT department owns, operates, and maintains a system; in others the stakeholder owns and operates the system but IT maintains it. The result is a lack of consistency in executing and operating projects. Lack of clarity in ownership and responsibilities can lead to inadequate budgeting for both capital and maintenance costs.

Solution: Clarify Roles and Responsibilities for All Phases of System Lifecycle and Budget

Before undertaking an IT project, airport executives must understand and agree on ownership. IT organizations' roles may vary, as evidenced by the following statements from different groups:

- The IT role includes researching, acquiring, implementing, and supporting technology. Infrastructure and integration systems are best owned and operated by IT. Application systems are best owned and operated by end users and supported by IT.
- IT is a service provider and business partner to stakeholders and/or users.
- IT works to help stakeholders enable their business visions and needs.
- IT is a technical enablement organization and a provider of a sound technical infrastructure. We enable other teams to use a variety of technical tools to perform their mission.

One single, correct solution to IT organization and project ownership probably doesn't exist. Circumstances, department size, and management styles, among other things, dictate how a department runs. However, if the system responsibilities are fractured—i.e., spread across many different organizations or managed by different groups on a project-by-project basis—the airport management should consider reviewing practices and policies and developing a streamlined process with an identified management team.

To assist in this process, the five primary roles that must be undertaken during a system's lifecycle are outlined in the following. These roles may be assigned to many different organizations and tailored to meet the specific needs of the management structure, but they must be clearly assigned, either across the airport departments or on a project basis, to avoid confusion of responsibilities.

- **System sponsor.** This role includes:
  - Championing the system to senior staff.
  - Providing funding for the system during the planning and implementation phases.
  - Developing the project scope and value proposition.
- **System implementer.** This role involves:
  - Project management for the systems implementation phase.
  - Overseeing and developing procurement documentation (either performed in-house or through outside resources).
  - Managing physical installation.
  - Activating and commissioning the system.
  - Managing final project acceptance.
- **End users.** End users are the beneficiaries of the system and make use of the system on a day-to-day basis; they are the best source of information about its functionality and problems. End users should be involved in initial planning, developing system requirements, and developing the concept of operations.
- **Operations and maintenance funding source.** This group provides financial support for operating and maintaining the IT system from acceptance until it is replaced or discontinued, including managing the budget, third-party contracts, and service level agreements.
- **System administrator.** Overall system configuration, operation, and maintenance fall within this role, which may be different from the funding organization.

Helpful Tip #13
Avoid organizational conflicts by using the checklist in Chapter 1 to ensure that roles and responsibilities have been assigned for all phases of the lifecycle.

2.3.8 Challenge: New System Benefits Are Not Measured

Once a project is complete, it is not always clear whether the time and effort resulted in achieving the benefits expected. Benefits may fail to be delivered or metrics may not be measured for a variety of reasons, such as:

- Benefits were not clearly stated or understood to begin with, or the value of a system was overestimated.
- Inadequate training may cause staff to be uncomfortable with the new system or to not use the new features available.
- The new system may cause new business process issues that are either cumbersome or risky, and staff are therefore reluctant to embrace it.

To illustrate the issue, consider an upgrade to a maintenance management system with the purpose of facilitating web-based entry of work orders and the ability to retrieve and close out work orders in the field. Were the goals achieved, or did lack of training cause the work orders to continue being delivered in paper form? Is the staff still completing and turning in paper records?

Solution: Set Measurable Performance Metrics

The key to resolving this problem is two-fold:

- Clearly state the expected benefits and goals at the start of the project and adjust them if the program changes.
- Define performance metrics that can be measured before and after the project.

From the example of the maintenance management system cited previously, the goals of the upgrade and some key performance metrics are provided in Table 2-6.

Metrics can be measured reliably to gauge performance of the system or process. These metrics must be implemented and measured before and after system cutover so that improvements can be calculated.

One good source of metrics (and the means to take action when they are not met) is a service level agreement (SLA). If an SLA is made part of the vendor agreement, the vendor has strong motivation to collect data and take corrective action to address deficiencies.

Helpful Tip #14
Developing service level agreements and enforcing them is vital to attaining the system performance and system benefits promised.

Table 2-6. Typical key performance metrics and measures.

Performance Metric	Current Value	Project Goal
Number of work orders per week	125 work orders	12% increase to 140 work orders (because submission will become easier)
Percentage of orders placed electronically	0%	At least 75% after 3 months
Time to close out a work order from receipt of work order to receipt of technician's close out	7.3 business hours	20% reduction to 5.5 hours
Customer satisfaction as measured by quarterly survey	C+ as measured in Q3 survey	A- or better based on Q1 survey
Hours spent per work order	2.5 hours	20% reduction to 2 hours or less

In Table 2-6, time spent per work order is a financial metric that directly affects the bottom line. This 20% reduction in average labor per work order will get the CFO's focus.

Measuring the hours per work order reduction requires actually measuring the work hours performed. Most airports measure the work hours of maintenance staff, but often that is a payroll function and the work hours for each ticket may not be counted. Efforts must be made to ensure that metrics are collected to measure the benefits achieved.

Establishing an expected benefit and checking that it has been realized is important in determining a project's success.

2.4 CEO–Stakeholder Communication

It may seem unnecessary to discuss CEO–stakeholder communication because interactions between these two parties do not typically involve IT. However, IT is necessary for stakeholders to perform their work, and thus the subject of IT will invariably come up at some point between CEOs and stakeholders. However, one cannot discuss IT-related communication between CEOs and stakeholders without focusing squarely on the CIO, who plays a critical role in putting IT systems in place. CEOs and stakeholders should make an effort to engage in regular conversations about IT and to include CIOs in the discussions, whether through regular meetings or in formal reviews. It's also important to ensure that stakeholders contribute to airport and IT master plans to be sure their needs and expectations for IT are addressed. The perspectives of the CEO and stakeholders are represented in Table 2-7.

The perspectives discussed so far in this section lead to common communication challenges regarding IT between the CEO and stakeholder executives. These challenges and suggested solutions are discussed in more detail in the following.

Table 2-7. CEO–stakeholder perspectives.

WHAT THE CEO WANTS THE STAKEHOLDER TO UNDERSTAND
Capital resources are limited and have to be applied where best for the whole airport.
Stakeholders need to partner with the CIO for successful projects.
Stakeholders must consider all costs of a proposed IT project, especially their own.
CIOs need appropriate representation in the management decision process.
WHAT THE STAKEHOLDER WANTS THE CEO TO UNDERSTAND
Information technology has to serve the operating departments of the airport.
IT systems have impacts on stakeholder budgets and efficiency.
IT projects need to allow for proper training of stakeholder staff.
The CIO needs to understand airport business and operations as well as technology.

2.4.1 Challenge: Competition for Limited Capital Resources

IT projects, like most other airport projects, must compete for limited funding. It is very difficult to compare the "apples" of renovating a building versus the "oranges" of implementing a new server architecture. CIOs and stakeholders each have valid reasons for promoting their project ideas, but that doesn't change the CEO's reality of limited capital funding.

This is further complicated by the fact that everything isn't always based on ROI. Airports are heavily regulated and often subject to making capital improvements for compliance rather than economic purposes.

Solution: Use Uniform Project Evaluation

Airports that are demonstrating best practices in this area have developed a uniform project scoring/evaluation form. This summary identifies the high-level financial value, compliance, strategic value, and risks associated with a project. A weighting system allows the airport to adjust the relative importance of certain factors over time and yet evaluate all projects using the same criteria.

If used for all projects (not just IT projects), these normalizing schemes allow management to rank projects in a consistent fashion. CEOs can use this technique to socialize project value amongst all stakeholders (including the CIO).

An added benefit of this approach is that stakeholders can self-score their projects and find ways to enhance their value, perhaps through collaboration with one another.

See Figure 5-2 for a sample scoring sheet.

2.4.2 Challenge: Managing Impacts of IT Projects on Stakeholder Staff

Most information technology projects do not happen in isolation. Stakeholders sometimes complain that change in information technology systems affects their operations in unintended ways. Typical impacts on stakeholder departments are:

- Additional information that now has to be entered to make an IT system effective.
- The meaning of some data elements has to change slightly so that all departments use it the same way.
- Additional training is required so that staff can properly use the system and thus get the desired benefits.
- New data security protocols need to be followed for IT systems.

Solution: CEOs Should Encourage Partnership with CIOs

Earlier sections have focused on the importance of the CIO–stakeholder partnership, and it is only through this partnership that unintended consequences of IT projects can be identified and mitigated. However, it is not entirely the CIO's responsibility to make this happen.

The CEO needs to foster an environment at the airport where stakeholders are expected to participate in the development of IT projects and CIOs are expected to be actively engaged in stakeholder projects. This can be achieved through a number of communication-enabling methods:

- CEOs can require stakeholders to attend regular status meetings that cover IT as well as other programs.
- CEOs can require stakeholders to involve CIOs in their regular status meetings.
- CEOs can invite CIOs to the executive management meetings.

The situation at each airport and the readiness of some CIOs to handle executive responsibilities may determine which of these approaches will work for a given airport. However, setting a corporate expectation that good communication occur with IT is the responsibility of the CEO.

As projects approach the funding stage, CEOs should ask stakeholders if they have been engaged in the development of the concept of operations and value proposition and if they believe that all of their staff training and operational impacts have been considered.

2.4.3 Challenge: IT Affects Stakeholder Budgets

IT projects can often have operational impacts on stakeholder organizations and their budgets. Examples of such impacts are:

- Increased labor cost due to revised business processes or new data-entry demands.
- Decreased labor costs due to efficiencies gained by the IT system.
- Retirement of operational costs of existing non-IT systems.
- Bumps in labor cost due to project involvement and training.
- Increased operational costs due to ongoing training.

These often unforeseen costs can leave stakeholders frustrated with IT systems and understaffed to perform their primary function.

Solution: Use the Budget Process to Incorporate Changes

As stakeholders and CEOs negotiate their budgets, stakeholders should look back to value propositions as tacit executive approval for increased staffing. During the project formulation phase, as value propositions and concepts of operation are developed, there are implied impacts to stakeholder budgets. Stakeholders should refer back to these documents to justify to CEOs any changes in head count and other operational costs related to the execution of IT projects.

The reverse is also true. CEOs should use agreements formed with stakeholders during project formulation to reduce budgets based on efficiencies promised by deployment of information technology. Surprisingly, this follow-up step is rarely done, and savings go unrealized.

2.4.4 Challenge: Airport Language Is Not Always Well Understood

The language of airports is unique. CEOs and stakeholders may be fluent in airport terminology and jargon, but for CIOs, who often come to aviation from an outside industry, the language of airports and the details of how airports are run may pose a challenge. For example, the way that rates and charges are set is complex, and the influences on IT from the governing organization may be new to a CIO transplanted from private enterprise.

For that matter, the terminology used in the development of a terminal is different from that used in the development of IT. Table 2-8 provides simple examples showing the different names given to the stages of project development for a facility versus an IT system. It's easy to see how IT professionals who are not familiar with airport terminology and how airport personnel who are not familiar with IT terminology can be misunderstood.

Solution: Help the CIO Understand the Business Model

Early in this chapter, a key message delivered to CIOs was to find a common language with which to speak with the CEO and stakeholders. This same solution applies to CEOs and stakeholders, who must help CIOs understand both the terminology and the business model of airports. The better the CIO understands the business model, the better he or she will be able to speak in terms that are understood by everyone on the team and to contribute IT solutions that offer business benefits.

2.4.5 Challenge: The CIO Must Be Positioned Effectively in the Organization

Because IT is so important within airports, the prime advocate for IT needs to have good access to executive management, specifically the CEO. Research for this primer reveals that CIOs are not reliably in the same organizational department across airports. Data show that CIOs report to the CEO less than half the time. This limits the IT department's ability to communicate effectively and can contribute to some of the other communication issues identified in this primer, including challenges that CEOs and stakeholders encounter when they are discussing IT.

Solution: CIOs Need to Be Senior Executives

Providing CIOs with a level of authority that gives them good access to the CEO and other members of the executive management team is a successful approach to bridging communication gaps.

Table 2-8. Language comparison for buildings and computer systems.

Stages of Architectural Design (Facility)	Stages of Technology Design (IT)
Concept design	Statement of need
Schematic design	Requirements definition
Detailed design	Engineering design
Construction design	Procurement
Bid award	Implementation
Construction	Testing
Commissioning	Cutover
Operations and maintenance	Operations and maintenance

It recognizes that IT is essential to successfully operating the airport and takes into account the role IT plays in every aspect of the airport.

The most direct means for granting access and authority is to promote the CIO to an executive position. The CIO's activities can be refocused to a higher level, and a senior IT manager can take responsibility for the IT department's daily operations and activities. In this way, when the CEO and stakeholder are discussing IT matters, the CIO can bring an executive perspective to the table.

If such a change is not practical or possible within the airport's structure, the CIO should at least have a direct means of access to the CEO to ensure that the CEO has a full and complete understanding of the high-level issues, operations, and plans for IT at the airport.

CHAPTER 3

The IT System Lifecycle—A Common Process

3.1 Introduction

This chapter introduces fundamental concepts of the IT system lifecycle that can be applied to the aviation industry. As implied by its name, the lifecycle is the process of managing the entire life of a system, from its conception through design, implementation, and ongoing operations until it is removed or replaced. Following a standard process in a deliberate, structured, and methodical way integrates people, data, and business systems from all areas of the airport and can generate a high-quality system that brings the following benefits:

- Meets or exceeds customer expectations.
- Reaches completion within time and cost estimates.
- Works effectively and efficiently within established IT principles and infrastructure.
- Is cost-effective to operate and maintain.

Much has been written about system lifecycles, and many names have been applied to the phases and documentation that result from following a standard process. Regardless of the names, the lifecycle is a sequence of stages in which the output of each stage becomes the input for the next. There is no one definitive lifecycle model, but the stages generally follow the same basic steps, which, for the purposes of the primer, have been simplified into four key phases:

- Strategic planning
- System planning
- Implementation
- Operations and maintenance (O&M)

Identifying requirements accurately and completely for a new system is vital to its successful implementation. Requirements are defined in progressively greater detail in each of the first three phases. At each phase, consensus between stakeholders and IT departments should be reached. The activities performed and the outputs of each phase are depicted in Figure 3-1.

The reality of IT system lifecycle implementation is more complex than Figure 3-1 shows. People and departments cannot perform their tasks in isolation, and the activities do not flow sequentially, with one starting only after the previous one is finished. Many activities are carried out in an iterative process until all parties can agree on the outcome.

The lifecycle portrayed here provides a common process that all organizations can implement to reduce time and costs, resolve conflicts faster, and create a commonly understood set of documentation supporting all systems.

The following sections give a high-level description of each phase in the IT system lifecycle, including inputs, activities, and outputs. Outlines and templates of many of the lifecycle documents referenced in the text are included in Appendix A.

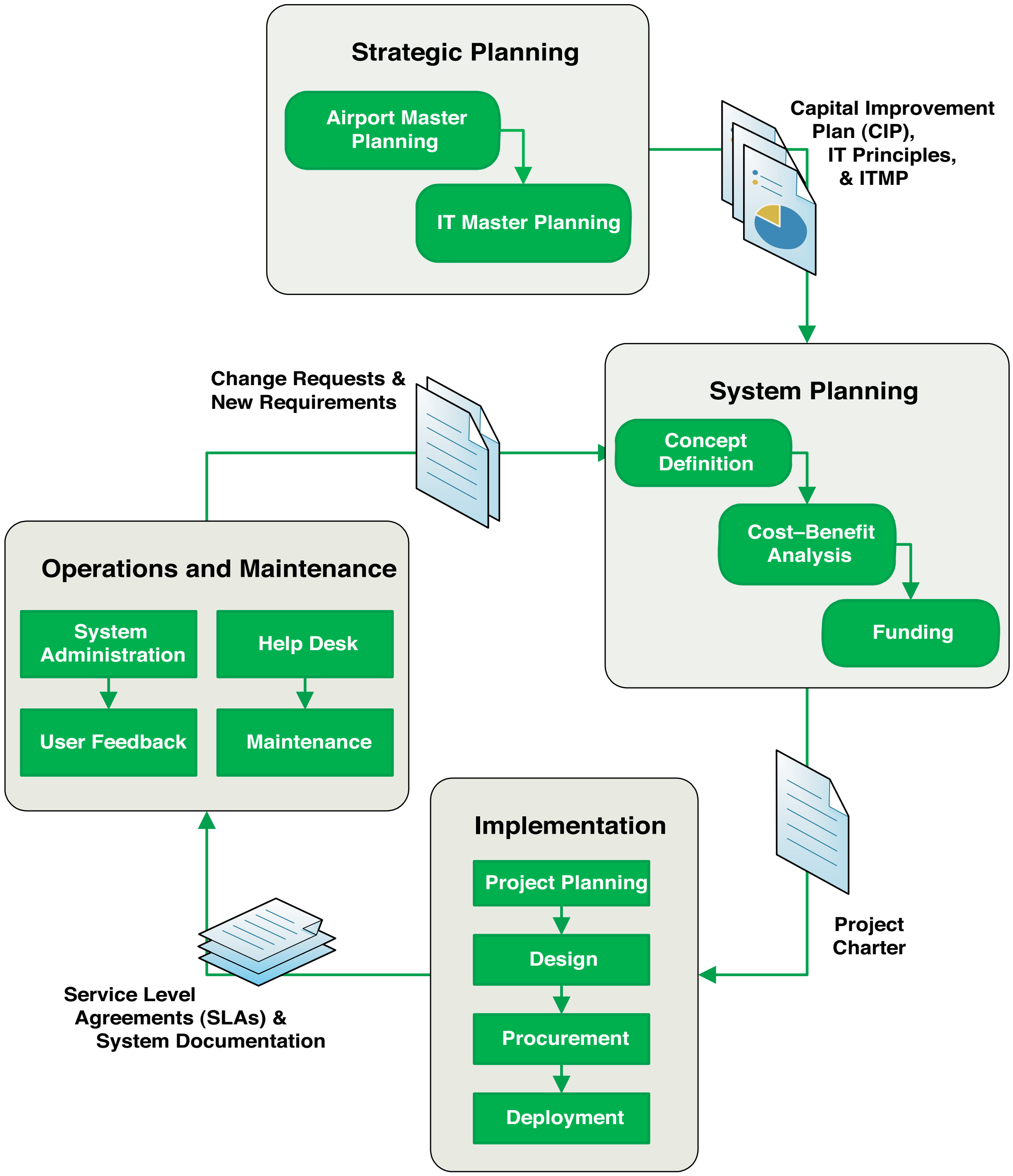


Figure 3-1. IT system lifecycle.

3.2 Strategic Planning

Strategic planning is the coordinated process by which the high-level aims of an organization are translated into individual projects. This phase is usually performed annually to establish or update the goals and high-level plans for the entire airport, including IT. Within the strategic planning phase, key tasks to accomplish include:

- Airport master planning
- IT master planning

Figure 3-2 depicts the activities and outputs of the strategic planning phase.

