Breaking the Mold: Forging a Common Defense Manufacturing Vision

Committee on Defense Manufacturing Strategy,
Commission on Engineering and Technical Systems,
National Research Council

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BREAKING THE MOLD

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William G. Howard, Jr.
Chairman

Preface

The Committee on Defense Manufacturing Strategy of the National Research Council's Manufacturing Studies Board was asked by the Under Secretary of Defense for Acquisition to advise the Department of Defense (DoD) regarding development of an effective manufacturing strategy. The committee's work was intended to help DoD identify policy options, based on changes in civilian and defense manufacturing, that would improve DoD's ability to use the total U.S. manufacturing base, to make smarter policy decisions related to the defense industrial base, and to define long-term research and investment strategies for manufacturing technology.

Given this broad scope, the committee established four working panels, each responsible for a specific aspect of defense manufacturing strategy: national manufacturing perspectives, policy, program initiatives, and suppliers. A colloquium was held June 5–6, 1990, to provide a common starting point for the panels. Dr. Jacques Gansler, a member of the committee and chairman of its Panel on National Perspective, described the scope and key issues for a defense manufacturing strategy based on economic and political trends. During the following six months, each of the panels addressed the barriers to, and opportunities for, a defense manufacturing strategy in their respective areas. The four panel reports were delivered to the committee by January 1, 1991. (Summaries of these reports are in Appendix A.)

The committee noted that the panels identified many of the same problems that have plagued the DoD for decades and have been addressed in prior studies. In fact, these problems have spawned hundreds of reports but their recommendations have resulted in little fundamental or systemic improvement in the way defense systems are designed, developed, and pro

duced. This committee did not believe that another recital of similar recommendations for specific defense manufacturing programs was likely to be any more effective than earlier efforts.

Concurrently, Operations Desert Shield and Desert Storm were instructive to the committee's deliberations. U.S. forces in the Gulf confirmed beyond doubt that the U.S. military is equipped with superior weaponry that performs reliably, predictably, and, in some cases, amazingly. The committee, however, also was reminded of weaponry cost and questioned whether such capability can be maintained given the pressing trends of global production, escalating hardware costs, increasing levels of technological sophistication, and dependence upon offshore technologies. The committee concluded that these problems, already relevant to business executives, must be addressed by defense planners. Therefore, in fulfilling its charge, the committee framed its defense manufacturing strategy around contemporary, and evolving, principles that are shaping the management practices of leading manufacturers, including defense manufacturers. (Defense, unfortunately, lags behind commercial practice to its disadvantage in many of these practices.)

The committee holds that substantial change within the defense manufacturing sector is required. The necessary changes are by no means limited to improved acquisition regulations, and, in fact, are not limited to the DoD. The entire defense community—contractors, DoD, Congress, and the Office of Management and Budget (OMB)—must be involved in an interrelated "Change Process" to achieve the benefits that are possible and essential.

In this report the committee describes a process for achieving the change needed within the defense community. Dozens of reports have identified *what* to change in defense manufacturing. We, here, try to describe *how* to change; that is, a management process (already under way in U.S. industry) that should be applied. The payoff is enormous—our current arsenal could be maintained for perhaps 30 percent less cost and with higher reliability and improved responsiveness. *That* is worthwhile.

There no doubt will be strong resistance to the change process outlined by the committee, but similar change has already started in many manufacturing companies. The end of the Cold War has brought different missions, reduced defense spending, and shifting acquisition priorities. The committee believes that initiating a major change process will minimize the loss of critical capabilities in a shrinking defense market and, at the same time, result in very significant cost, quality, and timeliness improvements in the design and production of weapon systems. Improvement will be slow but steady, provided there is constancy of purpose at the senior levels of DoD, the Congress, and corporations. The end of the Cold War provides an unusual opportunity, unparalleled in the past five decades, to effect such a change.

William G. Howard, Jr.
Chairman

Contents

Executive Summary

In 1992, the U.S. Department of Defense (DoD) spent over $75 billion on manufactured products (mainly weapon systems and other military equipment), more than 25 percent of the total defense budget of $290 billion. Although the defense budget will decline in real terms over the coming years, funding for procurement of manufactured items for defense will remain a significant proportion of the budget. While procurement budgets decline, however, weapon system performance, unit costs, and operation and support costs can be expected to increase along historical trends. Given these conflicting pressures, the predominant characteristic of the defense procurement environment in the 1990s will be "do more with less."

Arguably, this situation pervades defense acquisition, particularly if judged by the attention paid to improvement of the procurement system. Dozens of reports, including those from the Packard Commission, the General Accounting Office, and DoD itself, have urged shifts in weapon acquisition policies and procedures. (See Appendix B for summaries of a few.) Panels of this committee have made similar observations. (See Appendix A.) Despite substantial consensus among these various panels and committees on *what* DoD needs to change, their reports have made little impact, not because the recommendations were wrong—on the contrary, most of the recommendations make sense—but because they offered little guidance on *how* to achieve change. This committee has concentrated on the change process, for it is the manufacturing management process that has changed most during the past decade.

The approach, so far adopted by a small but growing number of compa

nies such as General Electric, Motorola, Ford, and Xerox, requires an iterative *process* for developing a new vision of manufacturing and its role in the corporation. Top executive commitment to the change process, deployment of adequate resources, continual action, reinforcement, and feedback are required. All, or nearly all, employees are involved, both in making the process work and in finding ways to improve it. Successful corporations have discovered that, contrary to conventional wisdom (which stimulates significant investment and management attention) technology is not the problem; application of technology by people is the problem. These organizations formerly suffered from the same inertia and active resistance that must be overcome to produce meaningful improvement in defense; but, with assertive leadership, effort, and time—and the recognition that it had to be done—these corporations achieved *major* gains in cost, quality, and time to market.

Their results prove that it is possible for the DoD to make the same sort of transformation. Already within the uniformed services, and within defense contracting firms, small units have applied these new techniques successfully. For instance, the Air Force Logistics Command received the President's Award for Quality and Productivity in 1991 as a result of the operational improvements from its total quality initiative. Rockwell Missile Systems Division in Duluth, Georgia is one example of a defense contractor that has pursued total quality aggressively with impressive results. Unfortunately, such examples remain isolated and are not as effective as they could be because they are so inconsistent with the surrounding web of DoD procedures and requirements.

Technology is not the problem. Clearly, new technologies are required, and can help significantly in making improvements. Much of this technology now exists and the rest can be developed, as long as the DoD is willing to make a significant reallocation of its resources—from an almost total focus on "product R&D" to a significant balance with "process R&D"—as has been the case in successful world-class corporations. In addition to "hard" investments in process technology, major investment in "soft" technology (e.g., training) also is required. This shift of resources and management focus to manufacturing is needed to implement the required changes successfully.

The committee recognizes that the change process unfolding at many commercial manufacturers is not strictly analogous to the process needed for DoD. While learning as many lessons as possible from commercial successes and failures, DoD must invent its own unique change process. Accordingly, this report describes a process for change in defense acquisition that the committee believes must occur sooner or later, driven by the rapid changes in industry and by DoD's need for lower cost, high-quality weapons during the next decade and beyond.

IMPLEMENTING A NEW DEFENSE MANUFACTURING STRATEGY: AN ILLUSTRATIVE MODEL

Changing the DoD's approach to acquisition of manufactured goods will require substantial effort at all the levels of the hierarchy within defense production and acquisition organizations, including the Office of the Secretary of Defense, the military services, the contractor and supplier base, and the Congress. Although the specific mechanisms for effective cooperation among these major constituencies are impossible to define and will evolve over time, the committee offers the following model to illustrate in specific terms how such cooperation in an effective change process might occur. The model includes four major phases of effort. To ensure the appropriate senior level of involvement, these phases would be managed from the Office of the Secretary of Defense, with the Deputy Secretary serving as Chief Executive Officer (CEO) and the Under Secretary for Acquisition serving as Chief Operating Officer (COO).

Create a Vision of Manufacturing

A *widely shared* vision of how defense procurement should be conducted several years from now must be developed. To be effective, the view must be shared by Congress, the White House, the Department of Defense, and defense contractors.

To create such a shared vision, a senior group of officials, including the Secretary of Defense, the Deputy Secretary of Defense, the Under Secretary of Defense for Acquisition, the Chairman of the Joint Chiefs of Staff, the military service secretaries, the chairmen of the House and Senate Armed Services Committees, the director of the Office of Management and Budget (OMB), and a few chief executive officers from the defense industry and from companies with successful change processes, must achieve a consensus on issues such as:

- improvement goals for cost, quality, time, and technical performance over the next decade, and how to manage inevitable trade-offs among these goals;
- control mechanisms to ensure effective and efficient procurements without onerous regulatory requirements;
- rate and sequence of change sought in the myriad of procedures, procurement policies, technical specifications, and practices that currently exist; and
- personnel policies regarding responsibilities, training, teamwork, performance review, and promotion.

Create a Working Cadre

A working cadre should be formed to address the operational details of achieving the vision. For a task of this magnitude, the working cadre will probably consist of 200 to 300 uniformed officers and civilians. The cadre will work for 5 to 10 years helping to lead the change. Tours of duty will range between 2 and 4 years for individuals.

Types of personnel represented within the working cadre should include:

- program managers from the military services and contracting firms,
- line officers,
- finance and contract administrators,
- engineers and manufacturing experts, and
- personnel and civil service experts.

Individuals who are likely to be leaders of their organizations in 5 to 10 years should be selected. Current or former congressional staff members from both parties who have recognized competence and understanding of both the political process and the weapon systems procurement process should be included.

Substantial training of the cadre is essential. Three months of full-time training in organizational change will be necessary, using facilitators and experts. Several days should be spent with the vision team during this period to understand their interests, commitment, and objectives.

Select a Change Strategy

The choices facing both the vision team and the working cadre include:

- Should the change be introduced broadly across all of DoD, or more narrowly?
- Should significant change be undertaken in those organizations that are "change ready," or in those organizations that need it most urgently but may resist strongly?
- In order to break the old system, should change be undertaken where it is easiest, or most significant, or most disruptive?
- Should change be attempted only for new, rather than existing, weapon systems, on large systems rather than small, or on systems that have a simpler customer/supplier relationship?
- Should change be undertaken where it can be accomplished by DoD directive alone, or is it more useful to address problems that will require Congress, OMB, contractors, and DoD to arrive at a new operating method?

- Can the mechanisms chosen to implement the change process accommodate the existing promotion system, or must amendment or exception be taken for those officers in the promotion zones that are assigned to this initiative?

Early in the process, the vision team and the working cadre need to answer these questions, defining the approach or strategy for change.

Communicating The Initiative

Communicating the vision and the commitment of senior executives and managers will be difficult. Listeners within DoD and industry will be cynical; they will be unlikely to believe that this is a serious effort or that it will last beyond a few months or a few incumbents. "Real" communication will take place through actual change, but that will not happen quickly, so major communication programs in the beginning can lead to more cynicism rather than build conviction. A strong message of senior level commitment would include:

- Direct involvement of the Secretary, Deputy Secretary, and Under Secretary of Defense for Acquisition. They must spend time, participate, and demonstrate commitment to change.
- A clear statement that change of this magnitude is required to free dollars for adequate procurement of weapon systems.
- Selection of a team including some of the most promising officers in the armed forces.
- Congressional support of change.

Early decisions on requests to amend existing practices transmit a powerful message. An effective approach would be to create pilot projects in which units are given greater freedom, with the concurrence of financial auditors and contract administrators. The results could then be monitored and communicated broadly to accelerate replication and further progress.

LATER IN THE CHANGE PROCESS

If this (or a similar) model of a change strategy is undertaken, the vision team and working cadre will make scores of decisions and choices during the early stages of the process. Once the essential commitment to the change process is achieved, the on-going activity might include:

- Managers of 10 to 20 existing weapon programs doing as much as possible to operate in a direct, simple manner within existing procurement regulations.

- A legal task team proposing amendments to non-controversial laws to simplify reporting and remove difficult and irksome requirements. A second legal team would be examining the more fundamental balance among oversight, financial control, equal employment opportunity, waste, fraud, and abuse.
- Some teams working on a shift to commercial products on fixed priced procurement, pointing out the simplification that such a shift entails for a substantial percentage of purchases.
- Other teams working on the difficult question of simplifying existing specifications and searching for ways to increase use of functional specifications.
- In each of the services the process would diffuse through the organization, with new teams forming to examine how they might procure and manufacture weapon systems better.
- A team of contractors working with engineering specialists from DoD would clarify inspection and testing standards, modify those standards that could be converted to commercial standards, and simplify complex military standards.

This partial picture conveys some of the activity that would take place during the early stages of the change process. Perhaps most importantly, there would be a belief among the top 10,000 people in the defense manufacturing community that the process would continue even through a change in senior officials. Although the Secretary, the Deputy Secretary, the Under Secretary for Acquisition, and congressional leaders would have spent more time on this change process during those early stages than they would have predicted, the normal conflicts between Congress, the White House, and DoD would still exist and would be far from resolved. However, the potential gains in quality, cost, and responsiveness would be clear by that time to those individuals, and there would be substantial commitment to achieve greater progress.

SUMMARY

In summary, this committee believes that:

- The need for change is clear.
- Now is an appropriate time to start, given the major change occurring in defense budgets, global defense needs, and the public pressure for improvement of defense procurement procedures.
- The proposed approach has worked well in large institutions.
- Technology is not the problem; application of technology by people is the problem.
- Consistent commitment and leadership over time are essential.

The time to act is now. Because the process of change is a multiyear effort (at least 3 to 8 years will be required), the ideal time to initiate such an activity is at the beginning of a new administration. Therefore, the beginning of 1993 represents a unique opportunity to initiate this process. New leaders can launch such a major initiative and see it into implementation. Each new administration has one or two main initiatives toward which energy, time, and interest are devoted, and for the new administration, this must be one of those priority initiatives. Four years from now will be simply too late. By that time, consolidation in the defense industry and continued changes in commercial industry's management and technology will have made any cost-effective revitalization of defense manufacturing even more difficult. The process of change must be initiated at the beginning of the incoming administration if there is to be any chance of success. This is truly a case in which the DoD must seize opportunity.

Dramatic and positive results can be expected. If the proposed changes permeate the government, the prime contractors, and lower tier suppliers, by the end of the Clinton administration the DoD should be in a position to obtain high-performance, high-quality weapon systems at far lower costs and much more rapidly, from a defense industrial base that is far broader and more efficient, effective, innovative, and responsive. The "way of doing defense business" will have been totally transformed, and the DoD will be a world-class buyer, dealing with world-class suppliers.

The United States can and must be able to change the way it does defense business. With a declining budget and rising weapon costs, there is no choice. The way to make this change exists, and has been demonstrated effectively. If the nation is to remain strong economically and militarily, it must accept this challenge and move aggressively to implement the needed changes. Our greatness in the twenty-first century depends upon it...and the taxpayers deserve it.

1

Defense Manufacturing on the Defensive

Defense manufacturing—the process that produces the most sophisticated, technically advanced weapons in the world—is one of the most complex enterprises in the nation. It encompasses not only the armed forces and the defense contractor base, but also the Congress, the White House, the Office of Management and Budget (OMB), and the Department of Defense (DoD) leadership. It requires constant mediation among political, economic, and military interests, between technology developers and implementers, between needs and desires. Effective management of the defense manufacturing enterprise is extremely difficult in the best of circumstances. Many involved in the defense manufacturing process believe that the overall management task has become too fragmented and complicated, leading to unnecessary sacrifices in the cost, quality, and timeliness of weapons.