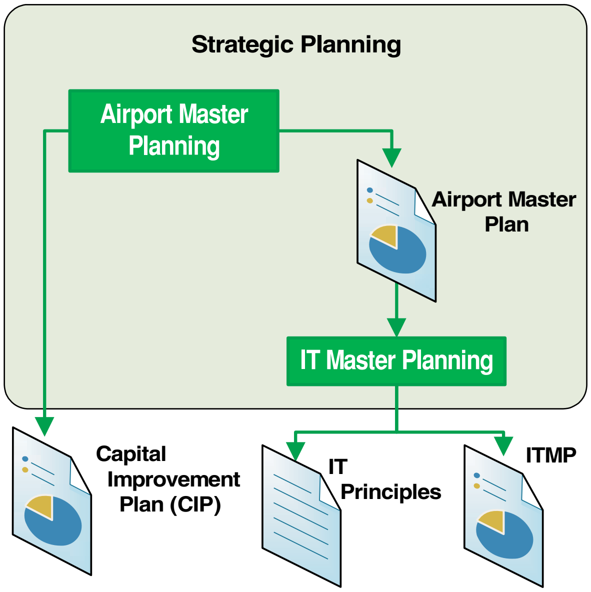


Figure 3-2. Strategic planning phase.

3.2.1 Airport Master Planning

Airport master planning is the first step in the strategic planning phase. It is the initial activity that determines the current and future needs of the airport, translates these needs into airport projects and programs, and sets financial investment strategies for the planning period. The results of this step should include the following:

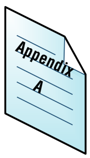
- **Airport goals.** The airport goals document takes the needs and deficiencies of an airport and creates the positive statements necessary to address them. It is vital that the airport goals developed be concrete and actionable. They should specify the anticipated beneficiaries and provide target metrics to measure success. Vague goals such as "better customer service" are difficult to translate into actions because they fail to specify the target audience (who the customer is) and the degree of improvement required ("better" can include marginal improvements). Examples of well-formulated goals are "Handle 10% more passengers with the existing terminal infrastructure within four years," "Grow parking revenue 6% over the next three years," and "Reduce inaccurate flight information complaints 30% next year."
- **Airport master plan (AMP).** An airport master plan is a long-term, multi-year document that takes the goals of an airport and maps them to major programs and projects. The aim of an AMP is to create a blueprint showing the intended state of an airport at the end of the planning period. AMPs are updated periodically to alter assumptions and ensure continued eligibility for FAA AIP grants. Future IT projects are often explicitly included or dramatically affected by the programs planned in the AMP.
- **Capital improvement plan (CIP).** A capital improvement plan is a medium-term document that selects individual projects, often from the AMP, and develops preliminary, high-level financing strategies. Available funds, the ability to raise revenue, and potential debt placement are considerations that must be evaluated in the document when projects are being prioritized. The CIP serves as an intermediate step between the long-term strategic plan provided in an AMP and the airport's annual budget.

These outputs are all used as input to the next step, IT master planning.

3.2.2 IT Master Planning

IT master planning is the step that translates the airport goals and projects proposed in the airport master plan and the capital improvement plan into the realm of information technology. It is an ongoing process that derives IT requirements from the airport master plan for new projects and the intrinsic replacement/updating needs of the IT infrastructure. Results of this step include:

- **IT principles.** IT principles are the guiding rules that govern how information technology is deployed and maintained at an airport. They directly reflect the airport goals and represent overarching practices that ensure airport planning aims are achieved. Sample IT principles are provided in Chapter 4.



- **IT master plan (ITMP).** The ITMP is built from the airport master plan. It explicitly addresses the IT systems of an airport and distills AMP programs down to the specific information technology components. Like an AMP, an ITMP is a long-term, multi-year document that builds an image of the state of IT at the end of the projected period. Projects appropriate to an ITMP may be directly addressed in an AMP but are more commonly derived from larger scopes (e.g., calculating the network growth necessary to accommodate a parking garage expansion). Table 3-1 gives examples of strategic airport goals that can be enabled by IT.

The ITMP, CIP, and IT principles established in the strategic planning phase are often used to establish an IT road map for new systems and enhancements. The ITMP and its road map, along with change requests and new requirements derived from ongoing operations, are inputs to the next phase, system planning.

3.3 System Planning Phase

Unlike the strategic planning phase, which deals with total airport planning and multiple systems, the system planning phase and subsequent lifecycle phases deal with one system at a time and are reiterated for each system being considered.

The system planning phase encompasses all tasks that must be completed before an airport can begin implementing an IT project. The system planning phase starts when a formal request is made for an IT solution that meets a valid new requirement or change to an existing system. Within the system planning phase, goals to accomplish include:

- Create a high-level concept definition of the system.
- Evaluate each system based on economic, operational, and technical feasibility.
- Evaluate the benefits and value of the system.
- Establish funding mechanisms.

Figure 3-3 depicts the activities of the system planning phase.

Table 3-1. Examples of airport goals enabled by IT.

Airport Goal	ITMP Project
Handle 10% more passengers with existing terminal	Implement common use technology
Increase parking garage use and revenue over next 3 years	Add pay-on-foot stations and E-Z Pass to allow faster egress
Increase non-aviation income to 75% of total gross revenue	Expand existing local area network (LAN), telephone, and closed circuit television (CCTV) to shared use

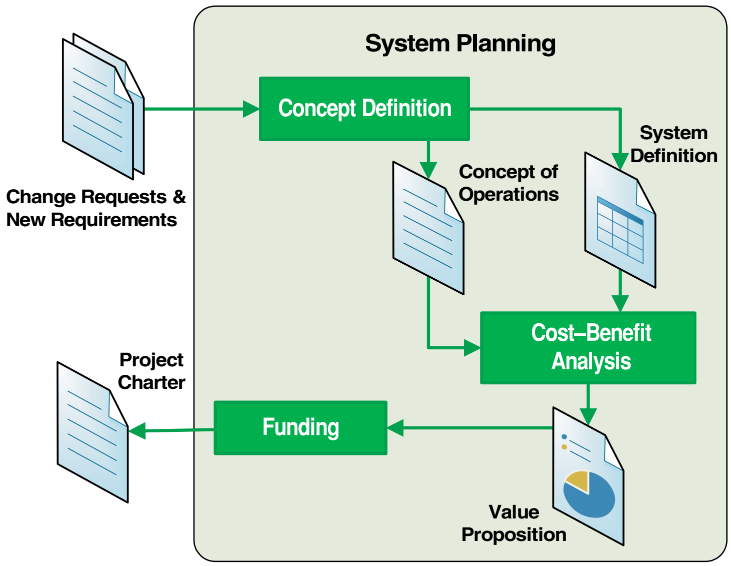


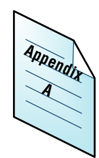
Figure 3-3. System planning phase.

3.3.1 Concept Definition

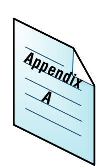
The first activity of the system planning phase is concept definition. The goals of concept definition are to further refine the initial request for an IT system, clarify the project goals and scope, and establish how the system will be operated. Documents that must be developed during this stage are:

- **Concept of operations (CONOP).** This document is a conceptual overview of how the proposed IT system will operate within the airport environment. It describes how the proposed IT system will interact with other systems as well as the burdens the new system will impose on responsible people or departments. The CONOP outlines specific roles and responsibilities of stakeholders, end users, system administrators, and others, and identifies processes and procedures that may need to be developed. Questions the CONOP addresses include:
  - Who will install the system?
  - Who will put data into the system?
  - Who will monitor the system and take action if there is a problem?
  - Who will take calls from users who have a problem using the system?
  - Who will actually fix parts of the system when they are broken?
  - Who will provide regular service (cleaning, restocking, lubricating) for the mechanical portions of the system?
  - Who will provide regular service for the software and data such as backups and updates?
  - Who needs to get data out of the system?
  - Who is going to monitor the quality control of the system?

  The CONOP is a very people-focused document describing how people and organizations will interact in the day-to-day operations of the system.



- **System definition.** This document is the first attempt to define the requirements of the system, including functional features, performance characteristics, other systems with which this system must interoperate, and important environmental considerations. These are all defined to the degree necessary for an initial budget to be developed later in the system planning phase. The system definition becomes the basis for discussing the system's primary features and a starting



point for a more-detailed requirements definition once the project is funded. The system definition should address:

- A system overview from the stakeholder's perspective.
- The business area of the new system.
- The needs the system will meet, mapped to the AMP or ITMP.
- The systems relationship or interactions with other systems or entities.
- Performance characteristics.
- Support elements such as maintenance, training, manpower, and other resources needed.
- Description of design considerations such as disaster planning, security, operational environment, and regulatory constraints.
- Desired acquisition strategy and schedule.

The system definition must adequately express the needs of the users requesting the system and should tie directly to the strategic objectives of the airport.

3.3.2 Cost–Benefit Analysis

Having completed the system definition and CONOP, it is time to develop the budget and define the benefits of the new system. These will be used to evaluate the system by performing a cost–benefit analysis. Evaluating the value of proposed systems is one of the more difficult tasks airport executives undertake. Chapter 5, Evaluating IT Investments, describes a detailed process and provides a standard scoring mechanism that airports can use to perform this activity, which is summarized here for completeness of the lifecycle description.

There is a four-step methodology to performing a cost–benefit analysis:

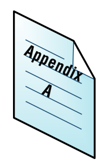
1. **Document system benefits.** The system benefits are the most important component when evaluating the value of a system. Without benefits there would be no reason to invest in the system. It's important for stakeholders to agree on the expected benefits so they will support the value that is assigned. Some benefits have financial value, and others have intangible value that cannot be expressed in monetary terms. Make every effort to find the hidden financial value in nonfinancial benefits.
2. **Determine TLC.** A key factor in deciding to invest in a new system is the cost. Often capital (one-time) costs are the only costs used when making investment decisions. However, ongoing operations and maintenance costs should also be considered when evaluating a new system because many of the system benefits are derived during the O&M phase. The TLC of a system is defined as the sum of all one-time (nonrecurring) costs and recurring costs over the full life span of a system. For IT systems, the life span is usually only 3 to 7 years.
3. **Perform the cost–benefit analysis.** After the system benefits and TLC have been determined, a cost–benefit analysis can be performed. The TLC is weighed against the system's total expected benefits to determine if there is a positive return. Figure 3-4 shows a sample cost–benefit analysis. The formulas for the cost–benefit analysis can be complex and should be implemented by CFOs.
    a. Lines 1 through 3 represent the one-time costs of the system, and lines 4 through 7 represent the net of the recurring costs and the projected financial benefits of the system. From this data, three valuation criteria can be calculated: net present value (NPV), internal rate of return (IRR), and break-even point.
    b. **Net present value** brings all project costs into the present. If the result is positive, the project is worth doing.
    c. **Internal rate of return** is used to measure the profitability of investments. The higher a project's IRR, the more desirable it is to undertake.
    d. **Break-even point** determines the point in time that total savings resulting from the system benefits surpass the costs of implementing the system. Most airports look for payback periods in the 3-year time frame.

Example Analysis		One Time	Recurring (Annually) 1	2	3	4	5	6	7
1	Project Direct Capital Costs	$ (100,000)							
2	Project Labor Costs	$ (25,000)							
3	Outside Funding	$ 50,000							
4	Net Change to Revenue		$ -	$ -	$ 5,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
5	Net Change to Direct O&M Costs		$ 4,000	$ 7,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000
6	Net Change to O&M Labor Costs		$ 2,000	$ 3,000	$ 3,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
7	Interest on Capital Avoidance		$ 6,500	$ 6,500	$ 6,500	$ 6,500	$ 6,500	$ 6,500	$ 6,500
8	Net Cash Flow	$ (75,000)	$ 12,500	$ 16,500	$ 20,500	$ 24,500	$ 24,500	$ 24,500	$ 24,500
9	Cumulative Cash Flow	$ (75,000)	$ (62,500)	$ (46,000)	$ (25,500)	$ (1,000)	$ 23,500	$ 48,000	$ 72,500
10	Net Present Value	$ 9,799		Assumptions:					
11	Internal Rate of Return	8.8%		Evaluation Period Is		5	Years		
12	Break-Even Point	3.8	years	Assumed Cost of Money		4.50%			

Figure 3-4. Sample cost–benefit analysis.

4. **Score system values objectively.** The cost–benefit analysis discussed only takes into account benefits that can be quantified in terms of financial savings. When evaluating a potential investment in a system, the nonfinancial benefits need to be considered too. Refer to Chapter 5 for a score sheet that includes both nonfinancial benefits and valuation data from the cost–benefit analysis.

Upon completing the cost–benefit analysis, the results should be documented in a value proposition. The value proposition is the key document for obtaining funding. Intended for management and financial audiences, the value proposition document should provide a compelling argument as to why the system is needed. In the value proposition, be sure to include a summary of the system definition and CONOP (in case the value proposition is the first document the reader sees) and a list of stakeholders with a description of their interest in the system.



3.3.3 Funding

As the value proposition takes shape, potential funding sources are important to consider. There are many possibilities, so it's helpful to work in collaboration with the finance department to determine which sources are appropriate for the project. Table 3-2 examines typical funding sources for an airport IT infrastructure.

Stand-alone IT projects (ones not associated with a large construction project) typically use airport funding. Often, the finance department will want to put the IT project into a larger capital plan, which helps the airport organize and coordinate its funding applications but may delay an urgent project. This is a great opportunity to use the IT master plan to coordinate funding in the capital program so that outside funding is available when the project is slated to begin.

Once the funding mechanisms are determined, the value proposition can be completed and a decision made about the overall value of the project in light of the following:

- Available capital funding and external funding.
- The stand-alone merits of this project based on its financial and nonfinancial value.
- The relative merits of this project compared with others vying for the same funding.

If the project is selected for execution, a project charter is created that restates the project scope, schedule, and budget and names the project manager and his or her authority to run the project. Issuing the project charter transitions the project from the system planning phase of the IT system lifecycle to the implementation phase. Table 3-3 provides a management project

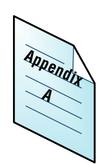


Table 3-2. Typical funding sources.

Administrator	Type	Funding Source	Restrictions	Other Comments
FAA	AIP grant	U.S. Congress Airport and Airway Trust Fund, funded by taxes on passengers, cargo, and fuel	Cannot be used to generate revenue	
	Passenger facility charge	Monies collected through PFC charges by airlines	Must be used to preserve or enhance safety, security, or capacity or reduce/mitigate noise	
Transportation Security Administration (TSA)	Cooperative research and development agreement	Congressionally approved funds	Must improve airport security	Usually a split investment requiring the airport to match the federal funding
	Security technology grants		Must improve airport security	
State and Local Government	Grants or projects	Funds come from such sources as state aviation fuel and airline property taxes, aircraft registration fees, state bonds, and state general fund appropriations.		
Airport	Tax-exempt bond issuance			It is common for cities, counties, states, and airport authorities to issue bonds, but usually they are for large construction projects that may have IT components.
	Airport revenue and/or O&M budget			Essentially a non-capitalized project paid for entirely within O&M budgets or annual funds earmarked for projects

Table 3-3. System planning phase checklist.

ITEM	QUESTIONS FOR SYSTEM PLANNING PHASE	☑
1	Does the project support airport strategic goals?	
2	Does project fit into airport master plan?	
3	Has a *system definition* and *concept of operations* been written?	
4	Have project responsibilities for funding, implementing, and operating been assigned?	
5	Have all stakeholders been identified and coordinated with?	
6	Have potential impacts been identified (e.g., other systems, projects, staffing, contracts)?	
7	Has the *value proposition* been presented (budget, ROI, benefits)?	
8	Have funding sources been identified?	

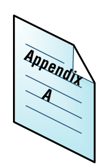
checklist for ensuring that all the necessary activities have been completed and the appropriate documents created during the system planning phase.

3.4 Implementation Phase

The implementation phase, which involves all efforts to manage, design, acquire, and deploy a new system, has four sequential activities, depicted in Figure 3-5.

3.4.1 Project Planning

The main challenge of project planning is to stay within all project constraints (time, budget, and scope) while achieving the desired goals. A critical tool developed at this stage is the project management plan, which serves as a guide for implementing the project methodically from start to finish.



- **Project management plan.** Guides all aspects of the implementation phase. Delineates how the internal project team will be organized, breaks down activities and tasks to be carried out, estimates the level of effort and funds required to complete each task, and provides detailed task schedules. Every project plan should:
  - Define scope and objectives clearly.
  - Define deliverables.
  - Create a detailed breakdown of each task from start to finish.
  - Identify the schedule for each task and dependencies among tasks.
  - Identify resources required to complete the project.
  - Estimate costs for each task involved in the project.
  - Discuss project communication channels.
  - Discuss risk management.

  For larger projects, several associated plans may be needed. Following is a list of plans for the project manager to consider developing in addition to the PMP.
- **Resource plan.** Identifies and allocates the resources needed to complete activities in the project plan. The resource plan should include people's roles and responsibilities, type and quantity of resources required (e.g., labor, equipment, and materials), and equipment specifications.

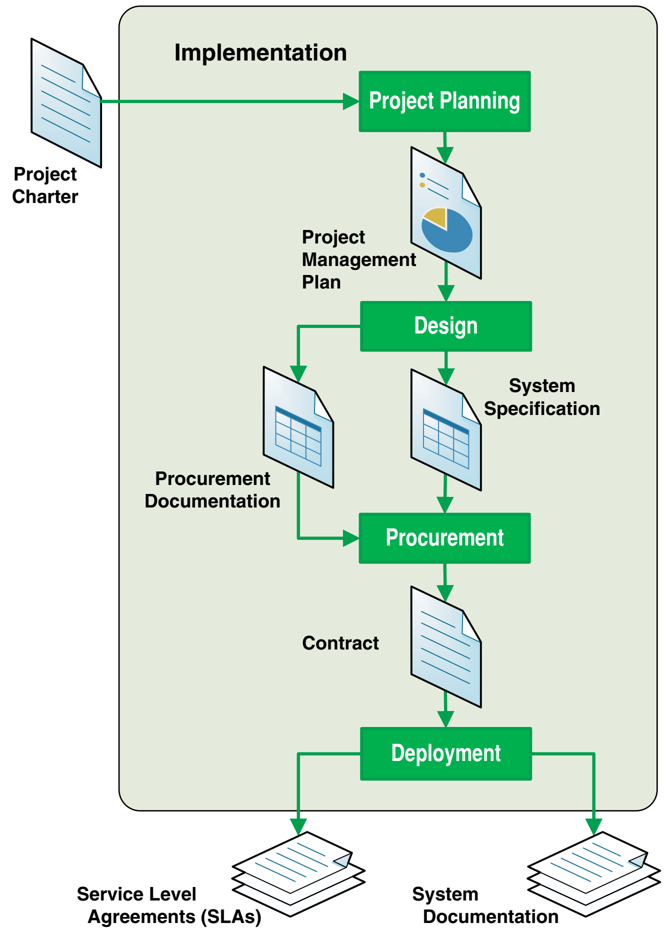


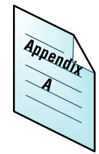
Figure 3-5. Implementation phase.

- **Quality management plan.** Defines quality expectations and clear quality goals for each deliverable and discusses the resources responsible for ensuring adherence to the plan.
- **Risk management plan.** Identifies all anticipated project risks and how they will be mitigated before the project is implemented.
- **Acceptance plan.** Outlines acceptance criteria indicating what is required for each deliverable to be successfully completed. This plan provides a schedule of acceptance reviews, giving stakeholders the opportunity to formally accept the original requirements.
- **Communications plan.** Establishes methods and procedures for informing stakeholders of project progress; includes the types of information to be distributed as well as the methods and frequency of distribution.
- **Procurement plan.** Describes the products to be acquired, outlines the product delivery schedule, and establishes the process for selecting vendors and procuring products.

3.4.2 Design

Once the PMP has been approved, system design activities can begin, including developing system specifications and completing procurement documentation (if the system is to be acquired).

Using the basic requirements agreed to during system planning and documented in the system definition, system designers must articulate detailed application requirements, functional requirements, performance requirements, and system integration requirements. Collecting detailed, accurate requirements may require multidisciplinary teams with representatives from multiple organizations. All stakeholders must agree on the system's functionality and performance requirements. The outputs of this stage include the following:



- **System specification.** Accurately and clearly defines the system's full attributes, functionality, and performance requirements. System specifications help to:
  - Establish agreement among planners, customers, and suppliers about how the system meets the requirements.
  - Provide a baseline for validating and verifying the system.
  - Facilitate transfer of the system to its owners and users.
  - Serve as a basis for later enhancements.

  Areas that should be addressed in the system specification include:
  - Expected functionality.
  - External interfaces.
  - Performance metrics.
  - Security requirements.
  - Environmental requirements.
  - Attributes of the system (portability, maintainability, business rules, etc.).
  - Specific design constraints (equipment to be used, standards, etc.).
  - Acceptance criteria or test scenarios.

  The system specification is the key document included in procurement documentation given to potential suppliers to define the requirements they are to meet. These requirements must be clearly stated and agreed on by all stakeholders before the system specification is released for procurement.
- **Procurement documentation.** When seeking competitive bids, be sure the procurement package has all necessary elements and is advertised appropriately to ensure adequate responses. Among items to include in the procurement package are:
  - Procurement instructions and schedule.
  - Proposal format requirements.
  - Pricing format requirements.
  - Vendor qualification and reference requirements.
  - Statement of work for the vendor to accomplish.
  - Bid evaluation criteria and selection methodology.
  - A sample of the contract to be signed.
  - A detailed system specification.
  - A draft SLA.
  - Minority business enterprise/disadvantaged business enterprise (MBE/DBE) objectives.
  - Bond requirements (bid and performance).

  The complexity and level of detail of procurement documents should be consistent with the value and risks of the system being procured. Procurement documents should be rigid enough to solicit consistent responses from proposers so that fair evaluations of the solutions can be made.

3.4.3 Procurement

The procurement process begins after the system specification and procurement documents are released to potential suppliers, who must be given adequate time to develop the required proposals and documentation. It is an intricate process that demands attention both to the time period allowed and solutions received to ensure that selection criteria are applied evenly.

When seeking competitive bids, be sure the procurement package contains all necessary elements and is advertised appropriately to ensure adequate responses. Strong attention must be given to local procurement rules and laws to ensure the process is fair. The culmination of this stage is the signing of a contract—the binding agreement between the firm selected to implement the system and the airport.

The proposed contract is often included in the procurement package to allow review by prospective respondents before they submit a legally binding response. Contract details vary between jurisdictions and airports, but standard features to include are:

- Schedule.
- Pricing and payment terms.
- Termination clauses.
- Indemnification and limitation of liability clauses.
- Insurance and performance bond requirements.
- Conflict of interest disclosure.
- Statement of nondiscrimination.
- MBE/DBE objectives.
- Acceptance criteria.
- Service level agreement and penalty clauses.
- Warranty and product support needs.

To these features, a statement of work is appended that specifies requirements the vendor must meet, including:

- Project management.
- Schedule.
- Reporting.
- Shipping.
- Installation.
- Testing.
- System cutover.
- Training.
- Operations and maintenance.
- Documentation (project management, system, user, administrator, training).
- System specification.

When the procurement process is completed, the PMP must be updated to reflect revisions to cost, scope, or schedule resulting from contract negotiations with the selected vendor.

3.4.4 Deployment

Deploying the system, the most complex task in the IT system lifecycle, is the culmination of the previous planning and documentation tasks, and it validates that all tasks have been completed correctly. Important steps in this phase include:

- Building the project team.
- Coordinating people and resources associated with the project.
- Monitoring progress.
- Loading necessary data from old systems.
- Identifying and correcting issues.
- Training end users and maintenance personnel.
- Monitoring contract performance (if the system has been procured from an outside vendor).
- Defining completion and acceptance criteria.
- Performing acceptance testing to ensure that the final product complies with specifications and requirements.
- Carrying out an operational readiness review to ensure that all logistical elements for operating and maintaining the system are in place (e.g., spares, consumables, staff, help desk).

Table 3-4. Typical system availabilities.

Goal	Typical Availability For	Monthly Outage	Annual Outage
99%	Networks	7.4 hours	3.6 days
99.5%	Telephone private lines	3.7 hours	1.8 days
99.9%	Private branch exchange (PBX) systems at airports	43 min	8.8 hours
99.999%	Air–ground communications systems	26 sec	5.3 min

- Ensuring that system documentation has been developed so that the system can be maintained and operated on an ongoing basis after it goes into service. These documents may include:
  - User manuals.
  - Operational manuals.
  - Technical manuals.
  - As-built drawings.
  - Training manuals.
  - System administration manuals.
  - Configuration management plan.
- Developing the service level agreement. The SLA defines the performance of the system in ways that are meaningful to the end user. It can serve as a contractual agreement between the IT department and its service vendors or as an expectation of performance by the IT department for its end users. Typical characteristics of an SLA include:
  - System availability. How many minutes or hours the system was available divided by the total minutes in the period, expressed as a percentage. Examples of typical system availabilities are provided in Table 3-4.
  - Response time for certain transactions, often measured in the 90th or 95th percentile. (e.g., "3 seconds or less in the 90th percentile" means that 90% of transactions had a response time of less than 3.0 seconds. The other 10% could have been very long.)
  - Measuring system capacity or utilization against an agreed goal.
  - Data throughput.
  - Number of transactions.
  - Accuracy of data.
  - Responsiveness of the vendor.
  - Number of active users.
  - Number of trouble tickets.
  - Mean time to repair (often confused with "mean time to respond," which does not include diagnosis or repair).

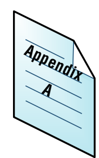


Table 3-5 provides a management project checklist for ensuring that all the necessary activities have been completed and the appropriate documents created during the implementation phase.

3.5 Operations and Maintenance Phase

The term *operations* refers to the ongoing use of the installed system to provide benefits enumerated in the value proposition and project charter. The O&M phase consists of the system's day-to-day operations as well as predictive and preventive maintenance such as periodically replacing hardware, deploying personnel to maintain the system, and putting end-user support processes, such as the help desk, in place. Figure 3-6 shows the activities occurring during the O&M phase.

Table 3-5. Implementation phase checklist.

ITEM	QUESTIONS FOR IMPLEMENTATION PHASE	☑
1	Has a project manager been named and given a project charter?	
2	Has a *project management plan* (with required cost, schedule, and resources) been approved by the stakeholders?	
3	Are there regular project reviews scheduled with stakeholders that discuss scope, schedule, cost, risks, issues, accomplishments, and goals?	
4	Has a *system specification* been approved by all stakeholders?	
5	Is source selection committee representative of key stakeholders?	
6	Has sufficient training (time and number of staff) been completed?	
7	Have operational procedures been coordinated with stakeholders?	

3.5.1 Help Desk

The help desk is the primary source of contact for users reporting technical malfunctions with a system. A service group for system users and administrators, the help desk leads and coordinates both in-house and external troubleshooting efforts. Problems are documented in the form of trouble tickets, which are tracked and acted upon until the problem is successfully resolved.

- Procedures and processes to be developed for help-desk support should include, at a minimum:
  - Hours of help-desk operation and after-hours support process.
  - End-user processes for notification of system failures.
  - End-user processes for new service or changes to existing service.
  - Internal processes for level 1 troubleshooting.
  - Internal processes for escalating problems above level 1 support.

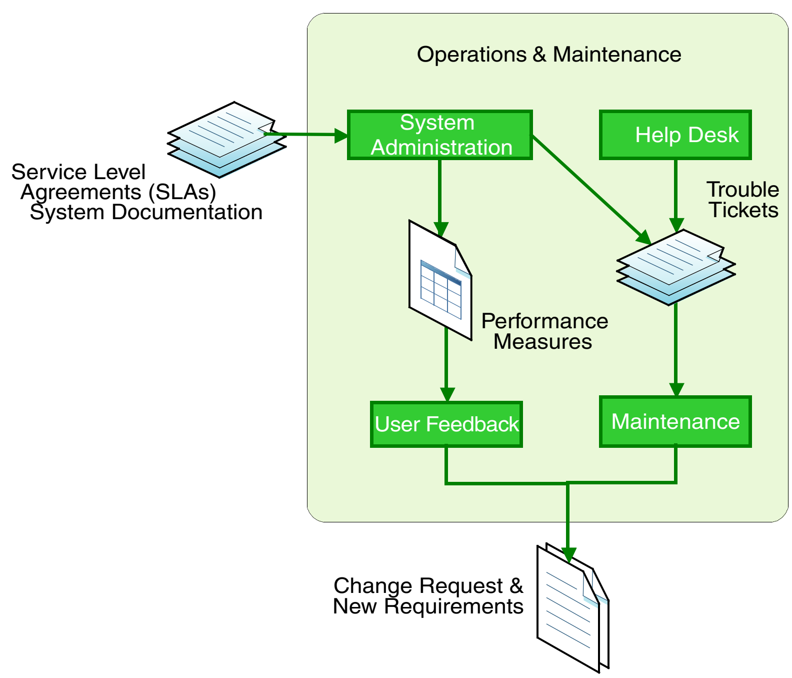


Figure 3-6. O&M phase.

- *Trouble tickets* are usually classified by type of issue, which determines the appropriate internal or external resource to address the malfunction. Until the issue is resolved, the trouble ticket is left open and the problem remains in the work queue, with issues of higher priority taking precedence in the workflow.

3.5.2 System Administration

System administrators handle day-to-day operations to keep the system operating effectively and smoothly for users. They take ownership of the system documentation developed at the end of the implementation phase and keep it up to date; they may also generate trouble tickets to correct malfunctions encountered in day-to-day operations.

- *SLA enforcement* is handled by system administrators, who collect system performance measurements in order to evaluate the system's ability to meet performance goals and SLA requirements.
- *Performance measures* established during system design are collected during the O&M phase to validate that system goals and user requirements are being met, enforce SLAs, and improve system and support methodologies. Performance measures must be objective and quantifiable.

3.5.3 User Feedback

User feedback complements performance measures by capturing subjective aspects of the user experience to help signal emerging requirements, maintain user satisfaction, and address new needs as they evolve over the life of the system.

- A *change request* is developed once a system's performance and functionality diverge sufficiently from the original goals. The document should list the features that are absent from the current system and explain the forces motivating the change.
- A *new requirement* is developed to suggest the need for a major system upgrade, replacement, or new system.

3.5.4 Maintenance

Ongoing maintenance is a critical component of meeting availability targets in the SLA. Maintenance, performed by system administrators or the system vendor, consists of both preventive and reparative activities instigated by an issue documented in a trouble ticket.

- *Preventive maintenance,* a scheduled activity arranged to minimize its impact on operations, aims to prevent unplanned disruptions in service from hardware or software failures.
- *Corrective maintenance,* a response to unplanned system malfunctions, may lead to change requests when problems recur so that systemic problems can be fixed or system upgrades initiated.

Table 3-6 provides a management project checklist for ensuring that necessary activities have been completed and that the appropriate documents from the operations and maintenance phase have been created.

Table 3-6. O&M checklist.

ITEM	QUESTIONS FOR O&M PHASE	☑
1	Are performance metrics defined, measurable, and monitored regularly?	
2	Are stakeholder/user feedback mechanisms in place?	
3	Are O&M budgets as predicted in planning phase?	
4	Does IT department have the proper staff and outside expertise to do the job?	
5	Is there a disaster recovery plan dovetailed to airport COOP?	

CHAPTER 4

Guiding IT Principles for Airports—A Common Framework

Airports are rapidly adopting new technologies so that they can better serve customers and tenants. An airport's IT infrastructure, including its applications and data, is becoming a strategic asset, helping the airport increase efficiency and reduce operational costs while improving and expanding service offerings. Given the critical importance of the IT infrastructure to the airport's successful operations, it is vital that a set of IT principles be established to guide IT investments and implementations.

Intended to be enduring and seldom changed, IT principles are general rules and guidelines developed to make the IT environment as productive and cost-effective as possible. They should be developed jointly by the CIO, CEO, and key stakeholders to align with airport strategic goals and visions. The development of IT principles is influenced by the following:

- Current systems and technology—the set of information resources deployed within the airport, including systems documentation, equipment inventories, and network configurations.
- Computer industry trends—predictions about the usage, availability, and cost of computer and communications technologies.

IT principles are used in a number of different ways:

- To provide a framework within which the airport can make conscious decisions about IT.
- As a guide to establishing relevant evaluation criteria, thus influencing the selection of new products or systems.
- As drivers for defining the functional requirements of the IT infrastructure.
- To help delineate transition activities needed in the IT master plan to implement an architecture that supports the airport's strategic goals.

4.1 Sample IT Principles

Table 4-1 lists typical IT principles. These may vary based on airport size and complexity.

4.1.1 Principle 1: Compliance with IT Principles

These IT principles apply to all departments within the airport. Having everyone abide by them ensures that decision makers get consistent, reliable information. Otherwise, the management of information would be rapidly undermined by exclusions, favoritism, and inconsistency.

4.1.2 Principle 2: Maximize Benefit to the Airport

IT decisions should provide maximum benefit to the airport as a whole. Decisions that support airport-wide goals and priorities have greater long-term value and bring a better ROI than decisions made from the perspective of any particular department. This means that IT priorities

Table 4-1. Sample IT principles.

SAMPLE IT PRINCIPLE	DESCRIPTION
Principle 1: Compliance with IT Principles	These IT principles apply to all departments within the airport.
Principle 2: Maximize Benefit to the Airport	IT decisions should provide maximum benefit to the airport as a whole.
Principle 3: IT Is Everybody's Business	All departments in the airport should participate in IT decisions needed to accomplish business objectives.
Principle 4: Business Continuity	Airport operations must be maintained in spite of system interruptions.
Principle 5: Enterprise Architecture	An enterprise-wide architecture is preferred over smaller duplicate or stand-alone systems.
Principle 6: IT Responsibility	The IT organization owns and implements IT processes and infrastructure to meet user requirements and cost constraints.
Principle 7: IT Quality	IT products and services are delivered with an appropriate level of quality relative to the business need.
Principle 8: IT Lifecycle Management	The lifecycle of each IT system will be planned and managed from conception through retirement.
Principle 9: Data Constitutes an Asset	Data has value to the airport and must be managed accordingly.
Principle 10: Shared Data	Timely access to accurate data is essential to high-quality, efficient airport operations.
Principle 11: Accessible Data	Data must be easily accessible for users to perform their day-to-day functions.
Principle 12: Common Vocabulary and Data Definitions	Data must be defined consistently throughout the airport.
Principle 13: Data Security	Data must be protected from unauthorized use and disclosure.
Principle 14: Technology Independence	IT systems should be independent of specific technology and able to be operated on a variety of platforms.
Principle 15: Ease of Use	IT systems must be easy to use.
Principle 16: Requirements-Based Change	Changes to IT systems should be made only in response to documented business needs.
Principle 17: Control of Technological Diversity	Technological diversity must be controlled to minimize the cost of operating in multiple processing environments.
Principle 18: Interoperability	Software and hardware should conform to standards that promote interoperability.
Principle 19: IT Staffing/Outsourcing	Investment in human resources is critical to the success of IT initiatives.
Principle 20: IT Vendors	Vendors with high market share and good track records for quality systems and delivery are preferred.

must be established by the entire airport. Some departments may have to concede their own preferences for the airport's benefit.

IT components should be shared across departmental boundaries, and IT initiatives should be conducted in accordance with the airport master plan. All system sourcing options must be evaluated so that decisions bring the greatest value possible. Conduct a risk/benefit analysis and closely examine ROI (economic and strategic) and total cost of ownership before making funding decisions.

4.1.3 Principle 3: IT Is Everybody's Business

All departments in the airport should participate in IT decisions to ensure that IT is aligned with business needs. Stakeholders and technical staff responsible for developing and sustaining the IT environment must work as a team to jointly define IT goals and objectives. By closely collaborating with the IT organization, departments should reap maximum benefits from the IT infrastructure.

4.1.4 Principle 4: Business Continuity

Because IT systems pervade all aspects of airport operations, the reliability of IT systems must be considered when they are being designed and used. Each department must be able to carry out its business functions regardless of hardware failure, data corruption, natural disasters, and other events.

When an organization depends on shared systems and applications, it's important to plan in advance for interruptions and determine how they will be managed. Recoverability, redundancy, and maintainability should be addressed at the time of design.

Suggested activities include:

- Periodic reviews of project implementations and ongoing operations.
- Testing for vulnerabilities.
- Assessing applications for impact on the airport mission, determining level of continuity required, and making recovery plans.
- Designing alternative or redundant mechanisms to ensure continuity of mission-critical operations.

4.1.5 Principle 5: Enterprise Architecture

Developing an enterprise-wide architecture used across the airport is much better than implementing smaller, duplicative systems for particular departments. Having duplicative systems should not be allowed because it is expensive, makes poor use of scarce resources, and causes conflicting data to proliferate.

4.1.6 Principle 6: IT Responsibility

The IT organization's primary responsibility is to provide leadership in developing quality, airport-wide IT infrastructure that supports the airport's strategic plans. IT analyzes new technologies and how they might be employed at the airport. The IT organization defines and implements IT processes and infrastructure to meet requirements defined by business units (functionality, service levels, and cost) while maintaining security and data integrity. IT should also create a process for estimating total lifecycle costs and prioritizing capital projects.

4.1.7 Principle 7: IT Quality

IT products and services must be delivered with a level of quality that is appropriate for the business need. Achieving quality involves:

- Planning and collaborating with stakeholders to understand and meet their requirements.
- Defining metrics that indicate quality.
- Applying repeatable processes.
- Carrying out adequate testing of systems.
- Putting service level agreements in place when working with vendors.