Convergence of a broad array of forces over the next decade will make defense manufacturing management increasingly difficult, with results that are less and less satisfactory. (Appendix A contains a description of the economic, technological, and geopolitical forces that are redefining the environment for defense manufacturing.) Shrinking defense budgets, the pace of technological advance, and pervasive changes in commercial production practices threaten to limit severely DoD's ability to acquire next-generation weapon systems with the cost, quality, and timeliness necessary to meet future defense requirements.

THE DEFENSE BUDGET

In 1992, DoD spent over $75 billion on manufactured products, mainly weapon systems and other military equipment.[1] This figure is already significantly lower than procurement budgets in the mid-1980s, and estimates for further reductions range as high as 50 percent.[2] Meanwhile, weapon costs have been rising astronomically. Individual airplanes cost hundreds of millions of dollars, some ships cost billions, and weapon systems procurement is in a spiral of rising costs, leading to decreasing quantities, leading to still greater cost increases. By cutting procurement quantities and stretching out deliveries, this growing conflict between available resources and costs also limits DoD's ability to benefit from improvements in commercial manufacturing products and processes.

TECHNOLOGY

In the last 10 to 15 years, global industrial competition has replaced global military competition as the impetus for technological advance in areas such as electronics, materials, information technologies, and telecommunications. Although DoD has the opportunity to benefit from the rapid pace of commercial technological improvement, the current defense procurement system is incapable of taking advantage of that opportunity. While global competition has inspired tremendous reductions in the development times and life cycles for commercial products, the trend is for weapon systems to take longer in development, be produced more slowly, and be kept in inventory longer. For example, while electronic advances are making many electronic systems technically obsolete in 6 months to 2 years, development of weapon systems now averages over 17 years from concept to first production. Since more than 50 percent of the cost of most sophisticated new weapon systems is in electronics, weapons development must be accelerated.

COMMERCIAL MANUFACTURING RENEWAL

Spurred by intense international competition, a growing number of American manufacturers are embracing a new concept of manufacturing and its role in competitive success. This new understanding is prompting companies to develop a process for changing manufacturing management, the role of employees, customer-supplier relationships, and investment strategies.[3] This change process goes by many names (some misleading) and has many variants, including Total Quality Management, "just-in-time," employee involvement, and concurrent engineering. Although few companies have mastered the management techniques and relationships necessary to benefit fully from

these changes, the process is under way and the results in cost reduction, quality improvement, and cycle time reduction have been impressive.

Unfortunately, the techniques and procedures needed to achieve these changes are increasingly incompatible with the defense procurement environment. Manufacturers must change to compete in commercial markets and find it increasingly inefficient to use incompatible methods in their defense operations. Consequently, companies are leaving the defense business, citing the punishing environment, the onerous regulations, poor profitability, and the unnecessary uncertainty induced by political and administrative processes.[4]

Given these (and other) emerging conflicts in the current defense manufacturing enterprise, serious consideration must be given to fundamentally changing how DoD procures weapon systems. The way to ease the defense manufacturing dilemma is not through marginal adjustments to traditional ways of doing defense business but—as demonstrated by the commercial firms that have led the way—through a deliberate break with the past. It entails a shift from the traditional "command and control" style of defense manufacturing and acquisition to a modern, comprehensive defense manufacturing strategy that would govern procurement policies and practices. This strategy would apply modern management methods to weapons manufacturing and acquisition in order to achieve lower cost, more rapid product development, better performance, and higher quality.

Just as commercial manufacturers are struggling to evolve strategies that will result in long-term improvement and increased competitiveness, the DoD must also identify the elements of an effective "change process" that will work in the unique defense manufacturing environment and achieve the long-term goals of affordable, high-quality weapon systems. Contrasting the requirements for success within such a "change process" with the current business environment in defense manufacturing may be helpful (see Table 1).

This comparison illustrates the magnitude of the challenge involved in undertaking a "change process" for defense manufacturing. It will require significant modification in behavior by the most senior executives in DoD, Congress, and defense contractors. The experience of leading companies suggests that at least 5 to 10 years will be needed to achieve significant improvement. Unfortunately, few of the senior leaders needed to initiate and participate in an effective change process are likely to be in their positions that long. Few (if any) executives from OMB or DoD are incumbent for that length of time, and military officers are rotated on a far more rapid schedule. Turnover is a very serious impediment to improvement.

Another equally critical impediment is that it is not in any single individual's interest to start this process, because initially it will create only difficulty. The benefits will not be evident for years, so the beneficiaries will not be

those who will invest the time, effort, and energy, and fight the jurisdictional battles for improvement during the early days of the "change process."

TABLE 1 Contrast Between the Attributes of a Successful "Change Process" and the Current Defense Manufacturing Environment

A. Attributes of Successful "Change Process"	B. Current Defense Manufacturing
A common vision is held by the participants concerning the change needed.	No common vision exists among the Congress, DoD, and corporations as to what defense manufacturing should be like in 5 to 10 years. (Many components of this vision do, however, exist.)
There is substantial commitment among the powerful participants to undertake the long and difficult process of change.	There is no commitment to the nature of change required, no consensus regarding who will invest the time, effort, and energy, or who will lead it.
There is a widely felt need, even urgency, for change.	There is a widely varying sense that change would be useful, but not an urgent sense of need.
A willingness to work through resistance to change exists.	Little willingness exists to work on decades-old relationships that impede change.
Agreement exists on the values that the organization will observe during the change process, including openness, sharing of information, constant discussion, and problem resolution.	There is no such agreement.
Significant investment in training of people to work through problems and to solve them jointly.	There is little or no training in the process of change.
Consistency of purpose exists for several years.	There is constant change, rather than constant purpose, in strategies to improve the defense manufacturing base, DoD, and the Congress, with single issues gaining and losing prominence in short times.

The pressure *against* change is strong. Current values are strong; these values reinforce the protection of existing charters, the perceived risk of changing when the outcome is not clear, and the risk that a new process will degrade control of weapon systems or technology.

So what should be done? This report outlines what must be done to start a process that could result in significant improvements in the cost, quality, and timeliness of weapon systems. It is a process that will involve pervasive and sustained changes in the way weapon systems are manufactured and procured; in short, a change in the culture that determines how DoD does business with its suppliers and administers its own procurement functions. The process itself will take 5 to 10 years. Improvement will be seen within 1 to 2 years if there is a constancy of purpose at the senior levels of DoD, the Congress, and private industry. The end of the Cold War provides an unusual opportunity, unparalleled in the past five decades, to effect such a change.

NOTES

1. Direct physical capital outlays by the federal government for national defense were estimated to be $82.3 billion in 1992. Almost all of this, an estimated $75.2 billion, was for the procurement of weapons and other military equipment, and the remainder, $7.1 billion, was primarily for the construction of military bases and family housing for military personnel. Other significant acquisition outlays include: $86.4 billion for operations and maintenance, and approximately $40 billion for research, design, test, and evaluation. See, Office of Management and Budget, *Budget of the U.S. Government for Fiscal Year 1992*, (Washington, D.C.: U.S. Government Printing Office, 1991), part 4, p. 4, Table A-2 and part 6, pp. 17–18.

2. The Bush administration projected that defense budget decreases will continue, with real reductions of 13 percent between Fiscal Year (FY) 1991 and FY 1996, and a total of a 32 percent reduction below the rate of inflation between FY 1985 and FY 1996. Defense spending would fall from an estimated 5.3 percent of GNP in FY 1991 to a projected 3.8 percent by FY 1996. Procurement in real terms is projected to fall almost 50 percent between fiscal years 1985 and 1996, from $123.9 billion to $64.3 billion (both in 1992 dollars). See Stephen A. Cain, *Analysis of the FY 1992–1993 Defense Budget Request*, (Washington, D.C.: Defense Budget Project, February 7, 1991).

3. In private corporations, the cultural changes taking place at Milliken, Xerox, General Electric, Motorola, Harley-Davidson, and Ford are good examples. In the DoD, the Willoughby templates are a good example. The templates were derived from a 1982 Defense Science Board Task Force (chaired by W.J. Willoughby, Jr.) report entitled, "Transition from Development to Production," which generated a matrix of the most critical events in the design, test, and production phases of the industrial process. These events were then transformed into templates and are used by program managers to identify critical engineering processes and their control methods. See, DoD Directive 4245.7, "Transition from Development to Production," January 19, 1984.

4. According to David V. Lamm, approximately 20 percent of firms surveyed refuse DoD business because of burdensome paperwork, government bidding methods, more attractive commercial ventures, and government attitudes. See, David V. Lamm, *Analysis of Reasons Companies Refuse to Participate in Defense Business*, (Monterey, CA: Naval PostGraduate School, March, 1987). In his book, Thomas L. McNaugher describes the complicated, bureau-cratically encrusted way the nation buys weapons as a procedural waste. He attributes the current weapon acquisition process as the result of a long process of political adoption in which Congress, DoD, and the defense industry all have participated. See, Thomas L. McNaugher, *New Weapons, Old Politics*, (Washington, D.C.: The Brookings Institute, 1989), p. 174.

2

A Change Process . . . That Changes . . .

"Change processes" are under way in many manufacturing corporations that compete worldwide. By focusing on continuous improvement in manufacturing throughout the full new product realization cycle (especially during the phases of concept formulation and early design) and by using modern manufacturing management techniques and technologies, these large corporations have been able to achieve major improvements in cost, time to market, and quality of their products. It can be done.

The parallels are striking between the challenges facing the Department of Defense (DoD) and demands in the commercial sector to reduce cost, speed development, and improve product attractiveness and quality. Companies that have successfully responded to cost and product development competition from abroad provide a model for DoD's approach and expectations, albeit an inexact and, relative to DoD, simple model.

Companies that have reached world-class performance in strongly competitive commercial manufacturing fields such as electronics, automobiles, and aircraft exemplify the benefits of establishing a new culture within the company and its community of suppliers and customers. Firms such as Milliken, Xerox, General Electric, Motorola, and Ford Motor Company have committed themselves to reexamination of product development, production, and supplier relations. Concepts such as "lean production" and "total quality management" understate the depth and breadth of the change in these corporations. Each, in its own way, is undergoing the same kind of cultural change that the committee now proposes for the DoD.

The results have been impressive:

- At General Electric, changes in manufacturing methods have more than doubled the annual rate of manufacturing productivity improvement, from 2 percent to 5.5 percent over the past five years, at a time when the annual rate of overall U.S. manufacturing productivity growth remained roughly constant.
- Motorola's change of corporate culture has helped the company achieve 60 percent sales growth, from $6.7 billion to $10.9 billion, between 1986 and 1990, while the number of employees has increased only 8 percent. At the same time, Motorola reports substantial improvements in product quality, design lead-time, and supplier relations.
- Xerox's transformation, based on benchmarking comparable external activities, has enabled it to regain product design and manufacturing leadership in office copier products after Japanese competitors gained major market share a decade ago.
- Ford Motor Company's financial problems in the late 1970s led to many changes within the company, including company downsizing, remodeling the product design process, and improving supplier relations. The success of the Ford products designed and produced under the revised procedures has been a major improvement over past performance, resulting in substantial gains in North American market share.
- Milliken has been able to cut its delivery lead times in half, improve its on time deliveries from 75 to 90 percent, and cut its defective products by 50 percent, all while tightening its definitions of "on time" and "acceptable quality." As one result, it has been able to cut the total cost of off-quality production (rework, returns, etc.) by 57 percent for the company as a whole.

And, of course, a number of Japanese companies have practiced variants of continuous improvement for years.

Each of these examples indicates that sustained, overall improvement is possible within large product design and manufacturing organizations through a commitment to a new vision of company operations. Their results prove that it is possible for the DoD to make the same sort of transformation. Already within the uniformed services, and within defense contractors, there are small units that are well advanced in application of these new techniques and are very successful. For instance:

- The Air Force Logistics Command received the President's Award for Quality and Productivity in 1991 as a result of the operational improvements from its total quality initiative.
- The Naval Weapons Center at China Lake, California installed an alternative personnel system, allowing management to reward individual performance in order to compete more effectively in the market for highly skilled, high-quality personnel. Increased retention of engineers and scien

CASE OF CULTURAL CHANGE: ROCKWELL INTERNATIONAL'S TACTICAL SYSTEMS DIVISION

The Tactical Systems Division (TSD) of Rockwell International is a Department of Defense contractor designing and integrating weapon systems. It has two major products currently in production: the HELLFIRE laser-guided anti-armor missile and the AGM-130 Standoff Weapon System "smart bombs."

HELLFIRE missiles have been in production since 1985 and are currently produced at a rate of 22 per day. AGM-130 is just beginning low-rate production replacing its predecessor, the GBU-15 Guided Weapon System. At the current time, HELLFIRE contributes over 75 percent of the production base for the division.

TSD experienced several "significant emotional events" in the mid-1980s which precipitated a real need for change. These included serious contract delinquencies and significant financial losses resulting in unhappy customers, both external and corporate. For one, HELLFIRE production was experiencing problems with suppliers, production yields, scrap and rework, and resulting delivery and profit margins. The AGM-130 development program experienced early flight test problems which caused government cancellation of the program, with TSD electing to complete the flight test program with its own funds.

The major barriers experienced in implementing change were the lack of a defined change process and getting management to lead the efforts towards continuous improvement.

In TSD's pursuit to make improvements, there was significant confusion due to the abundance of apparently disjointed "programs" available, such as Just-In-Time, Statistical Process Control (SPC), Design of Experiments (DOE), Quality Function Deployment (QFD), and Gainsharing. Adding to the confusion were external customers and corporate executives willing to "help" by promoting their favorite Improvement process as **the** silver bullet.

TSD recognized merit in many of the programs, but they had to be integrated in a cohesive manner. While reviewing the numerous initiatives having been implemented or considered, it was observed that they fell into three general categories: (1) change processes, (2) tracking and measurement processes, and (3) incentive and reward processes.

CHANGE PROCESSES

In order to implement change effectively, there must be processes. TSD has developed two fundamental change processes. One process addresses change in the organizational system. This change process is strategic in nature inasmuch as it addresses division-wide change and is typically addressed by management teams. The second process affects day-to-day methods and involves virtually every employee working in ad hoc value improvement teams.

TRACKING AND MEASUREMENT PROCESSES

In order to assure that all changes are directed at business objectives, it was necessary to develop a planning, tracking, and measurement system. This system, Functional Support Planning, is designed to focus all major change activities on the business objectives. It ties the strategic planning and the annual planning to the lowest levels in the organization, creating ownership and assuring constancy of purpose throughout all disciplines.

INCENTIVE AND REWARD PROCESSES

Change processes and tracking and measurement are two critical elements for assuring continuous improvement. However, in order to reinforce their application, a third element is necessary. That is the organization's incentive and reward process.

Incentives and rewards must reinforce the organization's total quality commitment. The mainstay of this process is TSD's gainsharing program which equally involves all employees in all disciplines. This program is designed to share back with the employees a significant portion of monetary gains made as a result of EXCEEDING the division's operating plan.

Many of these processes could not be effectively integrated into the organization without a change in its culture. Included in the cultural changes were the concepts of everyone's responsibility for quality and productivity, understanding the customer's needs and expectations, management's leadership role and its responsibility to be coach and counselor, and the empowerment of the people working in the system—those most knowledgeable about the systems and processes.

Also included was a detailed training program that initially targeted the management team. Management was required to understand concepts of waste and scientific tools and problem-solving methods toward improving the System and reducing/eliminating waste. Once management gained an appreciation of these modern methods, the rest of the organization was given the same training.