4.1.8 Principle 8: IT Lifecycle Management

The lifecycle of each IT system will be planned and managed from conception through retirement to ensure adequate maintenance and support and to maximize the value of the IT environment. IT will provide staff to help with planning and costing efforts. Investment decisions will be based on total cost of ownership.

During the planning phase, the expected life span of a system will be defined and any changes needed to existing infrastructure will be addressed. Each system will be reviewed regularly to ensure that it is kept up to date and that maintenance agreements are enforced.

4.1.9 Principle 9: Data Constitutes an Asset

Accurate, timely data forms the foundation for accurate, timely decisions and is an asset that has value to the airport and must be managed accordingly. Data stewards must be assigned who have the authority and means to manage the data they are accountable for.

4.1.10 Principle 10: Shared Data

To improve the quality and efficiency of airport operations, airport personnel must have timely access to accurate data. Maintaining data in a single application and sharing it across departments is less costly than maintaining duplicate data in multiple applications because it avoids rekeying the same information and promotes data consistency. For new applications, common data-access policies must be adopted and enforced to ensure that data remain available to the shared environment.

4.1.11 Principle 11: Accessible Data

Data must be accessible for users to perform their functions. Access to data allows staff to save time and leads to efficient and effective operations, faster response to information requests, and better service. The way information is accessed and displayed must be sufficiently adaptable to meet the needs of a wide range of airport users.

4.1.12 Principle 12: Common Vocabulary and Data Definitions

Data must be defined consistently, in understandable terms, throughout the airport. A common vocabulary facilitates effective communication, system interfaces, and data exchange.

4.1.13 Principle 13: Data Security

Data, including classified, proprietary, and sensitive information, must be fully protected from unauthorized access, manipulation, and disclosure. Therefore, security must be designed into systems from the beginning.

4.1.14 Principle 14: Technology Independence

As much as possible, IT systems should be independent of specific technology choices so that they can run on a variety of platforms and be operated and upgraded in the most cost-effective, timely way. Standards must support portability. Application programming interfaces should be developed so that legacy applications can interoperate with applications and operating environments developed under the airport architecture.

4.1.15 Principle 15: Ease of Use

Applications must be intuitive and easy to use, with underlying technology that is transparent to users. Minimal training should be necessary.

4.1.16 Principle 16: Requirements-Based Change

Changes to applications and technology should be made only in response to documented business needs, with effective airport operations as the key goal. Change management processes should be developed and implemented.

4.1.17 Principle 17: Control of Technological Diversity

Technological diversity must be controlled to minimize the cost of operating in and maintaining multiple processing environments. Using common technology across the airport brings benefits from economies of scale and better management of administration and support costs.

4.1.18 Principle 18: Interoperability

Software and hardware should conform to defined standards that promote interoperability for data, applications, and technology. Standards help ensure consistency, support from multiple vendors, and supply-chain integration. A process must be established for setting standards, periodically reviewing and revising them, and granting exceptions.

4.1.19 Principle 19: IT Staffing/Outsourcing

Investment in human resources is critical to the success of IT initiatives. The IT organization must build and maintain expertise in key skills. Outsourcing may be used to respond to variable workload requirements or acquire specialized skills.

4.1.20 Principle 20: IT Vendors

Vendors with high market share and good track records for quality systems and delivery are preferred. Minimize the number of vendors.

CHAPTER 5

Evaluating IT Investments—A Common Decision Tool

5.1 A Process for Valuing IT Systems

Evaluating the value of proposed systems is one of the more difficult tasks airport executives undertake. Executives often make investment decisions based on incomplete data. For example, total costs of the system may be underestimated, potential funding sources may be overlooked, or benefits may not be properly quantified. The solution is to have a consistent methodology for evaluating systems and a scoring mechanism for valuing them individually or against one another to make objective investment decisions.

Evaluating and deciding on IT investments is done during the system planning phase of the IT system lifecycle. (See Chapter 4 for information about all the activities performed during the system planning phase.)

This chapter outlines a four-step methodology for making these tough investment decisions:

- Documenting system benefits.
- Determining TLC.
- Performing a cost–benefit analysis.
- Scoring system values objectively.

5.2 Documenting System Benefits

The system benefits are the most important component when evaluating the value of a system. Without benefits there would be no reason to invest in the system. The IT department must take the lead on collaborating with stakeholders so that the benefits of a proposed system are described effectively. It's important for stakeholders to agree on the expected benefits so that they will support the value that is assigned.

Benefits are difficult to define. Some have financial value and others have intangible value that cannot be expressed in monetary terms. Table 5-1 gives examples of both financial and nonfinancial benefits to look for.

Clearly, the easier path to funding a project is to establish that the financial value outweighs the capital costs. Make every effort to find the hidden financial value in nonfinancial benefits. Following is an example.

In a project such as installing common use kiosks, a nonfinancial benefit, "enhances passenger satisfaction," can be converted to a financial benefit by doing a little research. Calls to other airports might reveal that this technology and the improved passenger experience have translated into a small increase (1% or 2%) of passengers using the airport—which could mean 20,000 more passengers

Table 5-1. Examples of benefit valuation.

Financial Value	Nonfinancial Value
Changes to net revenue (preferably up)	Regulatory compliance
Changes to net operating costs (preferably down) related to:	Improves security and/or safety
• The direct nonlabor operating costs of the system itself (typically up)	Improves information sharing
• Retirement of direct nonlabor costs from the old system (typically down)	Aligns with airport master plan
• Labor to operate the system (typically up)	Aligns with IT master plan
• Labor no longer required to operate the old system (typically down)	Attracts air carriers
• Changes to indirect costs due to the new system	Enhances passenger satisfaction
• Changes to indirect labor due to the new system (work that no longer has to be done)	Increases passenger/terminal capacity
Capital avoidance/deferral	Improves environmental sustainability

per year for a medium-sized airport. If each passenger generates $15 in revenue through parking, landing fees, concessions, and so forth, that's $150,000 of additional revenue for the airport. This becomes a quantifiable financial benefit of the system. Stakeholders are the place to turn for such information because they typically have the data needed to turn intangible benefits into financially meaningful ones.

5.3 Determining Total Lifecycle Costs

A key factor in deciding to invest in a new system is the cost. Capital costs (one-time costs) are often the only costs used when making investment decisions. However, ongoing O&M costs should also be considered when evaluating a new system because many of the system benefits are derived during the O&M phase. The TLC of a system is defined as the sum of all one-time (nonrecurring) costs and recurring costs over the full life span of a system. For IT systems, the life span is usually only 3 to 7 years because technology changes at a high rate in the industry. Table 5-2 reflects common costs to consider when calculating the TLC for a system.

5.4 Cost–Benefit Analysis

A cost–benefit analysis, performed after the system benefits and TLC have been determined, is a process for assessing a project's business case. The TLC is weighed against the system's total expected benefits to determine if there is a positive return. Figure 5-1 shows a suggested spreadsheet format (with sample data plugged in) to use when performing a cost–benefit analysis. The formulas for the spreadsheet can be complex and should be implemented by CFOs.

For ease of understanding, the financial discussions in the following are presented at a high level.

Table 5-2. Common lifecycle costs.

TOTAL LIFECYCLE COSTS	
One-Time Costs (Nonrecurring)	**Recurring Costs (Usually Annual Costs)**
Project Direct Capital Costs (Nonlabor) Hardware Software Contract labor	**Direct O&M Costs (Nonlabor)** Replacement hardware Software updates Consumables Rent/lease space
Project Labor Costs System specification Procurement activities Project management Installation (includes site improvements and system install) Testing Training (trainers and trainee labor)	**O&M Labor Costs** Operating labor (administration, help desk) Maintenance labor

- Lines 1 through 3 represent the expected one-time costs of the system.
- **Line 1—Project Direct Capital Costs.** Typically any cost for the project (not O&M) that will require a purchase order, such as the direct cost of the vendor who will supply the system, hardware, software, and implementation services. Beyond that obvious cost there may be other direct capital costs, such as consultants or design firms to complete some of the design steps, develop specifications, provide guidance during procurement, oversee implementation, or conduct independent validation and verification tasks.
- **Line 2—Project Labor Costs.** The costs of airport personnel to execute the project. A one-time expense, project labor costs do not include vendor implementation labor, but they do include airport IT department and stakeholder labor and the following types of work:
  - Project management
  - Design and requirements definition
  - Procurement
  - Data cleansing and entry
  - Test plan review

Example Analysis	One Time	Recurring (Annually) 1	2	3	4	5	6	7
1 Project Direct Capital Costs	$ (100,000)							
2 Project Labor Costs	$ (25,000)							
3 Outside Funding	$ 50,000							
4 Net Change to Revenue		$ -	$ -	$ 5,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
5 Net Change to Direct O&M Costs		$ 4,000	$ 7,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000
6 Net Change to O&M Labor Costs		$ 2,000	$ 3,000	$ 3,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
7 Interest on Capital Avoidance		$ 6,500	$ 6,500	$ 6,500	$ 6,500	$ 6,500	$ 6,500	$ 6,500
8 Net Cash Flow	$ (75,000)	$ 12,500	$ 16,500	$ 20,500	$ 24,500	$ 24,500	$ 24,500	$ 24,500
9 Cumulative Cash Flow	$ (75,000)	$ (62,500)	$ (46,000)	$ (25,500)	$ (1,000)	$ 23,500	$ 48,000	$ 72,500
10 Net Present Value	$ 9,799							
11 Internal Rate of Return	8.8%							
12 Break-Even Point	3.8	years						

Assumptions:
Evaluation Period Is 5 Years
Assumed Cost of Money 4.50%

Figure 5-1. Sample cost–benefit analysis.

- Testing and implementation oversight
- Initial training

- **Line 3—Outside Funding.** In many cases, an airport project's capital costs can be offset by funding from the FAA (through AIP or PFC eligibility), Transportation Security Administration (TSA), or other federal or state grant sources. Funding is discussed in more detail in Chapter 4 under the planning phase.
- Lines 4 to 7 represent the financial benefits to be achieved by implementing the system. These are the annual recurring costs, cost savings, or cost avoidance for each of the years in the evaluation period.
- **Line 4—Net Change to Revenue.** A given project can cause one or more sources of revenue to increase or decrease, usually related to a change in the number of units (passengers, planes, cars, etc.) resulting from the project's implementation. Occasionally the project allows for unit-price changes (e.g., higher parking rates, square foot lease rates, or concessions fee percentage) because the project improved the perceived value of the commodity. In other cases, the project creates a new revenue source where none was there before, so estimates of the unit volume and unit price both have to be made for each year.
- **Line 5—Net Change to Direct O&M Costs.** Represents the cumulative effect of direct O&M cost changes, which would be reflected as budget changes in years following the project's implementation. Direct costs are nonlabor expenses such as hardware and software maintenance, required telecommunications services, and consumables such as paper, printers, ribbons, and ID cards. Elimination of previous direct costs should also be taken into account; that is, costs from the current system that go away when the project is completed and the old system is decommissioned, such as expensive consumables, maintenance on obsolete equipment, or telecommunications circuits.
- **Line 6—Net Change to O&M Labor Costs.** Sometimes the labor to keep the new system running can be converted to direct costs through outsourcing and/or maintenance contracts. This category must include labor in the IT system and stakeholder organizations that is required to operate and use the system. Labor no longer required to operate the old system should be subtracted if the project involves replacing an older system.
- **Line 7—Interest on Capital Avoidance/Deferral.** By implementing one project, the capital required for another project can sometimes be deferred or avoided completely. Projected interest savings on the money **not** spent because a project was deferred is represented as a savings associated with the project being implemented.
- **Lines 8 and 9—Net Cash Flow** and **Cumulative Cash Flow.** Net cash flow represents the total investment in the system, taking into account all the projected costs over the evaluation period minus the financial cost savings achieved by implementing the system. The cumulative cash flow shows the expected net cash flow for each year of the system life span in the evaluation period.

  After calculating all costs and benefits and entering them into the spreadsheet, the data can be analyzed to assess the value of the system. Three important factors are usually calculated when performing a cost–benefit analysis:
  - NPV
  - IRR
  - Break-even point
- **Line 10—Net Present Value.** Brings all project costs into the present, taking the net monthly savings over the evaluation period (adjusted by the cost of money), presenting them as a lump sum, and subtracting net capital costs. If the result is still positive, the project is worth doing. The NPV is a means of representing the magnitude of the benefits of the investment or, simply put, is an indicator of the value of an investment.
- **Line 11—Internal Rate of Return.** Used in capital budgeting to measure and compare the profitability of investments. The IRR is an indicator of the efficiency of an investment. The higher a project's IRR, the more desirable it is to undertake. Assuming all other factors are equal among various projects, the one with the highest IRR should probably be given highest priority.

- **Line 12—Break-Even Point.** The fastest and easiest calculation to do, the break-even point determines the point in time that total savings resulting from the system benefits surpass the costs of implementing the system. Most airports look for payback periods in the 3-year time frame. Anything with a payback period of more than 5 years should be carefully vetted.

5.5 Scoring Systems

The cost–benefit analysis discussed in the previous section only takes into account benefits that can be quantified in terms of financial savings. When evaluating a potential investment in a system, the nonfinancial benefits need to be considered too. Figure 5-2 represents a spreadsheet with a simple scoring system that includes both nonfinancial benefits and valuation data from the cost–benefit analysis.

The spreadsheet is divided into three sections:

- Project information
- Nonfinancial evaluation
- Financial evaluation

Project information provides, in brief narrative form, a description of the system, project responsibility, proposed system benefits, and potential risks of implementation.

Nonfinancial evaluation takes into account all the benefits of the system that could not be quantified in dollars but are still important. Each benefit can be assigned a relative weighting of importance. For example, a regulatory requirement might be given a very high weighting on the scoring sheet. Each benefit is then scored from 1 to 5 based on the criteria presented for each. Using all the benefit scores, a total weighted score of the nonfinancial benefits can be calculated.

Financial evaluation takes into account the data calculated in the cost–benefit analysis. As with the intangible benefits, each financial aspect is weighted and scored, which allows the financial value of the proposed system to be calculated.

In the example presented in Figure 5-2, the project has an average nonfinancial valuation and a good financial value. Each airport needs to determine what values represent a good investment for it. Often, airports establish hurdle rates based on their particular financial environment—also known as the minimum rate of return the airport is willing to accept before starting a project.

The spreadsheet can also be used to compare the relative value of one system to another. Often, limited budgets dictate that some proposed systems, even though they have a good financial valuation, cannot be approved. This scoring mechanism allows an objective comparison of proposed systems to determine which ones will bring greater value to the airport.

Project Name	Sample Project
Advocate(s) Name	CIO and stakeholder
Project Description	Describe the project here
Expected Benefits	Describe benefits here
Risks	Describe risks here

		Evaluation Norms			Score	Weight
Nonfinancial Evaluation	**2.6**	a **1** means:	a **3** means:	a **5** means:		
Is this a regulatory necessity?		Not really	It could become a problem	Imminent danger of being shut down	**2**	25
Does this support the airport master plan?		No	Somewhat	Yes	**1**	0
Was this in the IT master plan?		No	Somewhat	Yes	**2**	10
Is there community goodwill to be gained?		None	Somewhat	Lots	**1**	15
Is this a green initiative?		Spends significant energy	Neutral	Saves significant energy	**3**	15
Is customer service improved?		No	Somewhat	Yes	**4**	15
Does it increase airport capacity?		It decreases it a little	Somewhat	Significantly	**3**	10
Does it attract air carriers to operate here?		Unlikely	May factor into their decision	Significant draw potential	**2**	10
Will it reduce errors and improve efficiency?		No	Somewhat	Yes	**3**	10
Will it make the airport safer?		Less safe	A little safer	Much more safe	**2**	15
Will it make the airport more secure?		Less secure	A little more secure	Much more secure	**2**	15
Does it diversify revenue sources?		All revenue comes from air carriers	Mixed revenue sources	No air carrier revenue expected	**5**	10
Will implementation disrupt operations?		No effect on operations	Some impact, but it won't be big.	Affects tenants & operations a lot.	**4**	10
How risky is the project?		Very risky	There is risk, but it is manageable	No risks	**2**	10
Financial Evaluation	**4.5**					
Internal rate of return	**8.8%**	Below 3%	Around 6%	Above 8%	**5**	50
Net present value	**$ 9,799**	Negative	Near zero	Positive	**4**	30
Breakeven point (years)	**3.8**	Above 5	Around 4	Below 3	**4**	20

Figure 5-2. System valuation scoring sheet.

CHAPTER 6

IT System Architecture—A Common Understanding

6.1 A Layered Architecture

Airport IT systems can be very complex. They are often organized into four conceptual categories and depicted in a layered fashion, as shown in Figure 6-1.

The layered architecture exemplifies how the systems of one layer act as a building block for the systems in the next layer. All IT systems can be categorized into one of these four layers. The layers of the architecture and the groups of systems common to them are described in the following.

6.1.1 Physical Layer

The cabling and fiber infrastructure, the foundation layer all IT offerings at an airport, is made up of the non-electronic physical components, including fiber optic and copper cabling and conduit and cross-connection structures. These form and protect the direct physical pathways over which IT systems communicate.

6.1.2 Networking Layer

Communications systems encompass the electronic components that send signals over the cabling infrastructure or wireless system. These systems of the networking layer communicate voice, video, and data and can use the wired physical layer as well as wireless infrastructure. The physical components include switches, routers, gateways, and wireless access points that guide voice and data signals from their source to their intended destinations. These devices also enforce a substantial amount of the security policies.

Systems at this layer form the networks that control the communications between all IT systems in the application layer. They include:

- LAN.
- Wireless LAN.
- Wide area network (WAN)—wired and wireless.
- Licensed wireless.

As of the writing of this primer, telephony is in a state of transition from the network layer to the application layer. At the majority of airports today, telephone systems typically have their own dedicated physical cabling infrastructure and devices [e.g., private branch exchange (PBX)], which perform both network and application functions. However, many airports have already converted to voice over Internet protocol (VoIP) systems, which cleanly separate the application from the network function that is now handled by the local area network. The local network can now move voice as well as video and data, and the telephone system is becoming one of many

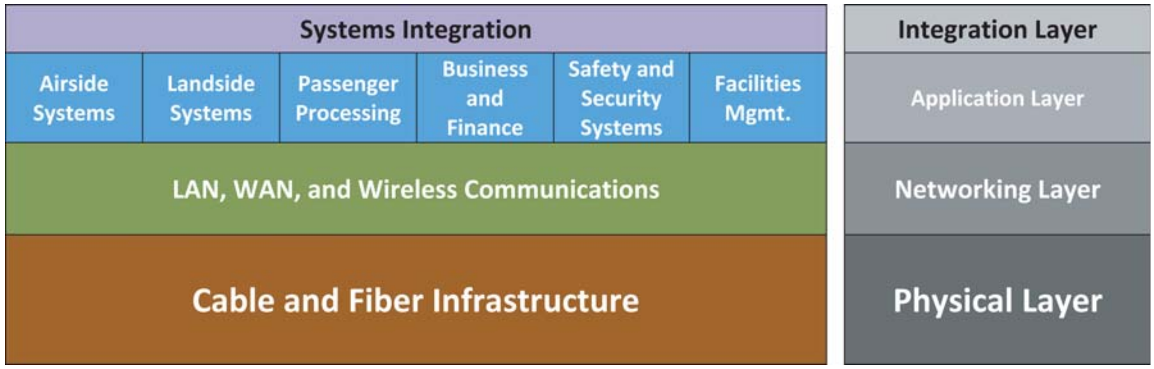


Figure 6-1. IT systems architecture.

applications on that network. Therefore, telephony has been included as an application layer system in this primer.

6.1.3 Application Layer

The application layer contains all the systems that support the operations of an airport. They are often called end-user programs because the staff uses them to accomplish their missions. There are numerous applications systems. For convenience, they have been categorized here based on their commonality of purpose.

- **Airside systems.** Airside systems, used to support an airport's aviation needs directly, are concerned with the physical movement and placement of aircraft on the ground and in the air. These systems are usually located on the airfield itself in nonpublic spaces. Airside systems can include:
  - Resource management system.
  - Noise monitoring.
  - Airfield lighting.
  - Surface movement guidance and control system (SMGCS).
  - Automatic weather observation system (AWOS).
  - Surface movement radar.
  - Fuel monitoring system.
- **Landside systems.** Landside IT systems are located in publicly accessible spaces, usually outside the terminal, and are not directly related to aviation operations but instead assist in passenger drop-off and pick-up at the airport. Many systems, such as automatic vehicle identification (AVI) and parking access and revenue control (PARC), generate revenue for the airport. Physically, they usually provide the first airport IT interactions with passengers starting or ending their trips. Landside systems can include:
  - Audio paging system.
  - AVI.
  - PARC.
  - Roadway dynamic signage.
- **Passenger processing systems.** With more airports adopting a common use approach to their facilities each year, passenger processing, which was once the exclusive domain of the airlines, has evolved into a new category of airport systems for processing and guiding passengers. These systems provide the means for airports to operate a flexible environment in which multiple airlines can share resources for airport ticketing, gates, or baggage. Passenger processing systems can include:
  - Common use passenger processing system (CUPPS).
  - CUSS.

  - Local departure control system (LDCS).
  - Multi-user flight information display system (MUFIDS).
  - Baggage sortation/radio frequency identification (RFID).
- **Business/finance systems.** Airport IT business/finance systems are used to meet the airport organization's administrative needs and are tailored to fit the airport's unique business environment, although the tools are similar to those in any business, such as email, word processing, and file storage. These systems benefit the airport's administrative staff by saving costs and time and helping with decision-making procedures. Business systems can include:
  - Financial management system.
  - Human resource management system.
  - Property management system.
  - Asset management system.
  - Website.
  - Email.
  - Telephony.
- **Safety/security systems.** Safety/security systems are critical in today's environment so that airports operate effectively and keep the traveling public safe. These systems provide video surveillance, controlled and monitored access to secure areas, and the ability to detect, announce, and control disaster situations at an airport. Safety and security systems can include:
  - CCTV.
  - Access control system (ACS).
  - Fire alarm.
  - Badging system.
  - Ring-down circuit.
  - Computer aided dispatch (CAD).
  - Police systems.
  - Fire department systems.
- **Facility/maintenance systems.** Facility/maintenance systems ensure that mechanical systems work properly so that building environments are pleasant and functional in all conditions, and they help the airport's staff keep the airport operating at peak performance. Facility and maintenance systems can include:
  - Building management system.
  - Computerized maintenance management system (CMMS).

6.1.4 Integration Layer

The systems of the integration layer allow the systems of the application layer to coordinate and share information among them. The systems can be directly linked together through the integration layer or they can share a common data pool. Integration ensures that shared data is timely and accurate for all systems using the same data. The more an airport invests in its IT systems, the more that integrating these systems benefits its operations. Benefits include:

- Improving staff efficiency by sharing information across both operations and administrative systems.
- Simplifying information distribution to employees, management, tenants, and customers.
- Providing for a higher level of redundancy, which improves system and data availability.
- Using a centralized data repository and dissemination, which cuts down on human handling of data and associated errors—thus improving data accuracy and response time.
- Making larger amounts of data readily available to management, allowing the organization and revenues to be fine-tuned.

Table 6-1 is a matrix of most systems found at an airport. They are sorted by layer and the grouping to which they belong. An alphabetical list of these systems with a brief description can be found alphabetically in Appendix B.

Table 6-1. Airport IT systems matrix.

System Layer	System Grouping	System Name
Physical layer	Cable and fiber infrastructure	
Networking layer	LAN, WAN, wireless communications	Licensed wireless
		Local area network
		Wireless area network WAN
		Wireless LAN
Application layer	Airside systems	Airfield lighting
		AWOS
		Fuel monitoring system
		Noise monitoring
		Resource management system
		SMGCS
		Surface movement radar
	Landside systems	Audio paging system
		AVI
		PARC
		Roadway dynamic signage
	Passenger processing systems	Baggage sortation/RFID
		CUPPS
		CUSS
		LDCS
		MUFIDS
	Business/finance systems	Asset management system
		Email
		Financial management system
		Human resource management system
		Property management system
		Telephony
		Website
	Safety/security systems	ACS
		Badging system
		CCTV
		CAD
		Fire alarm
		Fire department systems
		Police systems
		Ring-down circuit
	Facility/maintenance systems	CMMS
		Building management system
Systems integration layer		Airport operational database (AODB)
		Geographic information display system
		Message broker
		Systems manager

APPENDIX A

Example Document Outlines

IT Master Plan

Purpose

The purpose of the IT master plan is to assess the condition of the existing system and map its applicability to the airport's master plan. The IT master plan correlates all of the IT department's goals and envisions projects that will support the airport's goals and keep the IT infrastructure current.

Outline and Contents

1. **Executive Summary**
   High-level synopsis of the findings and conclusions intended to provide senior executives with a one- or two-page quick read of the complete document.

2. **Terms and Acronyms**
   Lists the terms and acronyms used in the IT master plan and provides their definitions.

3. **Methodology**
   Describes the approach used to construct the IT master plan.

4. **Existing Systems Assessment**
   Evaluates each independent system and its readiness to serve the airport's needs for the next 4 to 8 years. Examines the serviceability of the system, suitability to new evolving demands and requirements, conformance to standards (especially new ones), and ability to support the airport master plan. Mirrors the layers presented in the systems architecture section, progressing from the most physical to the most software oriented. Parallels the International Standards Organization (ISO) Open Systems Interconnection (OSI) model and the organization of systems in this primer.

   4.1 Physical Infrastructure
   Identifies the conditions of the telecommunications rooms and cabling infrastructure and includes:
   - Building facilities, including server room and telecommunications closets.
   - Cabling infrastructure, including copper and fiber-optic.

4.2 Network Architecture
Describes the current state of the wired and wireless networks at the airport or under management by the airport administration.
- Local area network topology.
- Wide area network topology.
- Wireless networks.
- Addressing, virtual local area networks (VLANs), and routing.
- Security including firewalls, remote access, and so forth.
- Network administration and operations.

4.3 Application Systems
- Airport operations systems.
- Passenger processing systems.
- Business, finance, and human resources.
- Safety and security systems.
- Basic office systems.
- Building systems.

4.4 Interoperability and IT Management Systems
Documents the current state of systems designed to provide interoperability among the other systems in the lower layers of the model. Includes systems management tools and integration tools.

5. **Management**
Describes the existing staff organization, charter of the IT department, project management methods, guiding IT principles, and budgets. May be appropriate to include a 360-degree evaluation of the IT department based on interviews with stakeholders.

6. **Business Models**
Describes any shared tenant business models, pricing, take-rates, and so forth, as well as cost allocation schemes and ways that labor is calculated in projects.

7. **Benchmarking**
Reports metrics from peer airports to provide comparisons, including the type and numbers of systems, size and organization of staff, and capital and operating budgets. Including basic airport comparison metrics such as number of passengers, gates, and/or traffic mix is useful.

8. **Technology Plan**
Lays out the important evolutionary changes required to maintain a current IT environment that serves the needs of the airport and its tenants and passengers. Should offer a cure for all deficiencies identified in the existing conditions. It is helpful to organize the technology plan into project-sized initiatives that are small enough to be funded and completed in a single fiscal year, which allows for systems definitions, CONOP, and value propositions to be quickly developed.

9. **Transition and Action Plan**
Prioritizes the recommendations from the previous sections and organizes them into a road map with recommended funding, presents a year-by-year capital budget, and includes a gap analysis that summarizes the deficiencies between the existing system and the technology plan.

10. **Management and Staffing Recommendations**
Describes, in light of the newly created technology plan, how management must adapt to enact these changes. May include recommendations for staff reorganization, redistribution, and/or retraining; business model modifications; alterations to the IT principles; assessment of outsourcing alternatives; and a 5-year projected O&M budget.

Concept of Operations

Purpose

The concept of operations document, used to ensure consensus among users, operators, and developers, describes the effort required to operate the new system after deployment. It should briefly describe the system as well as users' expectations for the new system, the operational environment, operation scenarios, support environment, and impacts to other systems and organizations. The intended audience includes technical and nontechnical personnel.

Outline

1. **Scope**
   Contains the title and overview of the new system.

2. **Terms and Acronyms**
   Lists terms and definitions of acronyms used in the document.

3. **Applicable Documents**
   Lists by title any documents that are referenced or are applicable to the system.

4. **Current System or Situation**
   Analyzes current system capabilities and limitations as well as the motivation for the new system. Describes current users and support environment.

5. **New System Description and Justification**
   Describes the new system's attributes, capabilities, and interfaces, summarizes benefits to be achieved, and provides justification details such as missions, objectives, and limitations of current systems.

6. **Concept for New System**
   6.1. Description of the New System, to Include:
   - Operational environment.
   - Major system components.
   - Interfaces to other systems and data flows.
   - Capabilities or functions of the new system.
   - Data flows.
   - Performance characteristics
   - Quality attributes (reliability, accuracy, flexibility, availability).
   - Safety/security requirements.

   6.2. Operational Policies and Modes of Operation
   Hours of operation, staffing constraints, hardware constraints, space constraints, and modes such as standard, after hours, maintenance, emergency, and backup.

   6.3. Organizational Structure
   6.3.1. System Users
   Identifies system users and how they interact with the system, the organizational structure, and required skill levels.

   6.3.2. Support organization
   Identifies the support organization, facilities and equipment, maintenance concepts, and supply methodology.

7. **Operational Scenarios**
   Describes step by step how the new system should operate under varying circumstances as well as what it should not do. Each scenario describes a specific operational sequence that

illustrates the system's functions and its interactions with users and other systems and includes events, actions, inputs, and data.

8. **Expected Impacts**
   Describes the operational impacts of the new system from the user's perspective, which allows affected organizations to prepare for changes the system implementation will bring about.

System Definition

Purpose

The system definition is a high-level requirements document that describes the need for a new capability. It is the first attempt to define the system's scope, serves as a starting point for defining requirements (which is carried out in detail later in the system specification), and should be written so that both users and technical personnel can understand it. The system definition may refer to trade studies and feasibility studies performed.

Outline and Contents

1. **Scope**
   Identifies the needed system by name, concisely describes the needed application or product, and specifies whether the system is an upgrade or correction to an existing system.
2. **Terms and Acronyms**
   Lists the terms and acronyms used in the document and their definitions.
3. **Applicable Documents**
   Lists by title any documents that are referenced in or applicable to the system definition.
4. **Business Environment**
   Defines the business area in which the need exists and relationships with other business areas.
5. **Description of System**
   Describes the needed system or capability in terms of shortcomings of existing systems or new functionalities needed.

   5.1 Functional Capability
   Describes functional application needs and interfaces with other systems.

   5.2 Operational Capability
   Specifies operational performance requirements and goals such as system capacity and throughput.

   5.3 Service and Logistical Support
   Describes support elements needed to achieve effective operations, such as maintenance, supply, support personnel, facilities, and training.

   5.4 Other Considerations
   Describes other issues that could have an impact on the system, including disaster planning, environmental impacts, and security requirements.
6. **Suggested Solutions**
   Describes the proposed solution, acquisition strategy, system deliverables, test strategy, and alternatives that could be pursued to satisfy the requirements such as an existing system upgrade.
7. **Schedule**
   Discuss the desired schedule for capability availability.

8. **Cost Estimate and Funding**
   Provides a high-level estimate of the total costs to implement the system and identifies the reference resources used. Also describes ongoing operational and maintenance cost assumptions and discusses potential funding sources for the new system.

Value Proposition

Purpose

The value proposition presents economic and non-economic arguments about why the project should be funded and completed, defines benefits that will be measurable after the project is completed, and describes stakeholders.

Outline and Contents

1. **System Description**
   A brief restatement of the CONOP and system definition, which are fundamental building blocks for the value proposition.
2. **Terms and Acronyms**
   Lists and defines terms and acronyms used in the value proposition. The acronym list in Appendix C of this primer is a good source of definitions.
3. **Applicable Documents**
   Lists by title any documents that are referenced in or applicable to the value proposition, including the CONOP and system definition, and possibly the airport master plan, IT master plan, publications from regulatory agencies, revenue studies, and operational cost studies.
4. **Stakeholders**
   Describes all departments and external entities with a say in whether the project gets funded; includes beneficiaries of such improvements as more efficient workflow, lower costs, increased revenue, or better service; and indicates those who may have to contribute to the system—including parties that may not receive direct benefits.
5. **Benefits**
   Lists each benefit the system delivers and which stakeholders receive each benefit, both financial and nonfinancial. Examples of typical benefits include:
   - More revenue.
   - Lower costs.
   - Reduced paperwork.
   - Fewer errors.
   - More accurate information.
   - Faster or broader access to information.
   - Fewer incidents.
   - Regulatory compliance.
   - Improved safety and security.
6. **Nonfinancial Value**
   Describes nonfinancial value, such as:
   - Meets strategic objectives.
   - Improves airport safety.

- Improves airport security.
- Regulatory requirement.

7. **Financial Value**
   Estimates and explains benefits that can be quantified in dollars, such as:
   - Increases in net revenue.
   - Reductions in net operating costs related to:
     – The direct operating costs of the system itself.
     – Retirement of direct costs from the old system.
     – Labor to operate the system.
     – Labor no longer required to operate the old system.
     – Changes to indirect costs due to the new system.
     – Changes to indirect labor due to the new system (work that no longer has to be done).
   - Capital avoidance/deferral.

8. **Capital Cost**
   One-time project-oriented expense required to deliver the financial and nonfinancial value, which is typically made up of direct and indirect capital costs. Direct capital costs should be supported with vendor estimates or quotes when possible. Indirect costs should be estimated and accompanied by an explanation of how the estimate was made.

9. **Return on Investment**
   Calculates return on investment using internal rate of return, net present value, or break-even point. Should be derived entirely from estimates in the financial value and capital cost sections.

Project Charter

Purpose

The project charter, completed after project funding is approved, initiates the implementation phase. It identifies the project manager (PM) and his or her authority, gives the PM the go-ahead to commence project planning and obtain a project number, and states the project's scope, schedule, and budget.

Note: This outline for a project charter has been aligned with the Project Management Institute's *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, Fourth Edition, published 2008 (Project Management Institute, 2008).

Outline and Contents

1. **Project Purpose or Justification**
   Summarizes of the value proposition.

2. **Measurable Project Objectives and Related Success Criteria**
   These are derived from the value proposition, CONOP, and system description. The updates should reflect any goals or success criteria introduced by the type of funding or in final negotiations to get the project approved.

3. **High Level Requirements**
   These are restated and updated (post-funding) from the system definition. The updates should reflect any constraints or requirements introduced by the type of funding or in final negotiations to get the project approved.

4. **Summary Milestone Schedule**
   A set of dates indicating the objective time frame the project must meet. It must include any date constraints imposed by the stakeholders, funding type, fiscal year, regulatory deadlines, or other deadlines, such as vendor offer windows.

5. **Summary Budget**
   Restates the value proposition sections estimating both direct and labor capital costs. Also states the funding sources and identifies the type of funds to apply to specific portions of the capital budget.

6. **Project Approval Requirements**
   Defines what is meant by successful execution of the project (in other words, what "done" means) and specifies who decides when the project is done as well as who signs off on it.

7. **Assigned Project Manager**
   Identifies the individual with authority to act as the project manager and verifies his or her authority to accept deliverables, approve payment of invoices, and assign tasks to other departments and vendors (via normal procurement channels). If a procurement is planned, this section should identify the source selection board (SSB) or define the project manager's authority to select the SSB.

8. **Authorization**
   Provides name, title, and signature of the manager with authority to assign the project manager and delegate the responsibilities mentioned previously. In most medium and small airports, this is likely the CEO or airport director. In larger airports, other senior executives may be given this authority, perhaps up to a certain project dollar ceiling.

Project Management Plan

Purpose

The project management plan is a management document that defines the overall plan for the project. It should describe the tasks, schedule, resources, and costs for completing the project in accordance with project objectives.

Outline

1. **Scope**
   Contains the title and a brief description of the system.

2. **Terms and Acronyms**
   Lists terms and definitions of acronyms used in the document.

3. **Applicable documents**
   Lists by title any documents that are referenced or are applicable to the system.

4. **Project Overview**
   4.1. Project Objectives
   Describes project goals as stated in the system definition, IT master plan, or airport master plan.

   4.2. Project Description
   Briefly describes the project in a way that reflects the system definition and project requirements.

4.3. Assumptions and Risks

States assumptions made about the system or the project execution; includes constraints regarding technology, schedule, or budget; addresses the strategy for monitoring, evaluating, and mitigating risks, which might relate to technology, schedule, or resource availability.

5. **Organizational Responsibility and Authority**

   Specifies roles and responsibilities of all organizations associated with the project, including contractors, and provides an organizational chart identifying key personnel. Responsibilities may include:
   - Project management.
   - Technical performance.
   - Quality assurance.
   - Configuration control.
   - Training.
   - Interorganizational coordination.
   - Signature authorities from each organization.

6. **Work Breakdown Structure (WBS)**

   6.1. Project Tasks

   Provides a detailed breakdown of tasks needed to perform the entire project and associates each task with a number, description, purpose, needed inputs, expected outcome, and deliverables.

   6.2. Project Deliverables

   Describes each project deliverable and cross references it to the associated task.

   6.3. Responsibility Matrix

   Identifies responsibilities of each person or organization associated with the project and assigns each task identified in the WBS to at least one organizational unit. If multiple organizations are involved, primary and support roles should be identified. It is useful to complete a spreadsheet with hours by resource by task. Estimate the level of effort and commitment required of the assigned resources and obtain buy-in from the organizational management regarding the resources' availability.