Almost all of the staff has been trained in TQM improvement techniques (including SPC). In 1992, each employee received an average of 28 hours of training in these and other skills, including team training.

The total process was enhanced because the top executive was committed to and involved in the changes. Change at TSD has led to a team-based organization providing for the application of concurrent product development and self-managed work groups in production and white collar disciplines.

As a defense contractor, TSD, in concert with the Army Missile Command (MICOM), the Defense Contracts Management Command (DCMC), and the Defense Audit Agency (DCAA), has plowed considerable new ground in applying many innovative principles to the weapons business. Two government initiatives were piloted by TSD and have provided a good opportunity

to develop a win-win relationship where the relationship had been historically adversarial. These two initiatives are the Defense Logistics Agency's (DLA) In-Plant Quality Evaluation (IOUE) program and the DCAA's Contractor Risk Assessment Guide (CRAG) program. These two programs are the agencies' application of TQM principles. Without the excellent customer relations TSD has been able to build, and a commitment mutually to prove the viability of the Total Quality Management approach, the significant and continuing improvements in productivity and quality by TSD, and the subsequent lower cost to the government, would not have been possible. TSD and DLA were invited jointly to brief the Defense Science Board to describe and emphasize the synergy of government/contractor relations in a total quality environment.

TSD's Total Quality System, a systems approach to total quality, has proven to be a very effective model for change. The results are shown in the division metrics:

- Sales per employee up 13 percent
- Scrap and rework down 74 percent
- Manufacturing hours per unit down 40 percent
- Test yields up over 200 percent
- Manufacturing cycle time down 50 percent
- 149 successive production test launches without a failure.

For TSD, there have been three crowning achievements that are attributed to a quest for excellence: first, the award of 100 percent of the HELLFIRE production in a winner-take-all competition; second, the resurrection of the AGM-130 program; third, the award of the Army's Contractor Performance Certification Program $(Cp)^2$ which recognizes exemplary Total Quality Management practices and continuous quality achievement.

- tists improved supervisor-employee relations, and dramatic reductions in personnel-related paperwork have resulted.[1]
- Rockwell Tactical Systems Division in Duluth, Georgia is one example of a defense contractor that has aggressively pursued total quality with impressive results: scrap and rework reduced by 74 percent, test yields raised by 200 percent, and manufacturing cycle time reduced by 50 percent. (See pages 15–17.)

Unfortunately, such examples remain too isolated and are not as effective as they could be because they are so inconsistent with the surrounding web of procedures and requirements.

The committee recognizes that the change process unfolding in many commercial manufacturers is not strictly analogous to the process needed in DoD. While learning as many lessons as possible from commercial suc

cesses and failures, and spreading the lessons from existing defense successes, DoD must invent its own unique change process. It is a daunting challenge that will require:

- a common manufacturing vision among the DoD, the Congress, and the defense manufacturing community;
- commitment and a willingness to invest among the powerful participants in the process;
- an orderly process for achieving change, agreed upon early;
- investment in training people to work to solve problems rather than to enforce regulations; and
- consistency of purpose over several administrations.

At the core of this change process is the active participation of the wide spectrum of powerful interests in defense manufacturing. Representatives from the Congress, the White House, the military services, DoD management, and the industrial base must all participate in development of a vision, goals and objectives, and specific actions.

NOTE

1. Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base*, (Washington, DC: Government Printing Office, 1989), pp. 67–72.

3

The Change Process

Changing the defense manufacturing culture will require an iterative process. The process must start at the top and be driven by a vision of how manufacturing will be conducted. The process must be repeated at each level of the organizations involved. The leadership of the change process must be accepted at the top of the Department of Defense (DoD)—by the Secretary and Deputy Secretary—and supported by other leaders throughout the defense community, including the military service secretaries and particularly the Congress. Unfortunately, the change process, like "quality," is difficult to describe in writing, but the following paragraphs should convey some sense of the process.

Industrial experience suggests that cultural change requires repetitive cycles, at successively lower levels in the organization. Each cycle consists of six generic steps:

1. Preparation
2. Commitment
3. Deployment
4. Action
5. Reinforcement
6. Results Measurement and Feedback

These characteristic phases must, in turn, be adapted to each successive layer throughout the defense manufacturing community—government, as well as prime contractors and suppliers.

STEP 1: PREPARATION

Preparation is the first step in the change process. In companies that achieve this kind of sweeping cultural change, the drive for change radiates from the top. Typically, the Chief Executive Officer (CEO) gathers his close colleagues to flesh out the nature of the change and the process: the vision. At General Electric (GE), Jack Welch drove the change process from his position as chairman and CEO; at Motorola, the process was driven by President Robert Galvin.

A vision for the change process is a prerequisite for the beginning of the process itself. Therefore, the defense community leadership needs to describe a vision of the future defense manufacturing culture. During subsequent change cycles, leaders at each successive level must likewise determine a representative version of the overall vision applicable to their own activities. This normally involves two important substeps: gaining pro-found knowledge of how the current system works to understand the changes possible and the leverage points for effecting change; and formulating a vision of how the system should look. To a substantial degree, both of these substeps have been covered by other reports that describe what needs to be achieved in the defense acquisition community (See Appendix B.); they also are the subject of various training programs. This shared vision of how the defense community's manufacturing systems can be vastly improved has been lacking in past attempts to change.

Given the many interests and organizations represented in the defense manufacturing enterprise, development of the vision for change is necessarily a group process. A senior level group should be formed to create a shared vision of how defense procurement should be conducted. The group should include the Secretary of Defense, the Deputy Secretary of Defense, the Under Secretary of Defense for Acquisition, the Chairman of the Joint Chiefs of Staff, military service secretaries, the chairmen of the Congressional Armed Services Committees, the Director of the Office of Management and Budget (OMB), and a few chief executive officers (CEOs) from industry. A working cadre also should be formed to investigate cultural change in other organizations and to adapt the lessons learned to defense needs. Such a group should be broadly representative of the elements of DoD's manufacturing community: DoD career civil servants, military officers, defense contractors and suppliers, and congressional staff. Its members should be those individuals likely to emerge as senior executives in the course of implementation of the change process—the "young Turks." The group would be managed by the Deputy Secretary, serving the role of CEO throughout the change process, and the Under Secretary for Acquisition, who would serve as Chief Operating Officer (COO). Under their leadership, this group should study examples of manufacturing culture changes,

within and outside of DoD, establish the DoD "strawman" vision, and design the implementation plan for debate and change by the senior decision makers of the defense community.

The vision must be relevant to community leaders. This requires that the leaders themselves create the vision, but implies a major effort by staff to gather and analyze information that will reveal the possibilities.

Commercial companies have prepared the necessary vision in various ways. At Xerox, competitive benchmarking plays a critical role in determining areas for improvement and developing continuously tougher improvement goals. At General Electric, the "Best Practices" program focuses on management practices used by highly successful companies, including AMP, Chaparral Steel, Hewlett-Packard, Ford, and Xerox. For DoD, public data resources are sufficient to generate both broad understanding of how much better defense manufacturing could be and to establish meaningful improvement goals. (See Appendix C, Suggested Reading.)

STEP 2: COMMITMENT

Once senior managers have formulated the vision (for DoD, a contracting firm, or a supplier organization), committed to its achievement, and taken responsibility for leadership of the change process, the vision must be articulated to the rest of the organization, and a plan developed for implementation throughout the community. This step demonstrates commitment of the leadership and builds conviction that change is required among managers and workers in the services, suppliers, research and development (R&D) organizations, and the Office of the Secretary of Defense (OSD).

Articulating the vision and achieving this conviction throughout the community may generate the creativity and enthusiasm needed for a successful change process. Each successive level of the organization must develop its own vision statement appropriate to that level's mission, but consistent with the broader vision generated at higher levels. Ideas for change should begin to emerge; leverage points begin to be identified. It is crucial during this stage for the leaders to encourage a wide variety of ideas, take the initiative to spur communication, champion the need for change, and generally build enthusiasm to gain buy-in among the diverse members of the defense manufacturing community. For this process to succeed, leaders at each successive level must be empowered with the flexibility, within broad guidelines, to initiate activities to meet the vision. Such flexibility certainly will require the cooperation of DoD and Congressional leaders. Such a process is frustratingly inclusive, non-directive, and slow, but it gets results.

The change process at Ford provides a good illustration of the need for commitment. When Ford was first beginning to change in the early 1980s,

the concept of employee involvement became a central part of the new corporate vision. The job of speaking on behalf of the change process and explaining the concept of employee involvement—and the business and political rationales behind them—was undertaken by Peter Pestillo, Ford's vice-president for labor relations, and Don Ephlin, vice president of the United Automobile Workers' Ford Department. Given their high visibility and credibility among Ford's workforce, they played a critical leadership role in educating Ford employees and building commitment to the new Ford vision.[1]

STEP 3: DEPLOYMENT

With some hope for change, energy and enthusiasm can become substantial. Based on the refined vision, senior managers can determine the initial target areas for changes in policy, procedures, and structure. Leaders at various levels will implement those targeted changes. Likely areas for attention include: (1) defining performance measurement tools for effective assessment of techniques that work well and those that do not; (2) wide-spread training in necessary skills, such as problem solving, teamwork, communication, and program assessment; (3) identification of formal legal constraints to change; (4) clarification of reward systems that provide incentives for use of new skills and reinforce actions; and (5) identification of specific high visibility initiatives that can generate fairly quick results and reinforce the commitment to change. It is especially important to develop a means of measuring progress toward vision goals.

Boeing provides some good examples in many of these areas. For instance, assigning managers and workers to solve small, manageable problems—"low-hanging fruit"—can give people a quick sense of the possibilities for effective change. However, Boeing learned the importance of emphasizing the long-term nature of its continuous quality improvement effort, so its employees would not settle for low-hanging fruit. Structured training programs were put in place, top management made quality improvement the first priority for middle management, and even some "sacred cows"—practices that are generally considered unchangeable—were scrutinized and discarded.[2] These and other initiatives have demonstrated clearly to workers and managers alike that cultural change at Boeing is a long-term proposition.

The reallocation and commitment of appropriate resources is a critical part of the change process. Given the current DoD environment, additions to financial budgets are not likely; rather, people will do new tasks, or do old tasks differently, so that the low-value-added activities of the old system are dropped or reengineered, and efficiency improves. Managers must be aware that the mission of the organization is sometimes best served by

dropping old tasks, which proves commitment to change to the organization at large. The key for managers is to ensure that essential activities are not neglected, even as more effective alternatives are proposed and tried.

STEP 4: ACTION

Next comes broad-based implementation of the ideas and plans formed to this point. Initial actions are monitored and results measured to gauge success and modify continued actions. Progress will be slow at first, but as actions are taken, the effects of those actions on procedures and relationships lower in the organization will be evident. Bottlenecks will emerge as the pace of change varies throughout the organization. DoD senior leaders and their counterparts elsewhere in government must appreciate the slow pace of improvement, but expect momentum to build as the change process persists. Perhaps most importantly, winners and losers will emerge, as both individuals and organizations are more or less successful in adapting to the changed environment. Effectiveness at leading the change process is likely to be a good indication of the readiness of leaders to assume greater responsibility.

The scale of action taken by Jack Welch at GE helps illustrate the extent of change necessary in defense acquisition. From 1981 to 1989, GE shed $9 billion in assets and spent $18 billion on acquisitions, in a company with about $60 billion in sales. GE has dismantled executive power, drastically cut corporate staff, and created programs to empower and involve everybody in the organization. In the process, 100,000 jobs were eliminated. Using a number of management techniques, known as "Work Outs," "Best Practices," and "Process Mapping," GE has begun to build a new culture that maximizes employee participation, breaks down the barriers between management and labor, and uses good ideas, whatever the source. Despite the benefits to date and the extensive use of these techniques, Welch admits that it will take a decade before the new culture is firmly established.[3]

STEP 5: REINFORCEMENT

Once success is achieved, a number of actions are necessary to foster further success. The individuals responsible must be rewarded. Based on typical experience in industry, such rewards need not be monetary, but may take the form of recognition through awards, increased responsibility or flexibility, additional training, and other steps. In general, the reward system must be seen to work throughout the organization to reinforce individual motivation. At Milliken, for instance, all manufacturing sites have abandoned individual incentives in favor of team-based incentives, which

was particularly difficult in an industry based on piece rates. The shift to teams has increased employee satisfaction, and team leaders are responsible for providing individual recognition through letters of recognition, awards, and similar means.[4]

Communication is essential. Leaders must continue to make their support known. Successful initiatives must be publicized and, to the extent possible, reasons for their success noted, published, and replicated.

STEP 6: RESULTS MEASUREMENT AND FEEDBACK

As plans are achieved, it is essential for the total change process to be monitored to identify further initiatives and possibilities for success. Appropriate performance measures are important; the degree of success can be measured and challenges for additional improvement can be defined. Managers at Milliken have learned that if it cannot be measured, it is not worth doing.[5]

This feedback loop must function continually throughout the organization at the local level (as described in Step 4), but it also must encompass the broad objectives of the change process and affect the initiatives of the senior leadership. It is easy for change to move off track, derailed by interest groups who cannot adapt fast enough, or simply by well-intentioned initiatives that fail. At Xerox, major change was delayed for years by the bureaucracy at corporate headquarters in Rochester. Only after David Kearns became president and took a personal leadership role in forcing change was the logjam broken and the change process really invigorated.[6] Similarly, the senior DoD leadership, including the military service secretaries, must stay abreast of any serious failures and take steps to overcome or minimize their impacts. Again, the communication and leadership role of the senior managers cannot be overemphasized.

DoD leadership must be tolerant of the time taken to achieve meaningful cultural change, yet press continually for progress. Industrial experience has shown that skilled facilitators may be necessary to help the process along, particularly through the first several iterations. For instance, GE uses consultants and university professors to facilitate many of its "Work Outs."

SUMMARY

In reading these six steps to cultural change, many will say that they are too elementary, too simple, just "Management 101". They are correct.

The committee is, in fact, recommending a return to very basic, simple management principles—principles that DoD does not now follow in manufacturing weapon systems. But DoD is not alone. Many U.S. corporations

discovered how far they had diverged from basic management principles when they lost markets to Japanese competitors. Those companies are struggling-some successfully, some not—to return to basics, and to improve continually as a result.

DoD, at senior levels, has yet to start. The committee argues that better management will provide major help to DoD in meeting existing goals. Many DoD executives have practiced these "basics" in prior positions, and believe these basics are required.

"Management 101" this is—but only because Management 101 is needed.

NOTES

1. Badore, N. L., 1992. Involvement and Empowerment: The Modern Paradigm for Management Success. P. 4 in Compton, W. D. and Heim, J. A., eds., *Foundations of World-Class Manufacturing*. Washington, D.C.: National Academy Press.

2. Gissing, B., executive vice president for operations, Boeing Commercial Airplane Group. October 24, 1991. Speech presented to the American Production and Inventory Control Society.

3. Stewart, T. A. 1991. GE Keeps Those Ideas Coming, *Fortune*, August 12, pp. 41–49.

4. *American Productivity and Quality Center Letter*. 1990. Roger Milliken Outlines Baldridge-Winning Philosophy. 10(6): December. pp. 4–7.