   6.4. Schedule and Milestones

   Provides a schedule of all tasks and major milestones for the duration of the project, including training, reviews, testing, system acceptance, and system cutover, and indicates dependencies among tasks. A program management software tool is helpful in managing task schedules and dependencies.

7. **Budget**

   7.1. Funding Profile

   Addresses all sources of project funding and amounts from each source.

   7.2. Cost Estimate by Task

   Provides a breakdown of the budget by task, including budgets for hardware, software, project management, special facilities, subcontractors, and other direct costs.

8. **Reporting and Communications**

   8.1. Project Reviews

   Describes formal and informal communications between the project manager and all organizations associated with the project, including stakeholders and future support personnel. Specifies the frequency of project reviews and personnel who should attend.

8.2 Project Tracking
Specifies the plan for tracking the project, including mechanisms for tracking cost, schedule, task progress, action items, and risks. When using a project management tool, specify the reports that will be generated to reflect project status.

System Specification

Purpose

The system specification is a requirements document that establishes the functional, performance, design, and testing requirements of a system.

Outline

1. **Scope**
   Contains the title and purpose of the system.
2. **Terms and Acronyms**
   Lists terms and definitions of acronyms used in the document.
3. **Applicable documents**
   Lists by title any documents that are referenced or are applicable to the system.
4. **System Requirements**
   Specifies the requirements for the system.

   4.1. General Requirements
   Describes the system, with emphasis on pertinent operational and logistical considerations. It is helpful to reference the CONOP and include a system diagram.

   4.2. Detailed Requirements

   4.2.1. Functional Requirements
   Describes the system's functional requirements. Each requirement should be numbered separately.

   4.2.2. Performance Requirements
   Describes the system's capabilities in a quantitative manner, including system capacity and capacity reserve.

   4.2.3. Interface Requirements
   Describes interfaces required with other systems. Each interface should be numbered separately and described in detail.

   4.2.4. Quality Requirements
   Specifies quality requirements in a quantitative manner, such as reliability, availability, maintainability, correctness, and efficiency.

   4.2.5. Environmental Conditions
   Specifies the environmental conditions the system must withstand during operations.

   4.2.6. Flexibility
   Specifies areas for potential growth and expansion, and highlights areas that might require additional capacity.

4.3. Design and Construction Requirements
Specifies system design and construction standards that might be applicable to the system equipment—whenever possible by incorporating established standards and specifications. Items to consider including are materials, product marking, safety, and human engineering.

4.4. Security Requirements
Specifies security requirements necessary to protect the system physically and to prevent sensitive information from being compromised.

4.5. Documentation
Specifies documentation required for the system, including specifications, drawings, technical manuals, acceptance test plan, user's manual, operations manual, quality assurance plan, and configuration management plan.

4.6. Personnel and Training
Specifies the number of personnel and skill level required for operational support and maintenance, as well as training requirements and training plan for support personnel.

Service Level Agreement

Purpose

A service level agreement sets clear expectations between a service provider and a service subscriber about the quality of the service and the way it will be managed. In airports, SLAs may refer to the IT department as the subscriber and a third party (such as a network or maintenance vendor) as the service provider, while simultaneously the airport IT department is the service provider and its subscribers are other airport departments and tenants. The SLA outline is generally written as an attachment to a larger general contract; if the SLA is to be the contract it will need many routine legal provisions.

Outline and Contents

1. **Service Description**
   Provides a high-level description of the service, its intended purpose, hours of operations, and the regulatory environment in which it is provided. May also define the meaning of minor, major, and catastrophic failures.

2. **Physical Service Boundary**
   Defines the physical point at which the service provider's responsibilities end and the subscriber's responsibility begins. (A drawing here is usually very helpful.) In a maintenance SLA the geographic area or specific sites should be identified.

3. **Performance Metrics**
   Defines the service performance covered by the SLA, describes how it is measured, and states expected and minimally acceptable levels. Performance metrics vary by the system, but may include:
   - System availability.
   - Average station availability.
   - Mean time to respond (electronically or in person).
   - Mean time to repair.
   - Mean time between failure.
   - Error tolerance.

- Latency or relay (e.g., response time).
- Number of simultaneous users.
- Transaction processing volume.
- Throughput.
- Percentage of problems resolved in a specific time frame.

4. **Trouble Reporting Procedures**
   Describes how the subscriber should notify the service provider of problems, how the service provider will track and provide status on corrective actions, and how close-out procedures are handled. Identifies who can report trouble, specifies who receives the trouble report, and includes contact information.

5. **Subscriber Responsibilities**
   Defines the subscriber's role in maintaining service quality. If penalties are contractually tied to performance that the SLA describes, this section is the one most likely to be used to escape penalties. Subscriber responsibilities might include:
   - Providing access to technicians at any hour of the day.
   - Providing storage, staging, or office space for technicians.
   - Providing specific information when reporting trouble.

6. **Escalation Procedures**
   Describes how the service provider notifies both its own management and the subscriber management when a problem exceeds severity or duration thresholds. Defines the form and frequency with which the service provider must provide status updates of a problem.

7. **Reporting**
   Describes the type and frequency of reporting from the service provider to the subscriber. Reports typically use the performance metrics and often compare results over multiple reporting periods.

8. **Maintenance Windows**
   Describes maintenance windows, usually at low-traffic periods, that may allow the service provider to be relieved of meeting the performance metric objectives. May also contain notification procedures and timing the service provider must conform with when notifying the subscriber of a planned change to the service.

9. **Subscriber Access**
   Describes tools at the subscriber's disposal for accessing data automatically from the service provider and specifies who is granted access in the subscriber organization. Such data might include:
   - Reports on service performance.
   - Trouble ticket information.
   - System status.
   - Knowledge base and FAQs.

APPENDIX B

Airport Systems

System	Description
Access Control System	An ACS is used to allow, restrict, and track the movement of people through entry and exit points. ACS technologies became critical at airports in the wake of the 9/11 tragedy, when security in the aviation industry became a major concern to both the traveling public and the government. Access control systems use a variety of technologies, including: • Proximity or contactless cards. • Magnetic stripes using encrypted encoding. • Barcodes (for non-security applications). • Weigand card readers (which use cards that contain a set of embedded wires). • Smart cards (both contact and contactless). • Keypads. • Biometrics such as hand geometry, fingerprint, retinal scan, facial features. • A combination of these technologies. Depending on the technology, a person seeking passage through an access checkpoint swipes a card through a mounted card reader or holds the card near the reader to transmit identifying data to a field controller, which may be located near the access point or in the nearest communications room. The data is checked against the database, the system grants entry through the checkpoint to authorized individuals, and transaction information is transmitted to the system's central server and database. If a door checkpoint is opened without the proper signal from the card reader, an alarm generated at the field controller goes off at the system's central monitoring station and at remote monitoring locations, as configured. In some system configurations, local notification appliances, such as audiovisual alarms, are activated. The system may also activate remote notification alarms at off-premises mutual aid offices. Typically, in large facilities, the security and access control system is configured in zones. Large-scale access control systems are often integrated with video badging and CCTV monitoring systems so that

System	Description
	cameras will automatically pan to view forced entry or trouble points. Access control systems are often integrated with other building systems, such as the fire alarm and building management systems, depending on what makes sense operationally. Within airport security, access control is one of two distinct areas that make up the overall security requirements; passenger/baggage screening is the other. Access control focuses on the movement of people, equipment, and material into the airport's protected areas, typically by controlling doors that lead into the secure identification display area and other protected areas. Passenger/baggage screening consists of verifying that people and their luggage do not bear firearms or explosives, usually by the use of metal detectors, x-ray machines, explosives detection system machines, explosives trace detection machines, and hand searching techniques. CFR Title 49, Part 1542, is the federal statute that governs airport security and access control systems. Other important references for airport security systems include: • RTCA DO-230A, Standards for Airport Security Access Control Systems • DOT/FAA/AR-00/52, Recommended Security Guidelines for Airport Planning, Design, and Construction • TSA TWIC (Terminal Worker Identification Card) Program (This program is still in the prototype phase and has not been implemented to date.)
Airfield Lighting Control System	Airport lighting is so complex it has been elevated beyond a simple electrical light system to require an IT overlay. An airport lighting control system can provide lighting control from one or more locations, remotely monitor the proper functioning of the system, and automate many functions. More advanced systems will often be integrated with a surface movement guidance and control system.
Airport Operational Database	An AODB acts as the centralized data storage location shared by systems such as resource management systems, multi-user flight information display systems, passenger messaging systems (audio and visual), common use systems, building management systems, and baggage handling systems. As information is updated in the operational database, changes are distributed to all integrated systems, including common use systems.
Airside Systems	Airside systems, used to support airport's aviation needs directly, are concerned with the physical movement and placement of aircraft on the ground and in the air. These systems are usually located on the airfield itself in nonpublic spaces. Systems in this classification include: • Resource management • Noise monitoring • Airfield lighting • Surface radar • Automatic weather observation

System	Description
Architecture	IT communications are often depicted by the OSI model, which shows seven conceptual layers necessary for any network to function. For airports, this highly detailed and accurate model can be simplified down to four main layers: • Physical layer • Networking layer • Application layer • Integration layer The layers are building blocks that stand on the previous layers to ensure robust yet interchangeable IT solutions.
Asset Management System	An asset management system is used to record asset ownership, track its usage, and determine who is in control of an asset or where it is located, with the overall goal of reducing asset loss and duplication. Assets are entered into the system and given a distinct barcode or RFID identifier; when the asset is placed in a location or given to someone, it is scanned and the control/location information is updated. In the system, the asset's file is often accompanied by an image of the asset, warranty information, and other relevant documents. Asset management systems are often integrated with the airport's financial management systems to share depreciation data relevant to the accounting department.
Audio Paging Systems	An airport audio paging system broadcasts public service, courtesy, and emergency announcements, sometimes in several languages. Modern systems may incorporate monitors to display messages in multilingual formats. Announcements may be directed to the traveling public or to onsite personnel. During emergencies, the airport's dispatch center may use the system to make emergency notifications or direct emergency actions. The audio paging system is typically set up in zones so that announcements can be broadcast to local gate areas, to selected terminals, or throughout the airport. At some airports, tenant airlines maintain independent paging systems in their gate areas to board passengers and announce flight arrivals. Tenant and airport audio paging systems often use prerecorded messages to simplify regular announcements—recording and playing back announcements at desired times so that airline employees can focus on helping customers, making the boarding process more efficient, and handling airport operation issues. The Americans with Disabilities Act (ADA) has had an impact on the way paging in public places is done; audio pages must also be made visually, although the extent of audiovisual paging varies from airport to airport. There is still some uncertainty about what is entailed in meeting ADA requirements.
Automated Weather Observing Systems	Airports use an AWOS to determine weather conditions and relay them to air traffic control and pilots. Though the sensors included on

System	Description
	observation stations vary between airports, they typically include temperature, precipitation, dew point, barometric pressure, wind speed and direction, cloud coverage, and ceiling up to 12,000 ft. Increasingly, new sensors are being included to determine the presence of freezing rain and lightning.
Automatic Vehicle Identification	In AVI systems, vehicular activity is monitored and controlled by outfitting each vehicle with a transponder or tag containing a code. When a tagged vehicle approaches a monitoring point or physical barrier, a receiver or reader detects the transponder or tag, which uses RFID—a technology that can detect, track, and sort a countless variety of objects, including people, vehicles, garments, containers, totes, and pallets. On AVI systems, the receiver or reader can be linked to a controller or management system so that details of the vehicle can be recorded or a barrier opened, according to the requirements of the installation.
Badging System	Airports use badging systems to automate the steps in processing and recording security clearance levels. After an applicant completes a badging form, biographical statistics and sponsorship information from the form are entered into the system and fingerprints are captured from optical readers. This information is sent to the Department of Homeland Security to obtain a background clearance. The applicant also takes a training course and an examination on the security clearance rules. If the applicant passes the exam and obtains background clearance, he or she is photographed and issued a badge. The necessary badge information is copied to the access control system, usually through direct integration. If the airport uses other biometric security measures, this information is also usually captured by the badging system.
Baggage Sortation/Radio Frequency Identification	Baggage sortation is the process of routing checked luggage to its intended destination while on an airport's baggage handling system. Traditionally, checked luggage has a baggage tag attached with a barcode indicating the unique license plate of each bag. Scanners on the baggage handling system read each tag and cross-reference the license plates with a stored baggage source message sent by the airline. In many airports, the airline information is sufficient to route checked baggage to the appropriate common baggage makeup space or bag claim station. In more sophisticated airports, flight data is correlated with the AODB and RMS to move baggage to the bag makeup area closest to the aircraft gate (for placement on board) or to the designated baggage carousel for passengers to pick up at their destination. In the next generation of baggage sortation systems, baggage tags will be augmented with RFID to further minimize unidentifiable and delayed bags. Able to receive signals without an uninterrupted line of sight, RFID has a higher read than traditional barcodes and is less likely to require the human intervention needed when tags are damaged or obscured.

System	Description
Building Management System	The BMS is used to help staff operate and maintain buildings and airfield systems by controlling plant equipment such as lighting, managing energy consumption, controlling comfort levels, identifying faults, and maintaining assets within the buildings and infrastructure. A BMS incorporates a multitude of systems that typically fall into one of four categories: • HVAC • Fire and security • Electrical metering • Lighting control. Examples of systems that can be controlled through a BMS, thereby providing greater efficiency, are central heating units, air conditioning, fire detectors, alarms, heat, water and gas meters, motion detectors, dimmers, and emergency lighting. A BMS can control a single category of systems or it can control every system in a building.
Business/Finance Systems	Airport IT business/finance systems are used to meet the airport organization's administrative needs and are tailored to fit the airport's unique business environment, although the tools are similar to those in any business, such as email, word processing, and file storage. These systems benefit the airport's administrative staff by saving costs and time and helping with decision-making procedures. Systems in this category include: • Financial management • Human resources management • Property management • Asset management • Website • Email
Cable and Fiber Infrastructure (Physical)	The cabling infrastructure, the foundation layer of all IT offerings at an airport, is made up of the non-electronic physical components of a network, including fiber optic and copper cabling and conduit and cross-connection structures. These form and protect the direct physical pathways over which IT systems communicate.
Cable Management System (CMS)	The CMS acts as an interactive, electronic road map for the cabling infrastructure and associated hardware. It uses a cable asset database to provide real-time information on connectivity throughout the infrastructure and tracks all cable terminations and users. In other words, it gives instant access to details about the cabling infrastructure, simplifying the process of discovering what is connected, where cables route, what spare capacity exists, and what has to be linked to give an end user connectivity. Controlling the substantial costs of cabling infrastructures demands effective management, which is aided by the comprehensive, accurate cabling records a CMS helps establish and maintain. A typical organization will move, add, or change (MAC) at least 30% of its communications infrastructure annually at an approximate cost of $1,000 to $1,500 per minor alteration. On average, 80% of this

System	Description
	cost is simply for rediscovering cables. More than 50% of network problems can be traced to the cabling infrastructure. By keeping an accurate overview of the infrastructure, a CMS can eliminate search costs from each MAC and allow airport staff and resources to concentrate on other tasks. The CMS can show every path a telephone connection requires, down to the individual cable pairs used, and can help with asset management, IT management, E-911 compliance (to help emergency dispatchers locate people calling from mobile devices), billing, and cable manufacturers' warranty management.
Closed Circuit Television	CCTV systems use a collection of video cameras for surveillance in areas where there is an increased need for security, such as banks, casinos, and airports. CCTV differs from broadcast television in that all components are directly linked via cables or other direct means. The first CCTV cameras used in public spaces were crude, conspicuous, low-definition black and white systems without the ability to zoom or pan. Modern CCTV cameras use small, high-definition color cameras that not only focus to resolve minute detail but can track objects semi-automatically by linking control of the cameras to a computer. For example, they can track movement across a scene where there should be no movement, or they can lock onto a single object in a busy environment and follow it. Because the tracking process is computerized, it can also work between cameras. In the latest CCTV and imaging developments, computerized monitoring means that the CCTV operator does not have to look endlessly at all the screens and can run many more CCTV cameras. These systems do not observe people directly but instead track their behavior by looking for particular types of movement, clothing, or baggage—an approach based on the theory that in public spaces people behave in set and predictable ways, and if they are not part of the crowd (car thieves, for example), they behave differently. The computer can identify their movements and alert the operator that they are acting out of the ordinary. Potentially, a person waiting in a busy street to meet someone could trigger this system. The same type of system can, if required, track an identified individual as he or she moves through the area covered by CCTV. This capability is being developed in the United States as part of a project co-funded by the Defense Advanced Research Projects Agency. With software tools, the system will be able to develop three-dimensional models of an area and track/monitor the movement of objects within it.
Common Use Passenger Processing System	Common use systems increase an airport's flexibility and efficiency by allowing multiple airlines to use the airport's host software and a common set of compatible hardware. CUPPS is a new common use standard, approved by the International Air Transport Association (IATA) in October 2007, that will allow airports to process passengers more efficiently and at lower cost. New software

System	Description
	applications are now being developed and tested to meet the requirements. CUPPS is an overhaul of the Common Use Terminal Equipment (CUTE) standard (Recommended Practice 1797), first implemented in 1984 when SITA's CUTE system was installed at Los Angeles International Airport. Since then, common use has evolved through successive generations of technology, advancing to a fully networked passenger departure and ticketing system with intelligent workstations built on open-standards–based hardware and software platforms. In a standard common-use installation, individual airlines' dedicated computer systems can be accessed from locations designated as "shared use"—allowing airline agents to use their network and related applications from any common-use workstations. The common-use workstations are connected to each participating airline's host computer (i.e., System One, Sabre, etc.) via gateway servers. When participating agents are assigned to a particular gate or ticket counter, they log on with a user name and password that identifies them and their airline affiliation. The server loads the appropriate airline application, and the agent interacts directly with the respective airline reservation system via the WAN link at the gateway server. Associated peripherals such as the automatic ticket and boarding pass printer, baggage tag printer, dot matrix printer, keyboard, and magnetic stripe reader are also shared use.
Common Use Self-Service	The concept behind CUSS is to enable airlines to share kiosks, allowing passengers to access many different airlines' self-service check-in applications from a single unit. This is different from the concept of proprietary kiosks, which are airline-specific and require a greater total number of installations at an airport. Space constraints make it difficult to accommodate the need for more proprietary kiosks; common use kiosks help to alleviate some of the congestion.
Computer-Aided Dispatch	A CAD is used by the airport operations center to allocate emergency personnel from various locations when emergency calls are received. The CAD timestamps when a call is received and allows notes to be taken as the caller is speaking; it can also record the phone call. If E-911 compliance measures have been put in place, integrating the CAD with the phone system can show the exact location of the caller. A duty roster and GIS assist in assigning the appropriate responder based on who is available and where they are stationed.
Computerized Maintenance Management System	A CMMS or enterprise asset management system is essential for proper support of maintenance functions, ranging from tracking work orders to handling requests for on-demand maintenance, scheduling preventive maintenance, managing facility resources, and tracking inventory and assets.

System	Description
	Ultimately, an effective CMMS helps achieve maximum operating efficiency while minimizing maintenance expenses, and it simplifies data analysis, reporting, and scheduling of maintenance functions. Computerized maintenance management systems vary in their levels of sophistication. The most common features are: • Plant inventory • Work order recording/tracking • Work scheduling • Work order closure • Work order history • Planned/preventive maintenance • Stock control/stores recording • System administration tools More sophisticated systems have additional features: • Links to other applications • Purchasing • Contract management • Document management • Web technology • Portable tool register • Reporting tools • Customization
Email	Email is a computer-based information exchange mechanism that uses the simple mail transfer protocol. Servers located on each domain house the email addresses of all registered users, not unlike a post office. Users interact with the server to receive or send emails to the addresses of other users on their or on other domains. Originally a text-only system, the addition of multipurpose Internet mail extensions to email now allows computer files to be attached.
Facility/Maintenance Systems	Facility/maintenance systems ensure that mechanical systems work properly so that building environments are pleasant and functional in all conditions, and they help the airport's staff keep the airport operating at peak performance. For example, a BMS monitors and automates many of the airport's building systems, such as power and heating, ventilation, and air conditioning. Two key systems in this category are: • Building management • Computer maintenance management
Financial Management System	Financial management systems analyze and store detailed financial data to help businesses make sound financial decisions. Functions these systems provide include: • General ledger • Cost accounting • Accounts payable • Accounts receivable • Case/treasury management • Budgeting

System	Description
	• Fixed asset management • Reporting
Fire Alarm	In general, a fire alarm system is classified as automatic, manually activated, or both. An automatic fire alarm system detects the unwanted presence of fire by monitoring environmental changes associated with combustion. It can be used to notify people to evacuate in the event of a fire or other emergency, to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.
Fuel Monitoring System	Fuel monitoring systems are used to manage aircraft refueling operations at airports. Typically, major users are identified via an access control methodology, ranging from a code entered on a keypad to transponder and RFID cards. When fueling begins, the type of fuel, quantity removed, and user identity are logged for billing purposes. Systems usually track fuel levels to ensure that adequate supplies are available, and some also monitor line pressure.
Geographic Information System	GIS, mapping software that provides location information for physical objects and events, is used by airports to track spatial occurrences in the air and on the ground. A GIS is a powerful model of an airport and its environs that integrates with many other airport systems to provide location information. In the air, a GIS can plan flight paths for efficiencies and covenants and model the noise generated. On the ground, a GIS can track landscape topography for civil projects while models of buildings and other structures track the placement of both hidden infrastructure, such as cable pathways and fire alarm plumbing, and visible objects, such as airport telephone locations. Data from GIS (CUTE) standard (Recommended Practice 1797), first implemented in 1984 when SITA's CUTE system was installed at Los Angeles mapping software can track locations, improve emergency response and maintenance, and allow future changes to the airport to be accurately modeled.
Human Resource Management System	Human resource management systems allow an organization to track, manage, and analyze information about employees, former employees, and applicants. When an airport's human resource management system is integrated with its financial management system, it can provide valuable information about possible scenarios based on a given business decision.
LAN, WAN and Wireless Communications Systems (Networking)	Communications systems encompass the electronic physical components that send signals over the cabling infrastructure or wireless system, as well as the type of communications intended—voice or data. The physical components include switches, routers, gateways, and wireless access points that select which route signals travel along and guide the signals to their intended destinations. Communications systems form the networks that control the communications methodology of all higher airport IT systems. They include:

System	Description
	• LAN • Wireless LAN • Telephony • Licensed wireless
Landside Systems	Landside IT systems are located in publicly accessible spaces, usually outside the terminal, and are not directly related to aviation operations but instead assist in passenger drop-off and pick-up at the airport. Many systems, such as AVI and PARC, generate revenue for the airport. Physically, they usually provide the first airport IT interactions with passengers starting or ending their trips. Landside systems include: • Audio paging • Automatic vehicle identification • Parking access and revenue control • Roadway dynamic signage
Licensed Wireless	Also known as trunked radio, uses frequencies licensed by the FCC to provide workers responsible for public safety, such as police, fire departments, and municipal services, with reliable secure radio communications. By using these frequencies, an increasingly limited radio spectrum can be used more efficiently by larger numbers of people because channels can be assigned to talk groups instead of frequencies. The primary benefit of this type of system is that many people can carry on many conversations over only a few distinct frequencies.
Local Area Network	The LAN refers to the local intelligent electronic components that transport, route, secure, and manage data sent over the cabling infrastructure. The networking technology in place determines which data transmission methods can be implemented and the upper limit of the speeds available for transmission. On an Ethernet LAN, the common standard of modern LANs, the following varieties are common: • 10 Megabits per second (Mbps) Ethernet • Fast Ethernet (100 Mbps) • Gigabit Ethernet (1,000 Mbps) • 10-Gigabit Ethernet (10,000 Mbps) The LAN components provide the bandwidth over which communications systems distribute and share data. Bandwidth refers to the amount of data that can be transmitted over a given network segment during a specific time period. Certain systems or applications, such as video and voice transmission, require large, dedicated amounts of bandwidth over the entire network. The process of guaranteeing this bandwidth is referred to as providing quality of service, which is possible only by properly configuring and implementing the network infrastructure. For example, if a class of service or 802.1p value is included in the Ethernet packet's header, traffic can be differentiated based on priority.

System	Description
	For logistical and security reasons, airports often have multiple LANs to segregate traffic. These LANs are either physically separate, using different hardware, or virtually separate, using encryption and other methods to ensure that only intended recipients can access the data. Airports vary in their decisions to dedicate a LAN to a specific user, but individual LANs are typically dedicated to airlines using the airport infrastructure, IT systems that do not require integration, and the administrative suite of network applications.
Local Departure Control System	LDCSs are used to process passengers and baggage for smaller airlines and charter flights that do not have a proprietary solution. Implemented as a stand-alone or part of a larger common-use solution, an LDCS will usually feature passenger check-in, baggage tag generation, seat assignment allocation, and advance passenger information system compliance.
Message Broker	A message broker provides decentralized information exchange between airport systems. When information of interest to multiple systems is updated in one system, the message broker ensures that the data is distributed to all systems requiring updating and is translated to the relevant local database format. As an integration mechanism, a message broker allows each airport system to maintain its own database in its chosen format and to ensure that information in each database is current and accurate.
Multi-User Flight Information Display System	MUFIDS provide flight information to the traveling public and to operational personnel on various types of monitors. Dynamic display systems such as MUFIDS have traditionally been implemented by individual airlines, but airport-installed and integrated systems have become more prevalent in the United States in the last 10 to 12 years. The typical MUFIDS has the flexibility to incorporate not only airline flight information functionality, but also information on baggage information display system (BIDS), gate information display system (GIDS), and ramp information display system (RIDS) processes, all of which use a common database. MUFIDS can support and consolidate the information of all airlines, eliminating the need for each to maintain a stand-alone system. The MUFIDS database allows each airline secure access to its set of flight data and restricts it from manipulating data associated with other airlines. Authorized airline users can perform all necessary updates and information queries using a common system interface. A typical MUFIDS is capable of handling free text messages (i.e., visual pages and general information) as well as full-motion graphics (e.g., video advertising). A significant advantage of airport-owned and -operated MUFIDS is that multiple data sources can be used to update flight information for all airlines, using direct data feeds from airline host systems as well as third-party providers of managed FAA flight information. Direct data feeds help ensure that the public sees accurate information and can reduce the effort required from on-site airline staff. FAA data can replace the airline-provided arriving flight

System	Description
	information if an airport elects to use methods that detect a significant difference (12 min, for example) between the airline-provided information and third-party FAA data.
Noise Monitoring	A noise monitoring system collects noise readings in the lands surrounding airports and correlates the data with aircraft movements. Usually these systems consist of multiple noise monitoring stations placed in sensitive neighborhoods, which relay data via cabled connection, radio, cellular network, or phone line back to a centralized server. The server compares the noise readings with aircraft movement locations to pinpoint a source and archive the data for retrieval upon complaint or violation. Aircraft locations are often retrieved from FAA radar.
Parking Access and Revenue Control	Airport parking systems, typically referred to as PARC systems, are often principal revenue centers for airports. Their features, management, and automation vary widely; a simple parking system, for example, may include collective lots with ticket machines at entry, staffed tollbooths at exit, and patrols to monitor proper use. At the other end of the spectrum are sophisticated garage complexes with features such as: • Designated areas for short-term, long-term, and preferred parkers. • Multiple payment options (such as automated pay stations, manual transactions at staffed toll booths, and payment through antenna-transponder systems). • Automatic revenue control and integration with airport financial systems. • Automatic regulation and monitoring of lot use (with devices such as AVI stations to regulate entry, automatic "lot full" signs, parking space proximity switches to track single vehicle stay times, and optical character recognition scanners to record license plate numbers). • License plate inventory using handheld devices to inventory vehicles and synchronize to a database of license plates to resolve lost ticket issues. Automated parking control systems, which range from stand-alone parking barrier gates to fully integrated computerized revenue control systems, typically have these components: • Barrier gate. • Ticket dispenser (spitter) issuing time-/date-stamped tickets automatically or by push-button control. • Key-card reader. • Electronic fee computer. Barrier gates used in parking control applications are typically equipped with automatic control logic and vehicle loop detectors and may include other features such as anti-tailgating, vehicle counting for monthly (contract) parkers and transient (hourly)

System	Description
	parkers, and sensitive reversing logic to reopen the gate arm should it strike an object during descent. A variety of access control devices are used for monthly parkers, including card readers, keypads, and radio controls. Ticket dispensers at entrances and parking fee computers at exits are useful for controlling revenue from transient parkers. At entry, a machine-readable system encodes the time and date on the ticket, and at exit the parking fee computer reads the ticket to calculate a fee, which is displayed to the cashier and customer. Details of the transaction are recorded for revenue and statistical reports. Automatic pay stations, sometimes called pay-on-foot stations, allow the patron to pay for parking before returning to the parking area. The machine calculates the parking fee, accepts payment, and re-encodes the parking ticket for use as an exit pass at an unattended exit gate. These machines may accept payment in the form of bills, coins, credit cards, vouchers (payment by a third party), or debit cards. Credit card processing systems with transport/validation units may be employed. Value card systems are sometimes used to create monthly passes or parking debit cards onsite.
Passenger Processing Systems	With more airports adopting a common use approach to their facilities each year, passenger processing, which was once the exclusive domain of the airlines, has evolved into a new category of airport systems for processing and guiding passengers. These systems provide the means for airports to operate a flexible environment in which multiple airlines can share resources for airport ticketing, gates, or baggage. Some of the individual systems in this category include: • Common use passenger processing. • Common use self-service kiosks. • Multi-user flight information display systems. • Baggage sortation and local departure control.
Perimeter Intrusion Detection System (PIDS)	A PIDS monitors, detects, and sends alarms when there is unauthorized entry to an airport's perimeter, secure area, or other equipment locations.
Property Management Systems	Property management systems help airports efficiently manage property and lease agreements, track and record tenant information and data, produce tenant billings, and manage tenant revenues. Because most airports have many airline and commercial contracts and subcontracts, and nearly as many variations and terms, those responsible for managing revenue flows are constantly challenged to simplify and improve efficiency. Billing and accounting processes often require data to be collected from many different sources on a daily, weekly, or monthly basis, creating many opportunities for mistakes, unnecessary paperwork, and miscommunications. To rectify this problem, in the early 1990s officials began replacing manual or partially automated accounting and billing systems with

System	Description
	technologies that streamline and consolidate data as it comes from each commercial tenant, licensor, third party contractor, subcontractor, or partner.
Resource Management System	An RMS helps operations assign common use resources, including gates, ticket counters, baggage claim carousels, remote parking stands, and baggage makeup conveyors. The RMS also helps operations manage these resources by providing planning functions, best-fit recommendations, and real-time conflict warnings. The RMS is integrated with common use systems so that resources can be automatically assigned and transferred. The RMS has a rule base that allows users to define airport-specific rules, including physical limitations (e.g., gate can't support wide body aircraft), convenience rules (e.g., location of ground handling equipment), and carrier preferences or restrictions. The rule base, flexible enough to take into account the many factors involved in assigning resources, helps with both the planning of gates and real-time conflict resolution. The supplying vendor coordinates with operations to configure the rule base initially. Because the rule base provides a simple-to-use rule-definition interface (no programming required), operations can maintain the rule base over the long term without vendor support. The rule base is coupled with an optimization routine that includes the necessary algorithms to produce best-fit assignments.
Ring-Down Circuit	A ring-down circuit is a direct physical phone line between two locations. Lifting a telephone receiver at one end causes the other to ring. Ring-down circuits are used at airports to provide direct communications lines in emergencies. Usually these phone lines directly connect the FAA air traffic control tower, the airport operations center, and the aircraft rescue fire fighting station. In case of power outage, ring-down circuits are powered by batteries to minimize service disruptions.
Roadway Dynamic Signage	Electronic roadway dynamic signage can be dynamically modified to provide general information and assist with airport operations and wayfinding—the process by which people find and navigate a path through a physical environment. Wayfinding information should allow people to develop and follow a plan for moving in the best manner possible from their current position to a destination, even if the destination's location is unknown. Roadway dynamic signage and portable variable message signs can convey valuable general information to travelers, such as the current national threat advisory, with the primary message stating the color of the threat level and the secondary message offering guidance to the traveler, depending on threat level.
Safety/Security Systems	Safety/security systems are critical in today's environment so that airports operate effectively and keep the traveling public safe. These systems provide video surveillance, controlled and monitored access to secure areas, and the ability to detect, announce, and control

System	Description
	disaster situations at an airport. Systems in this category include: • Closed-circuit TV • Access control • Perimeter detection • Badging • Fire alarm • Computed aided dispatch • Ring-down circuits
Structured Cabling System (SCS)	The SCS provides an organized, logical structure for the cabling infrastructure so that all necessary communications pathways are fault tolerant and efficient. In the SCS, fiber optic and/or copper cables are routed between each of the airport's communications rooms (which are the distribution points for end users of various airport systems) and from those rooms to user workstations. The cabling routed between communications rooms is known as "backbone" cabling, whereas the cabling to user workstations is "station" or "horizontal" cabling. With a life span of 15 to 20 years, the SCS is the longest-lived part of the communications infrastructure. Because the SCS is not easily replaced once installed, solid design and engineering practices must be employed during the planning and design phases.
Surface Movement Guidance and Control System	SMGCS is an advanced taxiway and runway lighting control system for directing aircraft and airport vehicle movements when visibility is low. Operated by the FAA air traffic control, the system utilizes sensors, stop bars, and other lighting aids to ensure safe taxiing and prevent runway incursions.
Surface Movement Radar	Surface movement radar is a high-frequency radar for identifying the location of vehicles and aircraft on airport taxiways and runways when direct line of sight is not available. A server correlates the positions of detected vehicles with other data sources and removes interference from environmental conditions such as rain. Vehicle locations are made available on monitors in the FAA air traffic control and ramp control towers staffed by the airport or tenants.
Systems Integration	The integration layer coordinates and shares information between end-user systems, either by directly linking two systems—controlled by one of the systems, both, or a third system—or by way of a shared common information pool. Integration ensures that accurate, timely information is available across IT systems and increases the value of each piece of the system. The more an airport invests in its IT systems, the more that integrating these systems benefits its operations. For example, by: • Improving staff efficiency by sharing information across both operations and administrative systems. • Simplifying the addition of new systems and reducing the cost of adding new systems thanks to a common infrastructure. • Simplifying information distribution to employees,

System	Description
	• Providing for a higher level of redundancy, which improves system and data availability. • Using a centralized data repository and dissemination, which cuts down on human handling of data and associated errors—thus improving data accuracy and response time. • Making larger amounts of data readily available to management, allowing the organization and revenues to be fine-tuned. • Simplifying staff maintenance and support requirements by using common technology standards (both hardware and software). Individual components to address when establishing an overall systems integration strategy at an airport include the core infrastructure (made up of the structured cabling system, LAN, airport operational database, and airport IT systems), and overall information management. To implement a properly functioning integrated system, each functional component must be defined. These components are not independent, and no one component is more important than another.
Systems Manager	A systems manager is a software application that ties together the management capabilities of many systems and integrates them with a common work process for handling troubles, maintaining configurations, reporting, and performance analysis. Systems managers are intended to deliver a uniform view of all the systems, often in graphical format, and frequently with substantial rules-based intelligence. It is important to note that a systems manager is a software tool that manages the managers of specific systems. As an example, if a network error causes a group of components from several different systems to become isolated, the managers of each of those systems may send several alarms. This can be overwhelming. A systems manager will correlate these alarms and using rules and perhaps other types of artificial intelligence, provide the systems operations staff with simplified alerting and diagnostics. This correlation allows for faster response. In some cases, the systems manager may even be programmed to take the corrective action.
Telephony	The primary voice system technologies used today are: • Centrex (central office exchange service) • PBX • VoIP Centrex service is a central office (CO) based communications system equipped with primary station lines, capable of receiving direct in-dialed calls and direct out-dialed calls. Centrex is a service that has been in existence for a long time; the service provider owns, operates, services, and maintains all the hardware and software to operate the Centrex system and charges users a monthly rental or lease fee.

System	Description
	Centrex is basically the service you receive at home, only with added features such as intercom and call transfer. A useful aspect of Centrex is that it can accommodate entities that need the look and feel of a single phone system for large or diverse physical locations. With Centrex, each station (or line port) has access to a dedicated trunk in the provider's CO on a one-to-one basis. To add modern functionality, a key or hybrid key system is sometimes added, or the CO is equipped with additional hardware and software. Although key/hybrid systems provide additional features, in large applications several of them are required at multiple locations. These systems generally do not communicate with each other and must be maintained separately, which increases operation costs. The **PBX** system has been the industry leader over the last several decades for providing voice services using customer premises equipment. Generally, PBX systems are owned by the customer and consist of centralized hardware and software with dedicated hardwire connections to each station (telephone) and each outside trunk line (dial tone). In this centralized system, a matrix switch connects telephones to outside lines or to other telephones inside the system. The PBX provides extensive features and can be customized for flexibility, diversity, and control. Although the customer owns or leases the PBX, a third-party vendor often services, maintains, and handles MAC for the system—except in larger applications, when these tasks are often handled in-house. Routine maintenance and normal MACs on a PBX require personnel certified from the manufacturer to enable log-on permission to the system; without this certification, all warranties are voided. In a traditional environment, the PBX system supports all voice traffic while the LAN supports all data traffic, a setup that requires separate voice and data distribution systems. For each of these two systems, all cabling, hardware, software, power, maintenance, support, and management are separate. With the popularity of VoIP technologies, traditional PBX manufacturers are now incorporating interface gateways in their PBX offerings to provide both traditional and VoIP telephony. VoIP technology treats a voice call as a data transmission. The voice is received, converted to a packet, and transmitted over a data LAN instead of through a PBX system matrix. When a call is sent to a location internal to the LAN, it stays under the control of the data network. When a call is sent to an external location (off the LAN), the call is routed to an outside line or trunk. VoIP technology is beginning to supplant traditional PBX telephone systems in many new airport construction projects because it's more cost-effective to eliminate a separate, dedicated telephony cabling infrastructure. VoIP offers a more robust communications experience than PBX because it can integrate with email and instant messaging, allowing users to receive voice mail via email and seamlessly switch between text chatting and telephone conversations.