5. Ibid., p. 7.

6. Jacobson, G. and Hillkirk, J. 1986. *Xerox: American Samurai*. New York: Macmillan. pp. 179–184.

4

DoD Is Different ... Partly

This committee has concluded that instituting cultural change is the single most important action needed to deal effectively with today's challenges to defense manufacturing. It may be among the very few highest priorities at the Department of Defense (DoD). However, the size and scope of change needed at the DoD is very large compared to others that have been undertaken (except perhaps the Defense Reorganization of 1948, the shift to all-volunteer forces, or the Goldwater-Nichols Bill of 1986). It must, in time, encompass the entire defense manufacturing establishment: the DoD, its contractors and suppliers, and other parts of government, such as the Office of Management and Budget and Congress.

Many will argue that this complexity of players and interests makes DoD unique. Unlike private corporations that can control internal procedures and processes, the defense manufacturing enterprise comprises many corporations and many government entities with multiple, sometimes conflicting, interests. Accordingly, it is clear that change cannot be undertaken by defense contractors alone; government and industry must cooperate to an unprecedented degree and the process of change must reach beyond the contractors into industrial suppliers.[1] The many subcultures within the DoD, other government entities, and defense contractors will require understanding, involvement, and, eventually, realignment. Although successful corporate change processes are not directly analogous with DoD or with each other, these experiences do provide valuable lessons and help define a strategy to get started.

The process of cultural change in corporations takes years. It cannot be

instituted by directive—it requires long-term personal involvement by senior managers. Such a cultural change in manufacturing is not a program. It is a persistent change *process*.

Patience is an absolute prerequisite for success. There will be a tendency to claim that the process is not working because results will not be immediate and because there will be resistance. Resistance to cultural change is normal and should be expected. Some participants in defense manufacturing will be at risk as emphasis shifts from a procedure-driven culture to one that encourages local problem solving and efficiency. Many existing activities using the traditional "command and control" style will relabel programs so they appear to meet the new process. While more elegant than open resistance, this will require serious challenge.

Such change will not be easy. Even though attitudes are firmly en-trenched, the defense establishment is now in a period of flux. Force reductions and base closings are difficult measures precipitated by the most pro-found changes in budget and strategy since the end of World War II. The defense manufacturing "system" must be similarly addressed *now* while the opportunity for fundamental change exists.

This change process is *not* simply "downsizing" the defense manufacturing establishment. Problems must be solved differently, decisions made differently, control exercised differently, information shared differently.

This report suggests the beginning of such a change. As with large corporations, cultural change is driven from the top, but must be supported throughout the organization. The process requires sustained commitment, patience, and consistency. It requires an understandable vision of how business is to be conducted and of the values needed to produce the best possible manufactured goods for the defense sector in the most efficient way. The change process must become ingrained within the defense manufacturing establishment and externally supported by the rest of government.

This initiative is probably best undertaken at the outset of a full four-year term of office of a Secretary and Deputy Secretary of Defense as part of an overall theme of departmental reform, so the process will have opportunity to take root and develop before the shift to new leadership. Further, support for this process of manufacturing and acquisition system reform should be a criterion for selection of succeeding defense leaders to ensure continuation of that momentum. Senior executives at defense contracting and supply firms also must come to believe that their best interests lie in promoting complementary changes within their own operations.

It is crucial that the DoD and the defense industry *jointly* define the urgency of, and the strategy for, change in the defense community. Such a "joint" approach to change management is not new. The perceived barriers to joint DoD/industry management and operational approaches have been overcome in numerous DoD programs, large and small. The normal im

pediments of tightly interpreted procurement regulations, non-value-added management or control processes, conflicting goals and objectives, and inconsistent priorities have often been resolved or minimized through joint leadership and teamwork. Team-building activities, training, proper decision authorities, and measurement and reward systems have been developed to create an efficient operational environment. The change process envisioned in this report is intended to institutionalize that kind of problem solving. Success will benefit not only DoD, but also the competitiveness of industry. Industrial experience with similar change processes teaches that particular attention must be paid to certain problem areas.

Some of the areas requiring joint solutions are described below.

CHANGING PROCUREMENT, ACCOUNTING, AND AUDITING PROCESSES

Success of the new vision depends on establishment and maintenance of effective working partnerships between customers and vendors at every level of the defense community, including between DoD and prime contractors. Professional procurement skills must extend well beyond how to live without today's acquisition system to understanding how to work to modify the system to make it more effective. Technical and procurement personnel will need the skill to work cooperatively with contractors rather than to police them. In parallel, defense contractors will have to change the skills of managers who interact with DoD. Experiences at Milliken, Boeing, and Xerox emphasize the importance of training in these new skills.

PROBLEM SOLVING, SKILL DEVELOPMENT, AND TEAM BUILDING

Empowering people to solve their own problems and to improve performance continually is likely to be an important element of the new DoD vision. Problem solving in this context entails working with teams of those involved, regardless of organizational affiliation. Team problem solving across organizational lines—both within an enterprise among design, manufacturing, engineering, and marketing functions, and between enterprises such as DoD, prime contractors, and suppliers—is difficult, but progress has been made in similar situations by Milliken, Apple Computer, and Federal Express.

TRAINING

Implementation of a new DoD vision will require people throughout the defense community to acquire new skills—management, technical, personal,

and manufacturing. In addition, the ability of the defense community to sustain the vision by adapting to changing circumstances will require continuous renewal training. The training effort is not trivial: Bob Galvin has noted that Motorola's investment in training is now greater than its research and development expenditure. Military officers already understand the value of training for military operations. Heavy commitment to training now also must be adopted in the defense manufacturing community.

In addition to studying management of successful corporate training programs, the committee suggests that early DoD participants who are unfamiliar with the new vision process should attend management and manufacturing training courses, such as the Motorola Manufacturing Institute, to understand, first hand, the educational process and the kinds of expertise that the new culture demands. Other corporate training programs that approach the size and scope needed by DoD include those at GE, IBM, and Xerox.

DECENTRALIZED MANAGEMENT AUTHORITY

The size and scope of the defense community make effective centralized management impractical. The new culture must take into account the need to build local management authority to promote improvements consistent with the highly centralized goals of the defense mission. Managers within government, contractor, and supplier organizations must be able to deal with local situations.

MANAGEMENT TURNOVER

Constant refurbishing and revalidation of the vision and the process will be necessary in order to compensate for turnover of managers. DoD's problem will be more severe than private industry's, given rapid political appointee turnover and rotation of officers.

Another factor will be the need to force a change in management personnel when necessary. The magnitude of the changes required by the shift to a new defense manufacturing culture will undoubtedly generate resistance among managers, at least initially. Some will be unwilling to adapt even after prolonged exposure to the process. The DoD must accept the need and establish the means to replace those who do not accept the new ways, just as industry has.

PERFORMANCE MEASUREMENT AND REWARD SYSTEMS

Measuring the performance of individuals and organizations, and rewarding those responsible for improvement, are critical to the institution of

a culture based on a new defense vision. DoD managers must learn from industrial experience that motivation without financial reward is possible and potentially more powerful than existing incentives. Xerox, GE, and IBM have devised broad measurement and reward systems that encompass a wide range of incentive possibilities; these can help provide guidance for the DoD.

IMPROVEMENT AND RESOURCES

The new vision for defense manufacturing calls for the kinds of improvement that result from doing business differently. It does not call for significant additional resources and, in fact, should provide substantial savings. At Xerox, overhead spending was cut by more than $200 million in less than five years, and inventory was reduced by almost $200 million in three years.[2] Efficiency savings of this magnitude provide the resources needed to support a process of continual improvement.

MEASURE PROGRESS OVER THE LONG RUN

As with other learning processes, improvements resulting from promotion of a culture based on the new defense vision will come in fits and starts. Uneven rates of progress characterize all efforts to make sweeping, long-term improvement.

NOTES

1. Data indicate that 60 percent of defense manufactured product costs are in purchased parts; suppliers must participate in the change process to ensure a viable defense industrial base. See, Department of Defense, *Report to Congress on the Development of a National Defense Manufacturing Technology Plan*, March 1992, p. 12.

2. Jacobson and Hillkirk, p. 235.

5

"We're Already Doing That!"

Many of those who skim these recommendations may well conclude that they are similar to either those previously proposed or those actually adopted in various forms by different departments within the Department of Defense (DoD). For example, some might point to the Manufacturing Technology Program (ManTech), the Industrial Modernization Incentives Program (IMIP), and Title III (of the Defense Production Act) programs as attempts to respond to the concerns about manufacturing; recent programs funded by the Defense Advanced Research Projects Agency (DARPA), such as Sematech, might also be cited. The committee hopes, however, that a careful comparison of these recommendations with such programs will reveal profound differences in both guiding philosophy and implementation strategies. The committee is not suggesting another program or changes in existing programs, though both are likely as the total change process progresses. Moreover, simply retitling existing programs so that they correspond better to the terminology used in this report would fall woefully short of addressing the problem as the committee sees it, though "re-titling" is often employed in both defense and commercial organizations.

The members of this committee are impressed both by the magnitude of the changes the committee believes must be made in defense manufacturing policies and practices, and by the likely resistance to such changes. The committee has reviewed dozens of recent reports of government agencies and special committees, all addressing essentially the same problems and proposing various corrective measures. (See Appendix B for summaries of a few.) Panels of this committee have made similar observations in areas

such as defense policies, programs, and supplier relations. (See Appendix A.) Most are thoughtful and persuasive, their authors well informed and highly regarded. Yet few of the changes they propose have been adopted. The obstacles and forces that have prevented the acceptance or successful adoption of these earlier recommendations appear to be the same: insufficient conviction, commitment, and effort by the parties involved.

In examining the failure of these previous efforts, the committee notes four stages at which failure occurred:

- The change process did not start properly. For instance, there has never been any strong momentum behind use of commercial products, despite repeated recommendations that defense-related products include more commercially available parts and subassemblies.
- Useful changes were made and programs initiated, but they proceeded only part way, and then stalled. Examples include inconsistent funding of the ManTech and IMIP programs.
- The change process began, achieved limited success within one service or agency in the DoD, but never propagated horizontally to other departments whose involvement was crucial to achieving the full potential of the change. For example, in 1985 the Navy Department established a data base of "Best Manufacturing Practices" in the defense electronics industry. The purpose of this program is to enhance the proficiency of Navy suppliers by identifying excellent design, manufacturing, and management practices and sharing these with interested companies. Although the program is successful within the Navy, it has not spread to the other services.
- The change process achieved limited success within either DoD or a defense contracting company, but was not able to cross the boundaries between them. For example, many defense contractors have adopted successful programs in their commercial divisions for continuous reductions in defects, inventory levels, throughput times, and new product development, but these programs have not been transferred to divisions engaged in defense manufacturing. (Rockwell's Tactical Systems Division is a rare exception.)

The committee's analysis of "failure modes" suggests possible causes of failure and ways to avoid similar failures in the future. If a change process is never begun, someone at the top of the organization either (a) was not persuaded that the change was necessary and appropriate, (b) could not spend the effort to lead the change, (c) believed that the change violated some law, policy, or tradition that would take too long to alter, or (d) believed that initiating such a change was more properly the responsibility of some other senior official in the DoD.

Similarly, the committee identified several reasons a change process,

once successfully underway, does not continue to spread. First, it may not continue to be supported by its leaders—or even becomes subject to their active resistance—for the reasons given above. Second, the structure of the system and the nature of its organizational boundaries may make the kind of communication and joint effort required to propagate the change difficult. Third, certain laws, regulations, or even rules of conduct may be in place that impede cooperation or make it illegal. Finally, the performance measurement and reward system in place may not provide adequate incentives for some members of the system to participate in the change process, if some emerge from the change relatively better off than others.

The goal of this committee, therefore, is to encourage DoD to build on a set of specific changes that are widely regarded within the defense and political communities as desirable (see Appendix B), and to develop a *change process* that, by involving all parties, will provide support.

6

Defense Manufacturing Would Be Different

If such a change process in defense manufacturing is to be undertaken, first there must be a substantial management effort with little visible improvement in cost, quality, or timeliness in the short term, due to the long cycle time for weapon development and production. However, within 3 to 5 years, significant improvements would be noted on single weapon systems, with sharply improved quality, or cost, or timeliness. [1] Between 5 and 10 years, a new "steady state" for defense manufacturing would emerge and *would be characterized by significantly lower cost for most systems, much better quality, and better adherence to shortened schedules*.

This new "steady state" would provide different benefits to each participant in the process.

The Congress would notice:

- Better management control of weapon systems, with fewer overruns, greater performance on initial testing, and more "reasonable" behavior by the Department of Defense (DoD) and its contractors.
- The need for fewer laws governing defense procurement.
- Greater access to information about the current status of weapon systems and greater understanding of the interaction between the DoD and the major contractors working on each system. DoD and the contractor would seem to be doing the "right thing," including meeting estimates and achieving sensible trade-offs among technical capability, cost, and schedule.

- New technologies would be incorporated throughout the life of a system, as priorities, military threats, and technologies changed.
- Although there would still be disagreements over the political aspects of defense manufacturing and procurement (such as closing bases), there should be a clearer understanding of the costs of politically based decisions.

These may seem counter-intuitive. Fewer laws leading to better control would not be the initial conclusion of most observers. However, *where this process has been implemented well in manufacturing companies, fewer "laws" (policies and procedures) are required to achieve better performance*.

DoD executives would notice:

- Less Congressional interest in single issues, "small" items.
- Better industry response on the big questions of weapon systems performance, cost, quality, and schedule.
- Greater real control of the procurement process with less administration, procedures, and rules. There would be less need for arbitration and appeals because more problems would have been avoided or resolved early by the parties immediately involved. Arguments over regulations would decrease.
- Less disruption of schedule, specifications, or objectives in the midst of a weapon program due to late changes.
- More technical function, faster, at higher quality for less money.
- Greater use of commercial items.
- Greater interest in cost reduction and control.

While this would require a change in the skills of DoD personnel, industrial experience is encouraging. Those people involved in procurement, manufacturing, and quality control of weapon systems would need to become problem solvers, able to control a project early and make trade-offs among costs, quality, performance, and time, which is not the rule now. Such a shift in skill is the reason the process takes 5 to 10 years.

Industry would notice:

- Trade-offs among a weapon system's performance, schedule, quality, and cost being made early in the system's life, or early in the life of a modification, rather than late in the design process.
- Increasingly stable schedules, functional specifications, and working relationships with DoD.
- Far fewer rules. Disagreements would be handled cordially.
- A more effective and motivated work force.

- Substantial two-way discussion with DoD as a customer in order to solve problems with the weapon system early. Supportive rather than adversarial relationships among major subcontractors and the customer. (Appendix A describes these customer-supplier relationships in more detail.)
- Consideration of the full life-cycle cost and performance from the start of a program.

While most contractors would applaud such a situation, it will be difficult for many to adapt to this manner of working because many contractor engineering managers, manufacturing managers, and executives are not accustomed to working this way. However, this new system will eventually develop managers competent to achieve world-class manufacturing levels in both defense and commercial markets.

Getting to this new steady state is difficult. As we have described, there is a need to:

- Establish values.
- Establish a vision.
- Rethink the planning and control of the weapon systems development and manufacturing process.
- Evolve new practices and procedures.
- Make thousands of decisions on how weapon systems will be developed and manufactured.
- Practice the new process.

Many corporations have found (admittedly on a smaller scale) that where this process has been followed there is little interest in returning to the prior way of working. **Success is likely.** The "gain to pain" ratio in early days will be unfavorable, but will be substantially favorable after 5 years if given sustained support.

NOTE

1. It is difficult to estimate realistically the benefits of a new defense acquisition culture. Others have made estimates of cost savings from implementing only relatively minor portions of the defense manufacturing strategy described in this report. For instance, according to the Congressional Budget Office, alternative procurement plans with higher production rates for the 1988–1992 period would increase production rates 19 to 127 percent. The higher production rates would reduce unit costs of selected weapons from 2 percent to more than 20 percent, thus eventually lowering overall program costs. See, Congressional Budget Office. 1987. *Effects of Weapons Procurement Stretch-Outs on Costs and Schedules*. Washington, D.C.: Government Printing Office. According to the Institute for Defense Analysis, cycle time can be reduced 40–60 percent by using concurrent engineering techniques and manufacturing costs can drop 30–40 percent by having multifunctional teams integrate product and process designs. See, Institute for Defense Analysis. 1988. *The Role of Concurrent Engineering in Weapon Systems Acquisition*. Washington, DC: December. p. vi.

7

Implementing a New Defense Manufacturing Strategy: An Illustrative Model

Changing the Department of Defense's (DoD's) approach to acquisition of manufactured goods will require substantial effort at all levels of the hierarchy within defense production and acquisition organizations, including the Office of the Secretary of Defense, the military services, the contractor and supplier base, and the Congress. Although the specific mechanisms for effective cooperation among these major constituencies are impossible to define and will evolve over time, the committee offers the following model to illustrate in specific terms how such cooperation in an effective change process might occur. The model includes four major phases of effort. The effort should be managed from the Office of the Secretary of Defense, with the Deputy Secretary serving as Chief Executive Officer (CEO) and the Under Secretary for Acquisition serving as Chief Operating Officer (COO).

CREATE A VISION OF MANUFACTURING

A widely shared view (vision) of how defense procurement should be conducted several years from now must be developed. To be effective, the view must be shared by Congress, the White House, the Department of Defense, and defense contractors. No such common view exists now.

To create such a shared view (vision), a senior group of officials including the Secretary of Defense, the Deputy Secretary of Defense, Chairman of the Joints Chiefs of Staff, the Undersecretary of Defense for Acquisition, the military service secretaries, the Chairmen of the House and Senate Armed Services Committees, the Director of the Office of Management and Budget

(OMB), and a few CEOs from industry—both defense contractors and leaders of firms with successful change processes—must achieve consensus on the following:

- *What improvement* in cost, quality, time, and technical performance over the next decade should a new manufacturing strategy achieve? Appropriate goals might be 30 percent lower cost, 30 percent shorter lead time, and an 80 percent reduction of defects without sacrificing technical progress.
- *What philosophy should guide trade offs* among cost, quality, time, technical performance, and social goals (such as Equal Employment Opportunity, small business participation, or control of waste, fraud and abuse) so that each of these is not treated separately but is treated simultaneously at each stage of procurement and manufacturing?
- *What philosophy of control* is needed so that the Congress and the DoD can determine that procurements are effective and efficient? For instance, in many cases the current accounting system makes "real" control more difficult and less effective than control in non-defense commercial work.
- *What should be the appropriate rate and sequence of change* sought in the myriad of procedures, procurement policies, technical specifications, and practices that currently exist?
- *What personnel policies are appropriate for the people required to make the transition* from an old system to a new system, where some may become redundant or technically obsolete?
- *What is the appropriate balance of time and energy* for the senior management to devote to the demands of the existing system and the need to change to a new system? How can the staffs involved do the work while the principals retain their conviction and understanding of the implications of change?
- *What performance review and promotion policies will permit* uniformed officers to participate in the change process without jeopardizing their careers? Their participation is essential if the new system is to operate well later in the decade.
- *What early wins* will have the greatest impact in terms of reinforcing conviction and communication? Modest gains can be made quickly, since many units already are trying to improve and have programs under way. Bolstering these units will yield small but significant results.

CREATE A WORKING CADRE

A working cadre should be formed to address the operational details of achieving the vision. For a task of this magnitude, the working cadre will probably consist of 200 to 300 uniformed officers and civilians.

- The cadre will work for 5 to 10 years helping to lead the change. Tours of duty will range between 2 and 4 years for individuals.
- A majority of the cadre should be analytically skilled. Skills represented on the working cadre should include:
  - — program managers from the military services and contractors;
  - — line officers;
  - — finance and contract administrators;
  - — engineers and manufacturing experts;
  - — personnel and civil service experts;
- Individuals likely to be leaders of their organizations in 5 to 10 years should be selected.
- Current or former staff members of Congress from both parties who have recognized competence and understanding of both the political process and the weapon systems development and production process should be included.
- A dozen or more facilitators will be required, all experts at change processes.
- Substantial training of the cadre is essential.
  - — Three months of full-time training in organizational change using facilitators and experts will be necessary.
  - — Several days should be spent with the vision team during this period to understand their interest, commitment, and objectives.
- Training should include practice in organizational analysis, review of all prior reports recommending change in procurement and manufacturing, and explanation of those reports by the authors.
- In addition to studying management of successful corporate training programs, cadre members should attend management and manufacturing training courses, such as the Motorola Manufacturing Institute and other corporate training programs, to understand the education process and the kinds of expertise that the new culture demands.

SELECT A CHANGE STRATEGY

Change in military organizations and military-like organizations generally has been top-down, implemented by directives, with mechanisms to ensure compliance.

Changes in manufacturing during the past decade, driven by Japanese experience, have been quite different from this model. More recently, senior personnel have been more deeply involved in determining what needs to change and helping lower levels understand and accomplish change. This approach has worked effectively both for small organizations and for complex organizations with powerful subunits and demanding external forces—such as those found in defense manufacturing.

The choices facing both the vision team and the working cadre include:

- Should the change be introduced broadly across all of DoD or more narrowly?
- Should significant change be undertaken first in those organizations that are "change ready" or in those organizations that need it most urgently but that may resist strongly?
- Should change be undertaken where it is easiest, or most significant, or most disruptive in order to break the old system?
- Should change be attempted only for new rather than existing weapon systems, on large systems rather than small, or on systems that have a simpler customer/supplier relationship?
- Should change be undertaken where it can be accomplished by DoD directive alone, or is it more useful to address problems that will require Congress, OMB, contractors, and DoD to arrive at a new method of operation?
- Can the mechanisms chosen to implement the change process accommodate the existing promotion system or must amendment or exception be taken for those officers in the promotion zones that are assigned to this initiative?

Early in the process, the vision team and the working cadre need to answer these questions, defining the approach or strategy for change.

COMMUNICATING THE INITIATIVE

Communicating the vision and the commitment of senior executives and managers will be difficult. Listeners within DoD and industry will be cynical; they will be unlikely to believe that this is a serious effort or that it will last beyond a few months or a few incumbents. "Real" communication will take place through actual change, but that will not happen quickly, so major communication programs in the beginning can lead to more cynicism rather than build conviction. A strong message of senior-level commitment would include:

- Direct involvement of the Secretary, Deputy Secretary, and Under Secretary of Defense for Acquisition. They must spend time, participate, and demonstrate commitment to change.
- A clear statement that change of this magnitude is required to free dollars for adequate procurement of weapon systems.
- Selection of a team including some of the most promising officers in the armed forces.
- Congressional support of change.

One measure of good communication is that half of the most senior 10,000 members of the defense community believe that change will occur. Therefore, building awareness through intensive communication with fewer people is probably preferable to widespread communication with little follow-up or belief. Furthermore, communication must be balanced between what currently captures people's attention (top-down directives) and what is needed to energize change (bottom-up involvement).

Early decisions on requests to amend existing practices send a powerful message. An effective approach would be to create pilot projects in which units would be given greater freedom, with the concurrence of financial auditors and contract administrators. The results could then be monitored and communicated broadly to accelerate replication and further progress.

LATER IN THE CHANGE PROCESS

If this or a similar model of a change strategy is undertaken, the vision team and working cadre will make scores of decisions and choices during the early stages of the process. Once the essential commitment to the change process is achieved, the on-going activity might be:

- Managers of 10 to 20 existing weapon programs doing as much as possible to operate in a direct, simple manner within existing procurement regulations. Both military and contractor people would be working closely together and auditors would actively encourage the maximum flexibility within the regulations. Improvement ideas would be shared among the 20 programs.
- A legal task team proposing amendments to non-controversial laws to simplify reporting and remove difficult and irksome requirements. A second legal team would be examining the more fundamental balance among oversight, financial control, equal employment opportunity, waste, fraud, and abuse.
- Some teams would have recommended shifting to commercial products on fixed priced procurement and identified the simplification that such a shift entails for a substantial percentage of purchases.
- Other teams would be working on the difficult question of minimal specifications of the existing type and searching for ways to make functional specifications more commonly used. This would be a long-term effort with some very difficult technical and economic issues.
- In each of the services the process would be diffusing through the organization with new teams forming to examine how they might procure and manufacture weapon systems better than currently. No results from these early teams would be expected at this stage because the roll-out would take three years.

- A team of contractors working with engineering specialists from DoD would have clarified inspection and testing standards, modified those standards which could be converted to commercial standards, and would be examining how complex military standards might be simplified.
- There would be a belief among the top 10,000 people that the process was going to continue even though some of the senior officials changed. There would be reasonable understanding among half of those about how change would occur during the succeeding several years.
- However, the normal conflicts between Congress, the White House, and DoD would still exist and would be far from resolved.

This partial picture may convey or imply some of the activity that would take place during the early stages of the change process. The Secretary, the Deputy Secretary, and Congressional leaders would have spent more time on this change process during those early stages than they would have predicted. However, the potential gains in quality, cost, and responsiveness would be clear by that time to those individuals and there would be substantial commitment to achieve greater progress.

APPENDIXES

A

Review of Study Panels

At the outset of the study, the committee established four study panels, each responsible for a specific aspect of defense manufacturing: national manufacturing perspective, policy, program initiatives, and the supplier base. The panels worked through the summer and fall of 1990, and delivered their reports to the full committee by January 1991. Because the panels identified many of the same problems that have plagued defense production and acquisition for decades and have been addressed by many prior studies, their reports served to convince the committee that radical change in defense manufacturing is required, as described in the body of this report.

The panel memberships and overviews of their deliberations are described below.

PANEL ON NATIONAL PERSPECTIVE

JACQUES S. GANSLER (*Chairman*), Senior Vice President and Director, TASC, Arlington, Virginia

RAY MARSHALL, Professor of Economics and Public Affairs, University of Texas, Austin

WILLIAM C. MOORE, Director of Operations, Readiness and Mobilization (retired), U.S. Department of the Army, McLean, Virginia

BRIAN H. ROWE, Senior Vice President and Group Executive, Aircraft Engine Business Group, General Electric Company, Cincinnati, Ohio

ALAN WILLIAM WOLFF, Partner, Dewey, Ballantine, Bushby, Palmer & Wood, Washington, D.C.

In its report to the committee, the panel defined its view of the likely environment for defense manufacturing, based on both military and economic security trends. For instance, the panel noted:

- Reduction in the tensions between the United States and the Commonwealth of Independent States and significant reductions in arms on both sides will result in a shrinking U.S. defense industry.
- A likelihood of increasing instabilities and dangers around the world, yet great unpredictability in the types of military missions that will be required of the United States.
- Growing importance of technology as the key to national power—both military and economic—with full recognition of the great advances likely in Europe and Japan (which will, in many cases, be further advanced than those of the United States).
- Growing economic and financial power of Europe and Japan—with corresponding implications for U.S. economic security.
- Growing foreign dependency (and increasing vulnerability) of military weapon systems due to manufacture of critical components offshore.
- Foreign governments increasing their support of "dual use" technologies.
- Growing confluence of critical technologies for both military and civilian applications, e.g., electronics, software, manufacturing equipment, supercomputers, new materials, etc.—with civilian applications often more advanced.
- Increasing trend toward further separation of defense and civilian sectors of the U.S. economy as a result of government procurement practices. (The defense business is moving contrary to the development necessary to enhance U. S. international competitiveness needs.)
- Continuation of the historical trends of increasing weapon system performance, unit costs, and operation and support costs.
- A great shortening of new product development times in the commercial sector, yet an increased tendency for defense systems to take longer in development, be produced more slowly, and be kept in the inventory for longer periods (due to the reduced funding for new procurement).
- Rapidly expanding worldwide markets in the fields of telecommunications, computer work stations, new structural materials, etc.
- Growing U.S. national concern with the issue of "economic security" as a complement to that of "military security".

Based on this assessment of the future environment for defense manufacturing, the panel called for the development of an integrated defense manufacturing strategy that would simultaneously address warfighting requirements, weapon acquisition requirements, industrial base requirements,

and national economic requirements. Elements of specific policy changes in these areas were addressed by the other three panels.

PANEL ON POLICY

ROBERT CATTOI (*Chairman*), Senior Vice President, Research and Engineering, Rockwell International, Dallas, Texas

FRED H. DIETRICH, President, Dietrich Research Incorporated, Sarasota, Florida

JOSEPH MARTINO, Senior Research Scientist, Research Institute of the University of Dayton, Ohio

DONALD E. PROCKNOW, Vice Chairman (retired), AT&T Technologies, Inc., Saddle River, New Jersey

VINCENT PURITANO, Vice President, Corporate Operations, Unisys Corporation, Blue Bell, Pennsylvania

The Panel on Policy identified and discussed 10 specific DoD manufacturing policies and areas in which these policies have an impact. To illustrate this relationship, these policies and problem areas were assembled into a matrix (see page 48). The matrix conveys the panel's sense of the importance of specific policy areas to a variety of defense manufacturing goals, and therefore provides a summary of the issues discussed by the panel.

PANEL ON PROGRAM INITIATIVES

GEORGE P. PETERSON (*Chairman*), President, George Peterson Resources, Inc., Miamisburg, Ohio

ROBERT H. HAYES, William Barclay Harding Professor of Management of Technology, Graduate School of Business Administration, Harvard University, Boston, Massachusetts

GEORGE R. JASNY, Vice President, Technical Operations (retired), Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee

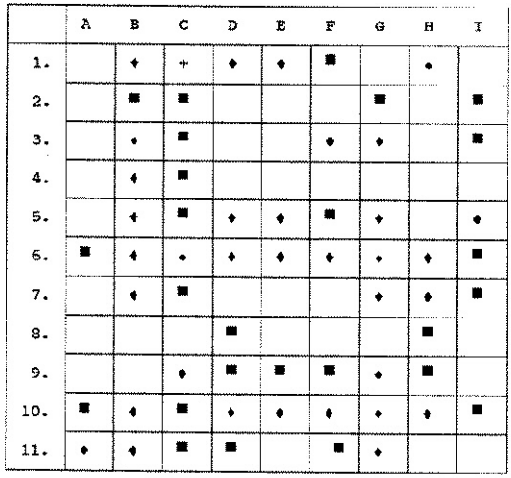
BARRY C. JOHNSON, Manager, Business Development, E.I. du Pont de Nemours and Co., Wilmington, Delaware

GEORGE H. KUPER, President, Industrial Technology Institute, Ann Arbor, Michigan

HOWARD D. SAMUEL, President, Industrial Union Department (AFL-CIO), Washington, D.C.

TIMOTHY L. STONE, Director of Corporate Intelligence, Motorola, Inc., Schaumburg, Illinois

The panel studied current DoD programs related to manufacturing and acquisition, including the Manufacturing Technology Program (ManTech),



	A	B	C	D	E	F	G	H	I
1.		♦	+	♦	♦	■		•	
2.		■	■				■		■
3.		•	■			•	♦		■
4.		♦	■						
5.		♦	■	♦	♦	■	♦		•
6.	■	♦	•	♦	♦	♦	•	♦	■
7.		♦	■				♦	♦	■
8.				■				■	
9.			♦	■	■	■	♦	■	
10.	■	♦	■	♦	♦	♦	♦	♦	■
11.	♦	♦	■	■		■	♦		

■ - Very Important
• - Potentially Very Important
♦ - Minor Importance
\+ - Problem only if military specifications and standards applied to technology base

Issues Causing Problems:

A. Proprietary Rights and Data Rights
B. DoD Directives and Procurement Regulations
C. Military Specifications and Standards
D. DoD and IRS Policies regarding education expenses
E. Tax and Depreciation Policies
F. Research and Development, Manufacturing Resource Management Policies
G. Congressional Authorization, Appropriation, Accounting, and Budget Process
H. Foreign Ownership
I. Accounting and Auditing Policies

Where Problems Appear:

1. Technology Base
2. Procurement Efficiency
3. Cost
4. Quality
5. Time to Market
6. Defense Business Attractiveness
7. Surge Response
8. National Skill Base
9. Competitiveness
10. Technology Transfer
11. DoD Mission

the Industrial Modernization Incentives Program (IMIP), and Title III (of the Defense Production Act), as well as relevant initiatives of the Defense Advanced Research Projects Agency (DARPA). The panel found that these existing programs do not focus sufficient attention on areas such as lower tier suppliers, quality improvement, minimizing life-cycle costs, and making maximum use of commercial components. The panel noted that a potentially effective approach to addressing problems in the defense manufacturing base through programmatic initiatives might be to focus on three objectives, each with different time horizons:

1. **Continuous improvement**—Objectives such as workforce skills improvement, total quality management, and improved cycle times would be appropriate for program initiatives in this area.
2. **Technology deployment**—Medium-term programs should focus on improving the state of technology used by second-and third-tier subcontractors.
3. **System improvement**—Includes efforts to strengthen the entire value chain in an industry, to build industrial networks of firms with specialized skills linked together for a more effective system, to develop the information management systems needed to allow such networks, and to build the management capabilities needed to take maximum advantage of a total industrial system.

PANEL ON SUPPLIERS

BRIAN E. BOYER (*Chairman*), Vice President and Deputy Department Manager, Business Management, Northrop Aircraft Division, Hawthorne, California

WALLACE P. BURAN, National Director of Manufacturing Strategy Services, Deloitte & Touche, Atlanta, Georgia

JAMES F. LARDNER, Vice President (retired), Deere & Company, Davenport, Iowa

DEAN M. RUWE, President and Chief Operating Officer, Copeland Corporation, Sidney, Ohio

ROGER W. SCHMENNER, Professor, Indiana University School of Business, Indianapolis, Indiana

JOHN M. STEWART, Director, McKinsey & Company, Inc., New York, New York

This panel addressed the evolving relationships between customers and suppliers in both commercial and defense manufacturing. By focusing on the ideal customer/supplier relationship, the panel described a template for change that could yield benefits at many points throughout the defense supplier chain.[1]

WORLD-CLASS CUSTOMERS2

World-class customers are characterized by the following qualities or behaviors:

• Intimate relationships with suppliers.

World-class customers use suppliers as extensions of themselves.

• Meaningful dialogue.

World-class customers enter into continual and meaningful dialogue with their suppliers (1) to help define customer needs, (2) to provide suppliers with feedback and assistance with such key criteria as quality, product performance, delivery cost, and technology, and (3) to provide suppliers with forecasts and updates.

• Lessened variability and increased realism.

World-class customers have a clear desire to lessen the variability faced by their suppliers, including variability of all types: quantities demanded, product mix required, product specification changes, capacity needs, tooling and other processing requirements, and process planning.

• Product and process development.

World-class customers use the design capabilities of their suppliers both to improve their own products and to shorten their own product development lead times.

• Responsiveness.

World-class customers are sensitive to the impact of time on their abilities to compete, including the time to market for new products, the time to manufacture existing products, and the time to satisfy customer orders.

• Benchmarking.

World-class customers benchmark their competitors and the competitors of their suppliers.

• Continuous improvement.

World-class customers seek improvement continuously, and in diverse ways, both for themselves and their suppliers.

• Strategy and vision.

World-class customers have clear visions and strategies concerning their products and processes, and they work diligently to communicate those visions and strategies to their workforces and suppliers.

WORLD-CLASS SUPPLIERS

The world-class supplier has attributes that compliment those of the world-class customer, such as:

• Stable relationships.

A world-class supplier is eager to enter into long-term relationships with customers, and for the benefits of such long-term relationships, it is willing to share enterprise data with its customers, assuring them of fair value.

• Meaningful dialogue.

World-class suppliers are in continual, mean

ingful, and proactive dialogue with their customers about product requirements.

• Stability of performance.

World-class suppliers deliver what has been promised, when it has been promised, neither too early nor too late, and for reasonable value.

• Product and process development.

The world-class supplier offers product and process development cycles that are short, and works hard to shorten those product and process development cycles to provide its customers with that added advantage.

• Responsiveness.

The world-class supplier is sensitive to the impact of time on its customer's ability to compete.

• Benchmarking.

The world-class supplier keeps track of prevailing and prospective technologies for its products and processes.

• Continuous improvement.

World-class suppliers seek improvement continuously, in diverse ways, and from all quarters of the business.

• Strategy and vision.

World-class suppliers have clear visions and strategies concerning their products and processes, and they work diligently to communicate those visions and strategies to their workforces, suppliers, and customers.

• Its own supplier base.

The world-class supplier treats its own supply base the way that world-class customers treat it.

Based on its description of world-class suppliers and customers, the panel identified a number of factors that impede the development of world-class customer-supplier relationships in defense acquisition. These include program instability, over-specification, inflexible regulation enforcement, and lengthy product development and procurement cycle times. Nevertheless, the panel argued that defense customers and suppliers can become world class, given effective communication and willingness to change on both sides.

NOTES

1. According to the Department of Defense, 60 percent of the manufacturing costs to manufacture weapon systems are for components and subassemblies purchased from subcontractors. Department of Defense, *Report to Congress on the Development of a National Defense Manufacturing Technology Plan*, March 1992, p.12.

2. The panel defined world-class companies as those that are as good as any in the world and better than most. A variety of leading companies has shown us how the customer/supplier relationship can indeed become world class.

B

A Review of Selected Reports on Defense Acquisition and Management

SUMMARIES OF PAST REPORTS

***The Weapons Acquisition Process: An Economic Analysis*. 1962. Merton J. Peck and Frederick M. Scherer. Cambridge, Mass.: Harvard University Press. 736 pages.**

This volume was the result of a three-year research project at Harvard Business School to investigate the development of advanced weapons. It was based upon comprehensive historical case studies of 12 weapon system programs and seven commercial product development programs and upon more limited investigations of several specific research questions. In Part 1, the book addresses the consequences of the unusual buyer-seller relationship in the nonmarket environment of the weapon acquisition process. A major conclusion is that, due to the great technical and strategic uncertainties in the weapons industry, the high expenditures in individual programs, and the difficulty of accurately predicting cost, development time, and end-product quality, the government commonly participates in managerial functions in the weapons industry that are performed exclusively by sellers in the rest of the manufacturing sector.

Part II examines the structure and dynamics of the weapons industry from both the buyer and seller sides. Thousands of firms, both large and small, serve as defense contractors, with the largest prime contractors showing a fairly high concentration of defense business at any one moment. However, turnover among the leading firms appeared considerably higher than in other sectors of the U.S. economy due to the more rapid rate of

technical change in weaponry at that time. Although an analysis of entry and exit trends over two decades (1940–1960) indicated that the incentives for participation in the national defense were adequate, there was a critical scarcity of engineers, scientists, and project managers.

Part III, on the execution of weapon programs, explored the nature of weapon system innovation and choice. Summaries of 12 weapon system programs showed that new program ideas generally were inspired by significant advances in conceptual and component technology. To the extent that basic and applied research continue to supply these advances, the crucial problems of weapon system choice involve selection of those programs that will afford the highest surplus of military value over acquisition cost, and achieve optimal tradeoffs among speed of development, cost of development, and end-product quality. A weapon system choice model demonstrates that only those programs that afford a very large surplus of value over cost should be conducted in the minimum possible time because reducing development time in an efficiently conducted program increases cost. Choices are made much More difficult by the uncertainties pervading program decisions. To some extent, however, the uncertainty problem is mitigated by the tendency for uncertainty to decline as expenditure rates increase. Thus, lack of urgency has been the most significant cause of development program delays. Program cost increases were found to be caused by technical uncertainties, unrealistic planning, and lack of urgency.

The book also points out the propensity for uneconomical qualitative features to be built into U.S. weapons and for weapon development programs to be overstaffed with technical personnel, leading to waste of national defense resources. Analysis suggested that the U.S. weapons industry had a superior record of efficiency in terms of process improvement, a slightly inferior record in wage and salary bargaining, and a slightly inferior record of overhead control and manpower productivity compared to U.S. industry generally. It also was found that additional contractor investment in basic and applied research, component development, and long lead time production items would benefit the weapon acquisition process.

The volume provides only one specific public policy proposal: the development of a top flight data gathering and analysis organization within the Office of the Secretary of Defense to provide the basis for improved program decisions. More generally, the volume concludes that there are no simple organizational and administrative solutions to the problems of advanced weapon systems acquisition. Neither standard business practices nor the pattern of decentralization used successfully in basic research are appropriate for weapons development. A system of buyer-seller relationships is needed to moderate the insecurity of defense firms who are focused on performing well in current programs rather than enhancing the probability of surviving future technical competitions.

***Defense Resource Management Study: A Final Report*. 1979. (D. B. Rice, Chairman). Washington, D.C.: U. S. Government Printing Office**

The Defense Resource Management Study (DRMS) was commissioned by the Secretary of Defense in November 1977 in response to the President's request for alternative reforms in organization, management, and decision processes in the Department of Defense (DoD). The DRMS focused on five topics within the broad area of resource management:

1. Resource allocation decision process (Planning, Programming, and Budgeting System)
2. Weapon system acquisition process
3. Logistics support of combat forces
4. Career mix of enlisted military personnel
5. Military health care system

The authors of this report recommend an array of "new" ideas and processes that they believe to be conceptually sound, relevant to real problems, and in principle, implementable. The focus of the review is the Planning, Programming, and Budgeting System (PPBS), which encompasses the full range of activities that support DoD decision making on the allocation of defense resources. The DRMS proposals for change to the PPBS include:

- combination of the traditionally sequential program and budget reviews into a single annual review,
- establishment of a Defense Resources Board (DRB) to manage combined program/budget review,
- use of the time in the annual cycle freed by combining the program and budget reviews to focus additional attention on strategic and resource planning, including resolution of selected major issues prior to the program/budget review,
- greater integration of the internal PPBS and the Presidential resource allocation process, enhancing the DoD's capability to support Presidential decision making,
- closer relationship of the program/budget process to the acquisition process.

The centerpiece of the DRMS proposals is a conscious "destructuring" of the current planning, programming, and budgeting cycle through the creation of a planning window, extending from January to May, and a combined program/ budget review extending from August to December. These

changes would enhance opportunity to focus on major resource questions that can be authentically zero-based, while recognizing that programming and budgeting are continuously incremental processes that incorporate selected fundamental reviews.

The DRMS found no major deficiencies in existing acquisition policies and procedures, only certain risks and weaknesses to be avoided in their implementation. For instance, to alleviate costly problems associated with the premature commitment of systems to a high production rate, the study recommends delaying the approval of high-rate production until the hardware has demonstrated both technical and operational adequacy, reliability, supportability, and readiness, and encourages the development of major, widely used subsystems independent of final weapon system development programs. The report recommends consideration of the following ownership issues during the acquisition process:

• Systems Availability:

Explicit and measurable system availability goals should be established once a system concept is accepted and the needed resources allocated.

• Testing and Evaluation:

Testing and evaluation should be required to verify "supportability" and measure progress toward availability goals.

• Support Analysis:

The Office of the Secretary of Defense (OSD) should establish a Support Analysis Improvement Group.

• Support Evaluation:

An integrated support evaluation should be conducted when adequate experience is accumulated on the fielded equipment and on the effectiveness of its full training and support system.

• Acquisition Process Support:

Increase top-level support for the acquisition process.

In addition to the PPBS and acquisition recommendations listed above, recommendations were offered in the areas of logistics, first-time career mix of military personnel, and health care issues.

***The DoD Acquisition Improvement Program*. 1983. Defense Systems Management College. Columbia Research Corporation. Washington, D.C.**

In April, 1981 the administration launched a series of 32 major management initiatives to improve the defense acquisition process. The DoD Acquisition Improvement Program (AIP), also known as the Carlucci Initiatives after the then-Deputy Secretary, were intended to increase stability in the acquisition process. These initiatives included use of multiyear procurement, dual-sourcing for procurement, and more efficient production rates, as well as other means to improve management of the procurement process.

The DoD budgets have incorporated certain Carlucci initiatives in procurement of individual weapon systems. The Congress has already considered many of these proposals. For example, the Congress approved 21 multiyear programs for which DoD claims savings of $3.4 billion. See Office of Technology Assessment's *Holding the Edge: Maintaining the Defense Technology Base*, Volume 2, page 20.

***Proposal for a Uniform Federal Procurement System*. 1982. Office of Management and Budget, Office of Federal Procurement Policy. Washington, D.C.**

The proposal for a uniform Federal Procurement System responded to Public Law 96–83 and is a compendium of the proposals for procurement system, management system, and legislative reform developed in response to that law. The effort was intended to put federal procurement on a more systematic, professional, and business-like basis to achieve substantial savings. The features of the proposed federal procurement system are integrated by a common objective—to satisfy agency mission needs effectively. Principal system features are:

- a streamlined management structure with clear lines of authority, responsibility, and accountability,
- decentralized agency procurement operations that are responsive, efficient, and free of cumbersome rules and regulations,
- a professional workforce with latitude for initiative and business judgement,
- understandable and measurable standards for management and operational performance,
- a control system that identifies problems early,
- organized feedback of information on system performance, and
- a means for adjustment of the individual components of the system.

Under the proposal, the procurement system would be simplified and made more responsive. The planned system called for agencies to plan procurement in sufficient time to analyze the market and attract competition. The professionalism of procurement personnel was to be enhanced. Since the availability of funds is essential to every procurement action, and legislative changes were suggested to make appropriations more timely, the proposal suggested increased flexibility in use of appropriated funds and expanded use of multiyear contracts. The proposal also recommended earlier advance procurement planning, since there was no government-wide requirement for long-range procurement planning.

The report describes a framework for management, evaluation, and modi

fication of the system so that it would remain integrated, interactive, and responsive. The Office of Federal Procurement Policy, as part of the Office of Management and Budget (OMB), would provide a leadership and coordination role in implementing, maintaining, and improving the system. The proposal was to be implemented by:

- Issuing an Executive Order to initiate administrative actions to expand competition, simplify and streamline the process of doing business with the government, sharpen agency management systems, and develop performance standards and career development programs. (This was completed by President Reagan as E.O. 12352 on March 17, 1982.)
- Amending the existing statutory framework to introduce substantive fundamental changes.
- Putting the proposed system into place and certifying that procurement systems meet approved standards.
- Maintaining the system and making design improvements to meet system goals.

***The President's Private Sector Survey on Cost Control (PPSSCC)*. 1982. The Grace Commission. (J. Peter Grace, Chairman) Washington, D.C.: U.S. Government Printing Office.**

President Reagan established the PPSSCC by Executive Order on June 30, 1982. The commission's mandate was to identify opportunities for increased efficiency and reduced costs achievable throughout the federal government system by executive or legislative action. The study was led by an executive committee of 161 chief executive officers of major corporations and other private-sector experts. The commission's report contains 2,500 recommendations on 784 different issues which it claimed would save $424 billion over three years when fully implemented. The PPSSCC, better known as the Grace Commission, characterizes its recommendations as means for reducing program waste, correcting system failures, improving personnel management, and attacking structural deficiencies within the federal government. The PPSSCC was organized into 36 task forces, 22 of which were assigned to study specific departments and agencies, and 14 to study cross-cutting functions such as personnel, data processing, and procurement practices.

In subsequent analysis of the commission's findings, the General Accounting Office and the Congressional Budget Office reviewed nearly 400 of the PPSSCC recommendations that account for almost 90 percent of the potential three-year savings to determine which recommendations require administrative or legislative action. The majority of the recommendations selected for review are concerned with management issues, such as finan

cial management, procurement practices, management of real property, and management of research and development programs. (See, *Analysis of the Grace Commission's Major Proposals for Cost Control: A Joint Study by the Congressional Budget Office and the General Accounting Office*, Washington, D.C.: Government Printing Office, February 1984.)

Cost savings were identified in diverse government operations such as federal income tax collection and administration, federal work force productivity, Social Security administration, and increased reliance on the private sector for support services (especially for the DoD and the Veterans Administration). The Congressional Budget Office (CBO) and the General Accounting Office (GAO) reviewed 112 different recommendations made by 12 separate PPSSCC task forces and in management office reports, all of which pertained to national security. The Grace Commission estimated that net savings in the national security area over a three-year period, after allowing for duplications and overlaps, would be $94 billion. However, the majority of the defense recommendations did not permit cost estimates because they lacked sufficient programmatic detail or because the nature of the recommendations did not lend themselves to savings estimation.

The GAO categorized the DoD recommendations into four areas: (1) procurement of weapon systems, (2) management of bases and base activities, (3) management of research and development programs; and (4) financial management. For example, the PPSSCC recommended that the DoD increase the use of common parts and standards in weapon systems, and establish a timetable for the consolidation of depot-level maintenance functions. The commission also recommended that the DoD take three steps to improve financing procedures for defense contracts:

1. review contract pricing, profit, and financing policies and simplify the entire process;
2. establish an integrated database management system for acquisition policy analysis, using the latest technology and tools; and
3. reduce cash progress payment rates on fixed-price contracts to February 1981 levels and establish the required contractor investment in work-in-process capital at 15 percent, rather than the then-current levels.

In addition, the commission recommended that the DoD increase the production rates for the individual weapons purchased each year and ameliorate the problems associated with altering planned purchases from year to year. The purpose of these proposals was to sustain highly cost-effective production levels for weapon systems. Specifically, the commission proposed that the DoD:

- Ensure that the proposed rate of weapons production is affordable before production begins. The weapons in production at any one time

should be restricted to those that can be afforded at production levels that ensure the lowest costs.

- Create a management reserve fund to meet financial emergencies and prevent production slowdowns (stretchouts) that raise costs.
- Establish a two-year budget cycle for major weapons to help prevent annual changes in production plans.
- Stabilize PPBS by issuing firm budgetary guidance at the outset of the annual budget cycle and by integrating the program and budgeting phases of the cycle.
- Present the best cost estimate for the entire weapon acquisition cycle, and provide key financial data for the affordability analyses suggested above. DoD also should provide estimates that identify separately the effects of inflation and quantity changes on weapon costs and establish a new baseline when a system undergoes a major change in its design.
- Establish an audit trail from each system acquisition report baseline cost estimate that would incorporate cost estimates into budget projections and calculations of unit cost growth.
- Allow greater reprogramming of appropriated funds from low-to high-priority projects in order to ensure funding of essential procurement programs.
- Analyze the effects of stretchouts on cost growth for each major system in order to establish procurement priorities.

The CBO-GAO review found that potential deficit reductions that might result in 1985–1987 from implementing most of the Commission's recommendations would be much smaller than the three-year savings originally projected. The majority of the Grace Commission recommendations can be characterized as proposals to change management to achieve greater efficiencies or to operate on a more business-like basis; however, the bulk of the projected savings were associated with proposals for changes in policies or restructuring of programs. All of the latter would require Congressional action.

***The Affordable, Acquisition Approach Study (A3)*. 1983. Air Force Systems Command, Andrews Air Force Base, Md.**

This study focused on the Air Force acquisition process and was undertaken in response to growing concerns over increasing costs and lengthening development and production times for major programs. The goal of the study was not to identify specific solutions, but to highlight key problem areas for later study. The principal finding of the study was confirmation that there had been a significant increase in the time required to develop new major weapon systems; at the same time, there had been a significant

decrease in annual production rates. Although significant performance gains had been achieved as new weapons were acquired, these gains had come with a significant increase in procurement cost as measured by total program unit cost.

The study examined 109 Air Force programs in five categories, only four of which had the necessary data to be analyzed statistically. The study team developed recommendations for improvement of the PPBS process and the acquisition process to alleviate the problems caused by funding instability and subsequent cost growth and schedule stretchout.

PPBS:

- A planning organization at the top level of the Air Force should develop 15-year investment plans that reflect realistic fiscal constraints. These plans would become the basis for Program Objective Memoranda (POM) and Air Force Systems Acquisition Review Council (AFSARC) decisions.
- All organizations involved with the programming process should redouble efforts to stabilize the budget, schedule, and technical baseline of high-priority programs, and limit new starts and cancel or defer programs that cannot fit into investment plans.

Acquisition:

- More emphasis should be placed on pre-full-scale development (pre-FSD) to include the proper balance of resources. Before entering FSD, program alternatives should be explored more fully and a well-defined baseline for cost, schedule, and technical performance should be established that reflects a total Air Force commitment.
- The approval to start FSD should be recognized as, or at least treated with the seriousness of, a commitment to production; plans, funds, and acquisition strategies should be developed to reflect this commitment.
- Continued emphasis should be placed on improving Program Management Tools. This includes timely implementation of the Defense Acquisition Improvement Program initiatives, development of enhanced cost management tools to ensure that program cost estimates incorporate most likely costs, and development of a comprehensive and realistic program baseline before proceeding into FSD.

The study established that program instability (large unplanned changes in program funding and/or schedule) is the major cause of cost and schedule growth.

***A Quest for Excellence: Final Report to the President*. 1986. President's Blue Ribbon Commission on Defense Management. (David Packard, Chairman). Washington, D.C.: U.S. Government Printing Office.**

The Packard Commission was established in part because public confidence in the effectiveness of the defense acquisition system had been shaken by "horror stories" of gross inefficiency—overpriced spare parts, test deficiencies, cost and schedule overruns. A major task of the Commission was to evaluate the defense acquisition system, to determine how it might be improved, and to recommend changes that could lead to the acquisition of military equipment with equal or greater performance but at lower cost and with less delay. For this reason, the Commission formed an Acquisition Task Force. Major areas addressed by the task force and specific recommendations are noted below.

National Security Planning and Budgeting Recommendations:

- Strengthen five-year plans (by the National Security Council, OMB, and the Office of the President) committed to the "top line" budgets and broad strategy
- Two-year budgets
- Chairman Joint Chiefs of Staff (JCS) in resource planning system
- Chairman JCS to do annual net assessments (related to resource levels)
- Milestone authorizations and appropriations for major programs
- Mission area budgeting

Military Organization and Command:

- Chairman JCS as principal military adviser
- Joint staff under JCS
- Chairman JCS in command loop
- Establish vice-chairman
- Strengthen the Unified and Specified Commands (CINCs)
- Shorten command path for Special Forces
- Unified Transportation Command
- Overall emphasis on jointness

Acquisition Organization and Procedures:

- Establish Under Secretary of Defense for Acquisition
- Establish only one level between "Service Acquisition Executive" and Program Manager

- Reduction of acquisition personnel
- Simplify and resolve all conflicts in existing procurement legislation (one regulatory package)
- Strengthen acquisition personnel systems—political appointees, civilian professionals, procurement personnel.
- Establish Joint Resources Management Board
- Greater use of commercial components and systems
- Greater use of prototypes (including costs)
- Increased role of the Defense Advanced Research Projects Agency (DARPA), especially with regard to prototyping
- Greater use of Operation, Test & Evaluation (OT&E)
- Commercial-style competition (with emphasis on quality and proven sources)
- Institutionalize "baselining"
- Increased use of multiyear procurement
- Revise data rights (correct laws and DoD abuses)
- Strengthen industrial responsiveness (including funding)

Government and Industry Accountability:

- Strengthen civil and criminal laws (especially Civil False Claims Act and administration action on false claims)
- Establish self-governing codes of ethics for industry (especially regarding enforcement)
- DoD should remove barriers to contractor self-governance (e.g., subpoenas of internal audits)
- The Under Secretary for Acquisition should have responsibility for overall audit policy
- Remove abuses of suspension and disbarment (establish a consistent DoD policy; Federal Acquisition Register amendment)

***Bolstering Defense Industrial Competitiveness*. 1988. Report to the Secretary of Defense by the Under Secretary of Defense for Acquisition. Washington, D.C.: U.S Department of Defense.**

This report identifies six strategic initiatives to address the fundamental causes of U. S. industrial competitiveness problems:

- forging the right relations with industry;
- improving the acquisition system;
- establishing strategic defense industrial plans that support U.S. strategic military plans;

- developing manufacturing capabilities concurrent with the development of weapon systems;
- laying the foundation for the technical skill base required for the defense needs of the future; and
- ensuring that industrial base issues important to U.S. defense benefit from a full spectrum of potential policy remedies when appropriate.

Addressing the first strategic initiative, the report concludes that the DoD's ability to meet the material needs related to U.S. security objectives is dependent on the private sector and is being impeded by an exaggerated adversarial relationship. Lack of trust on both sides creates an environment in which significant improvements are increasingly difficult. Regardless of the source of distrust, there is a powerful need to build a cooperative relationship between the DoD and industry that will lower barriers to improvements, enable more effective policy development and implementation, and contribute to the national goal of a strong industrial base.

The report suggests creation of a mechanism to enable senior industry managers to participate in the analysis of priority issues and alternative solutions, which would contribute to better understanding and consistency of effort. The report recommends establishment of two bodies, a Manufacturing Advisory Council and a Defense Manufacturing Board (DMB), to function in similar ways, but in different environments. The Manufacturing Advisory Council would focus on public policy issues and national economic issues relating to manufacturing, and would provide the DoD with essential input regarding civilian issues, programs, and policy options in these areas. The Council would be assembled by the National Academy of Sciences, as an objective third party between DoD and industry.

The Defense Manufacturing Board was established within DoD as a permanent entity to provide visibility to manufacturing and industrial base issues. The DMB was modeled after the Defense Science Board. Both advisory bodies played a major role in facilitating several other recommendations, such as advising the office of the Production Base Advocate on issues such as factory modernization investments, how to integrate commercial and military production, and how to achieve greater stability in major acquisition programs. (The DMB was disbanded in 1990.)

***Report Outlining U.S. Government Policy Options Affecting Defense Trade and the U.S. Industrial Base*. November 1988.**

The Defense Policy Advisory Committee on Trade

This report of the Defense Policy Advisory Committee on Trade addresses the need for more coherent, long-term policy related to defense

trade and the defense industrial base and more cooperative industry/government relations, and suggests an outline for such a policy. Recommendations contained in the report fall under the following categories:

Enhancing Participation in Global Markets

- Increasing Government Support for Trade and Cooperation
  - — Executive Branch Organization to Support Trade and Cooperation
  - — Legislation to Enhance Trade and Cooperation
  - — Technology Transfer Reforms
  - — Financing Defense Exports
  - — Middle East Arms Sales
  - — Congressional Notification of Arms Transfers
- Improving the International Environment for Trade Cooperation
  - — Effect of the Multilateral Trade Negotiations on Defense
  - — Implications of a Unified Europe on U.S. Defense Industry
  - — U.S./Japanese Defense Trade and Cooperation
  - — Coping with Escalating Offset Demands

Strengthening U.S. Defense Industrial Base

- Responding to Globalization of the Defense Industry
  - — Foreign Ownership of Defense-Related Firms
  - — Implications of Foreign Sourcing
- Preserving U.S. Technology Leadership
  - — Government Support of R&D
  - — Effective Use of Competition to Encourage Innovation
  - — Protection of Private Data Rights
  - — Effective Communication of Future Requirements
  - — Increased Use of Commercial Practices and Items
  - — Education, Training, and Recruitment
- Ability to Modernize and Attract Capital Investment
  - — Effective Government Industry Cooperation
  - — Status of the U.S. Semiconductor Industry

***Picking Up the Pace: The Commercial Challenge to American Innovation.* 1988. Council on Competitiveness. Washington, D.C.**

This report examines U.S. technological capability, particularly the ability of the United States to maintain its overall world leadership in science and technology development, and in the commercialization of that technology. The report argues that effective development and deployment of technology

are critical to America's ability to compete in world markets, that technological innovation is closely linked to systematic, incremental improvements that are driven by market needs, and that a variety of warning signals point to problems in the ability of the United States to commercialize technology rapidly. Industries cited as examples of deterioration in U.S. high-technology capabilities include consumer electronics and semiconductors. Recommendations regarding steps the federal government should take include:

- Improvement of the macroeconomic environment that affects the private sector's ability to develop and apply technology (reduce federal budget deficit, restructure tax policy to promote savings and long-term investment).
- Implementation of specific steps at the executive and legislative levels to improve the process for formation of technology policy.
- Increase investment in the education, facilities, and equipment that constitute the nation's technology infrastructure.
- Widening of the focus of national research and development efforts and streamlining, consolidation, and closing of federal laboratories until there is assurance that the missions and roles of the laboratories are relevant to the needs of the nation over the next 20 years.

***Lifeline in Danger: An Assessment of the United States Defense Industrial Base*. 1988. Washington, D.C.: Air Force Association.**

This report, prepared by the Air Force Association and the U.S. Naval Institute Military Database, identifies a number of challenges to American industry and its support of national defense, and suggests primary areas of emphasis to ensure adequate industrial support in the future. The major issue addressed is the inability of the United States to meet needs for defense mobilization or a surge in production. It examines the increasing dependence on foreign sources for high-technology military components and points out that the impact on American jobs and businesses is an additional reason for concern. Major recommendations contained in the report include:

- Appointment of a Presidential commission to plan defense management reform and strategic modernization.
- Assembly (by DoD) of crucial information on the full extent of supplier and subcontractor relationships and the degree of foreign dependencies for critical weapons and components.
- Reexamination by the Presidential commission of incentives and disincentives in defense production, and development of a plan for reform of the tangled network of laws and regulations that have led to the current condition.

- Avoidance of hasty legislation.
- Adoption of a more objective DoD stance in its dealings with the defense industry.
- Nurture of the domestic supplier contractor base by prime contractors.
- The federal government should conduct a major command post exercise to diagnose and demonstrate the state of the defense industry.

***The Defense Management Challenge: Weapons Acquisition*. 1988. J. R. Fox and J. L. Field. Boston, Mass: Harvard Business School Press.**

Fox and Field address two prevailing attitudes toward the government's role in their study of defense acquisition management. Those holding the "liaison manager" point of view believe the government program manager serves primarily to promote a program, prepare progress reports, negotiate with various parties within DoD, and resolve conflicts between parties and the contractor. Cost control is seen as the sole responsibility of the contractor and there is no need for the program manager to have excessive training or experience with industrial management or cost control methods. Program management is therefore a reasonable rotation for military officers between operational assignments. The alternative view is one of an "active manager." In this formulation, the program manager's role is one of planning, rigorous oversight, and negotiation with and control over the contractors. Fox and Field advocate the active manager view, where responsibility for cost control is shared between government managers and the contractor. By establishing and implementing incentives, both formal and informal, the program manager has significant opportunity to reduce costs throughout the life of the program. The existing system of staffing and training military program managers cannot produce individuals capable of taking this role.

On the civilian side, the authors recommend reforming civil service regulations to establish higher standards and permit removal of mediocre performers. According to Fox, absent these changes, "defense acquisition programs will appeal primarily to those satisfied with the present low level of responsibility."

***Affording Defense*. 1989. Jacques S. Gansler. Cambridge, Mass.: MIT Press. 417 pages.**

Chapter 11 outlines seven major reforms needed to achieve cultural change in weapon acquisition. The objectives are to achieve higher quality weapon systems that fail less often and are easier to maintain. These weapon systems would be far less expensive and would still have the high perfor

mance needed to maintain the technological leadership that is the essence of America's defense strategy. Another objective is more rapid fielding of new weapon systems so advanced technology can be brought to bear in sufficient quantity to make a difference in the outcome of a conflict.

Gansler advocates that these objectives be achieved through natural (i.e., market) incentives rather than through increased government regulation. These incentives would be geared toward improved quality and lower cost as well as toward the traditional goal of improved performance. To achieve the objective, two necessary conditions are outlined:

1. The government must create an environment in which both government employees and contractors have self-evident reasons for improving quality and lowering costs. Such incentives include promotion, profits, increased sales, and professional pride. Clear lines of responsibility need to be consistent with this approach (using incentives as a principle means of motivation). For this reason the Unites States should move toward far greater centralization of the process of making acquisition decisions by strengthening the authority of the Under Secretary of Defense for Acquisition and the Vice-Chairman of the Joint Chiefs of Staff.
2. In order to achieve the needed reforms, Congress must play a cooperative role. Although most of the changes recommended can be implemented within existing legislation, the full support of Congress will be needed and, in a few cases, new legislation will be required to allow the changes to take place.

The seven reforms necessary to achieve cultural change are:

1. Enhancing the quality of acquisition personnel
   - — create clear career paths
   - — retain top talent
   - — increase promotion opportunities
   - — increase salaries
   - — increase knowledge of technical and production functions
2. Streamlining the acquisition organization and procedures
   - — fewer but more qualified people making decisions
   - — reduce oversight within DoD to two levels
   - — develop simple government procurement regulations that give procurement personnel far greater freedom to exercise their management decisions (empowerment).
3. Achieving program stability
   - — increase cost realism in planning programs
   - — increase scrutiny in selecting programs
   - — prove technology before production

- minimize changes in programs as they evolve (save for next generation)
- combine multiyear contracting and multiyear budgeting

4. Achieving a better balance between cost and performance in evaluating the initial requirements for a new weapon system

   - constant interaction between the users and developers
   - increased availability of information on production and support costs when design tradeoffs are being made
   - strong military involvement in the early operational testing of systems

5. The use of advanced technology to reduce costs

   - Redouble engineering effort devoted to the technology of manufacturing, as well as the weapon system itself
   - Emphasize the attainment of high quality through improvements in the production process
   - Establish cost as a design parameter throughout a product's evolution ("design to cost")
   - Make organizational changes to ensure that non-traditional uses of advanced technology are encouraged

6. Expanding the use of commercial products

   - take advantage of high volume in the commercial sector at the component level, subsystem level, and even the system level
   - rely less on military specifications, rely more on commercial specifications, and change procurement practices

7. Increase competition, with emphasis on quality and demonstrated performance

   - rely on market incentives where prior performance and quality are major decision factors
   - overcome hindrances such as higher up-front costs that promise savings later

A broad strategy for the defense industry is offered involving five major points:

1. Development of a research and development strategy geared toward advanced materials, components, and manufacturing technology.
2. Integration of the defense economy and the civilian economy at the plant level (with the DoD taking the necessary steps to remove the existing barriers to integration).
3. Increase the use of continuous competition, stressing quality and performance criteria as well as cost.
4. Consider explicitly the impacts of all the DoD's major policy, resource, and program decisions on industrial strategy and vice versa.

5. Recognize the defense industrial base as a critical part of the nation's overall national security capability, approaching the strategic and tactical forces in importance.

***Holding the Edge: Maintaining the Defense Technology Base, Volume I, II*. 1989. U.S. Congress, Office of Technology Assessment. Washington, D.C.: U.S. Government Printing Office.**

This report focuses on the management of defense technology base programs and facilities, technology transition, and dual-use technology. It is divided into three sections. The first addresses strategic management of DoD technology base programs. It examines the system by which the goals of the technology base programs are identified, as well as the methods used to allocate resources in order to reach those goals. Emphasis is on the role of the Office of the Secretary of Defense (OSD) in guiding and coordinating the efforts of the Army, Navy, Air Force, and other DoD elements. The management of the laboratories run by the three services also is addressed. The second section analyzes delays in application of technology in the field. The final section is concerned with dual-use technology.

Volume 2 of this report contains detailed supporting material on selected topics, including the DoD acquisition system, summaries of studies on acquisition times, acquisition milestones and phases, the fiber optics industry, the advanced composites industry, the software industry, European research and technology, and Japanese strategic management. In the absence of recommendations, Chapter Two of the report presents issues and options for Congress, including:

- Reform of the Defense Acquisition System—If Congress is serious about making the system work better, it will have to face some hard choices.
- Independent Research and Development (IR&D) Recovery—The DoD needs to present a coherent position.
- Reform of the DoD Laboratory System—The Congress should reform the system itself, order DoD to reform it according to congressional guidelines, or leave the job to DoD.
- Reform of Strategic Planning of Research and Development Programs—If there are to be strategic planning and central coordination, these functions will have to be assigned to the OSD. Accordingly, OSD will need greater power to plan, coordinate, and oversee technology base programs.
- Reform of Government Personnel Practices—Loosening the rigid civil service salary structure is a fundamental step in reform of laboratory management. The ability to provide competitive compensation is a major prerequisite for converting laboratories to government-owned contractor-operated status.

- Fostering Greater Coordination Between Defense and Civilian Research and Development—Several steps Congress could take include: expanding the availability of commercial exploitation of the vast amount of research and development done in DoD laboratories and under DoD contract, coordinating the activities of defense laboratories more closely with other federal agency laboratories, moving technical personnel between government and industry, and reforming DoD acquisition to make it easier for DoD to do business with innovative companies.
- Dealing with International Trends in High-Technology Industry—Congress will have to formulate policy regarding foreign ownership of U.S. plants and foreign siting of U.S.-owned facilities, or encourage the administration to do so. The solution lies between the two extremes of buying defense components only from U.S.-based and U.S.-owned suppliers, and buying solely on the basis of the best business deal. Intermediary choices include buying from U.S.-based foreign-owned companies, U.S.-owned companies regardless of location, and nearby sources (i.e., Canada and Mexico) regardless of ownership.

***New Weapons, Old Politics: America's Military Procurement Muddle*. 1989. Thomas L. McNaugher. Washington, D.C.: The Brookings Institute.**

Although huge sums are spent on defense systems, no one likes the process that brings weapons into existence. The problem, McNaugher argues, is that the technical needs of engineers and military planners clash sharply with the political demands of Congress. He highlights the extent to which strategies for developing arcane and uncertain technologies have come to be shaped more by the needs of American politics than by the needs of technology. The resulting acquisition process errs systematically in the way it chooses new technologies, develops them into weapon systems, and rushes them prematurely into the field. Worse, it operates largely beyond the control of policymakers and politicians charged with providing for the common defense. Repeated attempts to solve these problems with acquisition reform have not just failed, but often have made things worse. He offers reforms that would fundamentally reorganize the way the defense sector interacts with American business, such as:

- Extended competition. Because important parts of the design process unfold so late in development (even in the early stages of production), competition should continue longer than it does currently. Competition should end only after early operational models of competing new designs have been subjected to operational as well as technical testing. Extended

competition will require the use of less detailed technical and project financing requirements.

- Buying systems. Given the DoD's long procurement history and intimate knowledge of complex systems, McNaugher argues that the requirement for a new system should focus principally on a unit production cost the government finds acceptable. In financing systems, it should be possible to estimate the cost of development permitting more frequent use of fixed-price development contracts with minimum detail. Rather than basing prices on cost, the government should state the price it would be willing to pay for the final product and allow developers to base their costs on that price.
- Buying information. The government should spend more money fully exploring new technologies before making commitments. The DoD's goal should be to create a stable environment, over a reasonably long period (say, 5 years) during which development teams can explore and test a new device.

***Deterrence in Decay: The Future of the U.S. Defense Industrial Base.* 1989. Washington, D.C.: Center for Strategic and International Studies.**

This study represents the final report of the Center for Strategic and International Studies (CSIS) Defense Industrial Base Project, which was co-chaired by Senators Jeff Bingaman and John McCain. The report analyzes the nature and causes of trends in the defense industrial base and argues that the U.S. defense industrial base faces significant challenges. These challenges include: (1) the U.S. defense acquisition system is grossly inefficient with the greatest cause of this inefficiency being unrealistic defense programming and budgeting, (2) U.S. firms are becoming increasingly unwilling to do business with the DoD, (3) the declining levels of investment and profitability in defense firms, and (4) the increasing import penetration and foreign dependence in the defense industry. The study measures the magnitude of the U.S. defense base problem. The report argues that present U.S. policies toward the defense industrial base do not address these problems. Following a "smarter not richer" strategy, the report recommends more productive oversight of defense industries in peacetime to reduce costs; more rational planning, programming, and budgeting in the context of U.S. national security strategy; and selective incentives for firms in industries that are particularly disadvantaged in globally competitive defense markets or for industries in which it is especially vital to have a domestic production base.

***Integrating Commercial and Military Technologies for National Strength: An Agenda for Change*. 1991. Report of the Steering Committee on Security and Technology. Washington, D.C.: Center for Strategic and International Studies.**

The committee envisions a future in which the government maintains only a very few defense-unique sectors in the economy for technologies, like nuclear weaponry, that are specific to defense. For most of its needs government would cooperate with the commercial sector in research and development and in acquisition of materials, components, and equipment. Investments in technology and facilities would not be divided artificially by end user, but used synergistically to enhance both the security and economic competitiveness of the United States.

The report identifies the DoD's inability to reach easily beyond its captive defense industrial base as a central problem. The DoD procurement system virtually forces a separation of the private sector into two discrete economies: defense and non-defense. In a series of industry case studies, the committee found that, in most companies, defense products are designed, developed, produced, and supported separately in isolated plants or independent divisions. Many companies maintain separate engineering and production facilities for military work, much of which duplicates billions of dollars in capital and labor investments in the commercial sector.

This segregation of commercial and military work also is reflected in the federal research laboratories, where there is little attempt or desire to exploit the growing synergies between military and commercial technologies.

An integration strategy requires two types of actions: a total commitment to change by the DoD—fully supported by Congress—and a specific legislative and regulatory agenda for implementation. At the policy level the burden rests heavily with the DoD; it must be the task of the Deputy Secretary, the Under Secretary for Acquisition, and the service secretaries to reallocate and redirect resources, organizations, programs, and policies to this objective and continuously to monitor progress. The committee maintains that an integration strategy merits such priority because, without it, DoD will not be able to afford a viable military posture.

The committee identified four areas of regulation or legislation that are the dominant factors driving a wedge between commercial and military business. Listed in order of priority these are:

1. Accounting Requirements and Audits:

The committee's recommendation is to broaden the exemption from cost and pricing data for commercial products or products procured in competitive bidding. The committee suggested creation of exemptions for those corporate operations primarily

involved in the commercial market, and upgrade of training in market research for all DoD contracting officers.

2. Military Specifications and Standards:

The committee urged the DoD to create internal incentives, directives, and measures of successful implementation in each buying command for movements away from defense-unique processes or product requirements.

3. Technical Data Rights:

The committee's recommendations are intended to create a better balance between industry's proprietary rights and DoD's data requirements. The intent is to limit the government's demand for "unlimited" rights in data and software, which discourages companies both from incorporating commercial technologies into defense contracts and from exploiting commercial opportunities arising from defense investments.

4. Defense Procurement Regulations:

The committee's objective is to exempt commercial products and/or commercial suppliers from government-unique contractual obligations that are inconsistent with the Uniform Commercial Code (which governs the majority of transactions in the private sector).

Finally, the committee recommends that as the federal laboratory system is reduced in size (corresponding to cutbacks in defense), the laboratories also should shift their focus—consistent with broad movement toward integration. Thus, the government should implement more fully the provisions of the Stevenson-Wydler and Federal Technology Transfer Acts.

SYNOPSIS OF RELEVANT DEFENSE SCIENCE BOARD REPORTS

1979 Defense Science Board Summer Study on Reducing the Unit Cost of Equipment — **March 1980. 155 pages.**

A fundamental premise of this evaluation was that the DoD procurement account would increase only moderately in the next decade. With this basic assumption, the Board analyzed four significant alternatives for action: (1) reduce unit costs for both new and existing systems; (2) increase the capability of current platforms and major subsystems where needed to meet the changing threat; (3) reduce the number of new starts, buying more of current systems; or (4) reduce the number of systems procured. The Summer Study Task Force concentrated on the first two alternatives. A number of concepts were examined that showed promise for achieving cost reductions, including competition; use of commercial equipment; reducing the cost of current regulations, specifications, and the acquisition process itself; and minimizing the cost drivers inherent in the process of setting performance requirements.

Use of Commercial Components in Military Equipment **— January 1987, 69 pages.**

Following the Packard Commission recommendations to increase the use of commercially developed, off-the-shelf equipment, this DSB study panel was asked by the Under Secretary for Research and Engineering to evaluate the cost-effectiveness and performance trade-offs involved in commercialization and to recommend specific ways to accomplish it. This report documents successful examples of commercializations and makes recommendations on ways to do more. Specifically, the panel indicates that, although increased use of commercial equipment has advantages, the increased use of commercial procurement practices could augment these advantages.

Defense Semiconductor Dependency **— February 1987, 103 pages.**

The study addresses the impact of U.S. military dependency on foreign sources for semiconductor devices that are used in all advanced military systems. The report concludes that, while current dependency on foreign sources is modest, semiconductor manufacturing trends indicate that the United States will become highly dependent in the future if immediate actions are not taken. U.S. technological leadership in this critical area is rapidly eroding, with serious implications for the nation's economy and immediate and predictable consequences for the DoD. The report further concludes that actions must be taken to: (1) retain a domestic strategic production base and (2) maintain a strong base of expertise in the technologies of device and circuit design, fabrication, materials refinement and preparation, and production equipment.

Technology Base Management **— December 1987, 55 pages.**

This DSB study focuses on two main issues: (1) the effectiveness of DoD's Technology Base program in producing technology options for various users and operations; and (2) how effectively new technology is transferred to field application. The study evaluates the management of DoD's Technology Base Program, including the processes by which resource allocation decisions are made. The efficiency of employing available resources is addressed, but the adequacy of the present level of resources