System	Description
Website	A website is a virtual presence on the World Wide Web that provides text, images, video, and other digital assets on one or more virtual pages found on a single Internet protocol (IP) address or domain name. Users of the Internet reach a website by entering its IP address or domain name into the uniform resource locator (URL) bar on their Internet browser. Airports use websites primarily to disseminate information to the travelling public, including information about layout of the facilities, security measures, flight arrivals and departures, parking, and retailers located at the airport.
Wide Area Network	WAN is formed by two or more individual LANs connected via a long-distance network—often provided by leased fiber or copper cabling or wireless microwave relay. Airports frequently use WANs to connect multiple airfields and city or county government LANs. The Internet is the world's largest WAN, and the Internet can also be used within an airport to connect networks and form a WAN.
Wireless LAN	The main focus of an unlicensed wireless system is to provide network connectivity to mobile users. Wireless components can also be added to LAN infrastructures to support a variety of systems and applications. In most installations, the wireless component is an extension of the wired network, and the wireless access points are physically connected to access layer switches in the same configuration as an end-user device. In some installations, additional devices are connected to the network's core to provide wireless monitoring, configuration, and management.

APPENDIX C

Airport and IT Acronyms and Abbreviations

Acronym/ Abbreviation	Full Phrase	Description
ACC	Airport Communications Center	A centralized communications facility that provides emergency dispatch, airport information services, and other customer services, such as lost and found, to the traveling public.
ACI	Airports Council International	A trade and standards association representing the interests of global airports with international organizations and governments.
ACS	Access Control System	A physical security system deployed to restrict access to sections of an airport to select authorized personnel. Users are typically issued access cards that validate permissions at access points against a database.
ADA	Americans with Disabilities Act (2008)	An act of Congress signed into law in September 2008 modifying the ADA (1990), which prohibits, under certain circumstances, discrimination based on disability.
AGRS	Air to Ground Radio Service	A radio link between aircraft and ground-based operators.
ALCS	Airport Lighting Control System	A monitoring and control system for the taxiway and runway lights of an airport.
AOA	Airport Operations Area	The space inside the airport perimeter designated for aircraft landing, taking off, and ground movement. Spaces include taxiways, runways, ramps, and aprons.
AOC	Airport Operations Center	The office within an airport where troubles are reported and dispatching occurs. Often in operation 24/7.
AODB	Airport Operational Database	A single, centralized database used to store and share flight schedules, resource assignments, and other airport data with other airport systems.
APIS	Advance Passenger Information System	The system that collects passenger manifest information for customs and border patrol.
APS	Audio Paging System	An announcement system used to amplify, store, and broadcast messages via microphone or telephone over designated airport terminal zones.

Acronym/ Abbreviation	Full Phrase	Description
ARFF	Aircraft Rescue Fire Fighting	A designated airport fire and rescue group trained and equipped specifically to deal with accidents involving aircraft.
ATB	Automatic Ticket and Boarding Pass Printer	A printer located at ticketing and gate locations for agents to use; also located within CUSS kiosks to produce boarding passes and tickets for passengers.
ATC	Air Traffic Control	Ground-based controllers responsible for the organization and flow of airborne aircraft traffic to ensure adequate separation between aircraft and to provide support.
ATM	Asynchronous Transfer Mode	A network protocol utilizing fixed-size packets to ensure fast transmission over bandwidth-restricted networks.
AVI	Automatic Vehicle Identification	A technology used by airports to identify individual ground transportation vehicles in designated pick-up/drop-off areas. Individual vehicles are registered in a database and issued unique transponders. Readers at airport entrances and exits read the transponders and determine charges based on a ground transportation model.
AWOS	Automated Weather Observing System	A system that automatically measures a series of weather statistics and broadcasts them via radio to aircraft both on the ground and airborne.
BHS	Baggage Handling System	A physical conveyer transportation system for airport baggage between the check-in positions and airside baggage makeup.
BICSI	Building Industry Consulting Services International	An international industry and standards group for voice, data, and video distribution system design and implementation.
BIDS	Baggage Information Display System	A system that collects baggage sort information and displays it for passengers at baggage claim and for ramp workers on the airside baggage makeup.
BMS	Building Management System	A control, monitoring, and automation system for building electrical and mechanical systems, traditionally including heating, ventilation, and air conditioning, lighting, and electrical backup generators.
BSS	Baggage Sort System	Baggage tag readers and baggage conveyer switching/sorting equipment used to read baggage tags and divert them to their intended destinations.
BTP	Baggage Tag Printer	A printer located at check-in and gate positions and within self-tagging enabled CUSS kiosks that is used to produce baggage tags to be affixed to checked luggage.
CAD	Computer-Aided Design	A computer software drafting application used extensively to develop architectural and engineering solutions at airports.

Acronym/ Abbreviation	Full Phrase	Description
CAD	Computer-Aided Dispatch	Software that coordinates the dispatch of airport support personnel by dispatch coordinators.
CATV	Cable Television	A coaxial cable distribution network used to transmit television signals over a physical medium. Often used at airports to transport airport-specific programming to hold-room televisions.
CCTV	Closed Circuit Television	Surveillance video transmitted from cameras via a network to monitors or digital video recorders.
CENTREX	Central Office Exchange Service	A PBX-like telephone service where the common carrier operates the PBX and provides the service on a per-line basis.
CLEC	Competitive Local Exchange Carrier	A telecommunications provider that competes with the incumbent LEC by using the LEC infrastructure to provide service or resell LEC service.
CMS	Cable Management System	Database software used to track the attributes and terminations of individual segments of cable, which is achieved either by manual input or automatic integration with switches.
CMMS	Computerized Maintenance Management System	A computer system for managing workflow and assignment of maintenance personnel. Many CMMS systems also manage parts inventories.
CO	Central Office	Telephone company's communications hub.
CONOP	Concept of Operations	A document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system.
COOP	Continuity of Operations Plan	A document that provides instructions for how to maintain operations during times of emergency or degraded capability.
COTS	Commercial Off-the-Shelf	Software application that is built ready-made for sale by a vendor. The software can be enhanced by user when necessary.
CoS	Class of Service	A priority system for marking data that have different performance requirements.
CPE	Customer Premises Equipment	Telephone equipment that is owned by and resides on the end user's premises.
CUPPS	Common Use Passenger Processing System	Software and hardware standards designed to allow a single passenger processing station to serve multiple airlines. These standards overhaul the original CUTE standards.
CUSS	Common Use Self-Service	Software and hardware standards developed to allow a single self-service kiosk to serve multiple airlines.
CUTE	Common Use Terminal Equipment	Software and hardware standards approved by IATA to allow multiple airlines to share passenger check-in and gate positions. This standard has been supplanted by CUPPS.

Acronym/ Abbreviation	Full Phrase	Description
DAS	Distributed Antenna System	An array of antennas connected by a common infrastructure that permits wireless services to be transmitted over an obstructed area.
DDC	Digital Display Controller	A small computer consisting of a microprocessor, graphics card, and network connection used to render information for display on monitors. These are found directly connected to BIDS, GIDS, and flight information display system (FIDS) monitors.
DMS	Document Management System	Computer software used to track and store digitized copies of documents.
E-911	Enhanced 911	The capability to report information such as location when a 911 call is placed.
EAM	Enterprise Asset Management	Asset management software system that is used throughout the enterprise to track, manage, service, dispose of, and replace assets.
EDS	Explosives Detection System	Devices used in conjunction with the baggage handling system to scan all checked baggage and detect weapons and explosives.
EOC	Emergency Operations Center	A centralized command and control facility responsible for emergency and disaster planning and management.
ERP	Enterprise Resource Planning (System)	A set of database programs designed to store and manage all information associated with a business, with full integration.
ETD	Explosives Trace Detection	A system for detecting explosives by sensing traces of residue on hands, clothing, or personal articles.
FAA	Federal Aviation Administration	An agency of the United States Department of Transportation responsible for oversight and regulation of all aspects of domestic civil aviation.
FAR	Federal Aviation Regulation	Rules made by the FAA governing aviation activities within the United States. They form part of Title 14 of the Code of Federal Regulations.
FBO	Fixed Base Operator	A commercial business granted the right by the airport sponsor to operate in an airport and provide aeronautical services such as fueling, hangaring, parking, aircraft rental, aircraft maintenance, and flight instruction.
FCC	Federal Communications Commission	An independent agency of the federal government of the United States responsible for the radio spectrum and telecommunications.
FIDS	Flight Information Display System	A networked system at an airport used to display real-time flight arrival and departure information.
GHz	Gigahertz	A rate of billions of cycles per second. Commonly used to measure microprocessor speed in computers and radio frequency.
GIDS	Gate Information Display System	A FIDS system specifically concerned with airport departure gate information.

Acronym/ Abbreviation	Full Phrase	Description
GIS	Geographic Information System	A geographic placement system used by airports to accurately represent the location of infrastructure and assets on maps and blueprints.
GMS	Gate Management System	A system for assigning aircraft to specific airport gates and recording presence.
GPS	Global Positioning System	A constellation of satellites placed in orbit by the United States government and used by receiving devices to calculate and display location, speed, and time information to users.
GUI	Graphical User Interface	The visual piece of computer software displayed on a monitor, through which people interact with the software.
HVAC	Heating, Ventilation, and Air Conditioning	The mechanical devices used to heat, cool, and exchange air in an airport to provide a comfortable, healthy environment.
IATA	International Air Transport Association	The international association whose membership is airlines.
ICAO	International Civil Aviation Organization	An agency of the United Nations that facilitates development of policies and techniques for international air travel.
IDF	Intermediate Distribution Frame	A cabling infrastructure distribution point, usually a designated room or closet.
IEEE	Institute of Electrical and Electronics Engineers	An international professional organization dedicated to the advancement of electrical technology.
IP	Internet Protocol	The communications protocol used on the Internet.
IT	Information Technology	The study, design, development, implementation, support, and management of computer-based information systems, particularly software applications and computer hardware.
ITIL	Information Technology Infrastructure Library	A set of concepts and practices for managing IT services, development, and operations, which is maintained by a division of the treasury of the United Kingdom.
Kbps	Kilobits per second	A data transmission rate in thousands of bits per second.
LAN	Local Area Network	A computer network covering a smaller physical space, such as an airport terminal, without the need for long-distance cabling
LATA	Local Access Transport Area	Geographic divisions in the United States that form telephone company service areas.
LCD	Liquid Crystal Display	A thin, low-energy monitor display technology that uses liquid crystals to produce images.
LDCS	Local Departure Control System	A check-in system that manages passenger seat assignments, baggage, and boarding for airlines.
LEC	Local Exchange Carrier	A regulatory designation of a telecommunications company usually referring to the original or incumbent local telephone company in a given region.

Acronym/ Abbreviation	Full Phrase	Description
LPI	License Plate Inventory	A system using optical character reading to sense and record license plates on automobiles. It is often used in parking lots to detect overstays.
MAC	Moves, Adds, and Changes	An alteration of the airport network indicating that cabling has been added, moved, or altered.
MCR	Main Communications Room	A room that houses the central node of a network. It is often indicated by the presence of one or more core switches and a minimum point of entry.
MDF	Main Distribution Frame	The designated location of the central interconnection point of cabling infrastructure.
MHz	Megahertz	A rate of millions of cycles per second. Commonly used to measure microprocessor speed in computers and radio frequency.
MIME	Multipurpose Internet Mail Extensions	An Internet standard that extends the format of email.
MPOE	Minimum Point of Entry	The closest point to where telecommunications cables from external service providers enter a building.
MSR	Magnetic Stripe Reader	A device for reading the magnetic stripe on certain information cards.
MTBF	Mean Time Between Failures	The predicted time a given system will operate, on an average basis, without a significant fault.
MUFIDS	Multi-User Flight Information System	A common FIDS shared between airlines.
NEC	National Electrical Code	A standard for the safe installation of wiring developed by the National Fire Protection Association and often mandated by local and state law.
NIC	Network Interface Card	A device in a computer that translates and exchanges information on a network. It's the card the network cable plugs into.
NTP	Network Time Protocol	A standard protocol for synchronizing time in an accurate manner over a packet-switched network between devices on the network.
OCR	Optical Character Recognition	Technology that translates images of text into data characters through vision matching, pattern recognition, and artificial intelligence.
OSI	Open System Interconnection	An industry standard for the interoperation of software and hardware modules.
PARC	Parking Access and Revenue Control	A system used to track the time a vehicle is parked in a lot, calculate charges, bill, and accept payment.
PBX	Private Branch Exchange	A switch that supports telephone connectivity within an airport and provides access to the outside public switched telephone network. It is owned and operated by the airport.
PC	Personal Computer	A general-purpose computer or workstation with the microprocessor and storage to function as a stand-alone unit even when connected via a network.

Acronym/ Abbreviation	Full Phrase	Description
PDS	Premises Distribution System	The planned physical cabling system designed to transmit voice, video, and data within a campus.
PFC	Passenger Facility Charge	A charge levied by an airport on an airline for each passenger serviced.
PIDS	Perimeter Intrusion Detection System	A method of monitoring perimeters and fence lines, often with radar or intelligent video cameras, that alerts when an area has been breached.
PMP	Project Management Plan	A document used at the start of the implementation phase to organize the work associated with building a system.
PoE	Power over Ethernet	Refers to IEEE standard 802.3af, which describes a system to safely pass electrical power, along with data, on Ethernet cabling.
PSAP	Public Safety Answering Point	A call center responsible for answering telephone requests for help via designated emergency numbers such as 911.
PSTN	Public Switched Telephone Network	The physical telephone network that connects and routes all telephone calls outside of PBXs.
PTZ	Pan Tilt Zoom (Camera)	A variety of CCTV cameras capable of physically moving on two axes and using zoom to simulate a third. It is often deployed by airports to be manually controlled by operators or automatically move position in response to a trigger.
QoS	Quality of Service	The ability to apply different priorities to the transmission of certain packets on networks. For time-sensitive information, such as voice or video transmission, QoS ensures that speed will not be reduced by less vital packets.
RAID	Redundant Array of Independent Drives	A series of data storage technologies that can provide duplication, faster recall, and reduced error rates by splitting data across multiple physical hard disks.
RF	Radio Frequency	The wavelength of electromagnetic radiation.
RFID	Radio Frequency Identification	A wireless method of identifying an object. The distinct chips are often imbedded in airport identification cards and compared against a database when a signal is received by a reader.
RIDS	Ramp Information Display System	A system that displays flight, gate, and other pertinent information to ramp crews via exterior dynamic signs and monitors.
RJ	Regional Jet	An aircraft smaller than a narrow body that is often used on feeder routes.
RMS	Revenue Management System	An integration technology that accepts and translates the multiple sources of revenue information at an airport and places them in the financial system.

Acronym/ Abbreviation	Full Phrase	Description
RMS	Resource Management System	A computer system that uses the planned flight schedule and operational updates to allocate check-in counters, gates, and bag belts to certain flights. It is often used in conjunction with a common use system.
ROI	Return on Investment	An evaluation ratio to determine the percentage of an asset's cost that will be recouped over a given time frame.
RVR	Runway Visual Range	The maximum distance at which the markings on a runway are visible to an observer measured by instruments located by the runway.
RWIS	Runway Weather Information System	A meteorological system for determining the surface and proximal weather conditions of a runway using a surface scan system and other sensors.
SCS	Structured Cabling System	A campus telecommunications infrastructure consisting of standardized elements.
SIDA	Security Identification Display Area	A restricted section of an airport in which only badged and trained individuals in compliance with title 49 of the Code of Federal Regulations are allowed.
SMGCS	Surface Movement Guidance and Control System	A prescribed system used to ensure safe ground movements of vehicles and aircraft in low visibility situations.
SMTP	Simple Mail Transfer Protocol	The mail protocol that is used to send email from server to server on the Internet.
SNMP	Simple Network Management Protocol	A network protocol used to monitor network-attached devices for a variety of events that may warrant attention.
SONET	Synchronous Optical Network	A WAN technology that provides redundant counter-rotating ring connectivity that spans large geographical distances.
SQL	Structure Query Language	A standard computer language used to design, query, and alter data in databases.
SSS	Surface Scan System	Sensors used to transmit aircraft movement surface information to a RWIS.
STS	Shared Tenant Services	An airport's provisioning of services such as telephone and Internet for resale to tenants to control infrastructure and generate revenue.
TCP/IP	Transmission Control Protocol/Internet Protocol	A set of transmission protocols commonly used over the Internet and on LANs.
TSA	Transportation Security Administration	An agency of the Department of Homeland Security tasked with screening baggage; inspecting airports, aircraft and cargo; and providing in-flight covert protection through its Federal Air Marshalls program.

Acronym/ Abbreviation	Full Phrase	Description
UHF	Ultra High Frequency	Electromagnetic waves with frequencies between 300 MHz and 3 GHz. These frequencies are used by cellular phones, GPS systems, and airport trunked radio systems.
UPS	Uninterruptible Power Supply	A battery backup for electrical failures deployed by airports to bridge power outages caused by external failures and the use of internal generators.
VHF	Very High Frequency	Electromagnetic waves with frequencies between 30 MHz and 300 MHz. These frequencies are used by air traffic control, FM radio, and television broadcasts.
VLAN	Virtual Local Area Network	The virtual segregation of a single physical LAN into multiple LANs operating on the same infrastructure.
VMS	Variable Message Sign	A dynamic sign typically displaying dot-matrix text information. These signs are used at airports to send roadway messages to the traveling public and over gates as displays for the RIDS.
VoIP	Voice over Internet Protocol	VoIP technology treats a voice call as a data transmission, allowing voice conversations to be sent over the data network. VoIP is typically used as a telephone system to eliminate the need for a separate telephony infrastructure. VoIP often reduces or eliminates the toll charges of the copper wire system.
VPN	Virtual Private Network	A logical network layer implemented to create a private and secure data path over an otherwise unsecure network.
WAN	Wide Area Network	A computer network covering a vast area, in contrast to a LAN. WANs often require leased external cables and stretch over distances
WAO	Work Area Outlets	The permanent end termination point of the physical network infrastructure. End-user devices are plugged into the WAO via the final length of cable.
Wi-Fi	Wireless Fidelity	Wireless LAN service based on the IEEE 802.11 standard. Wi-Fi is often used to connect to the Internet and other services wirelessly inside an airport terminal.

References

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Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation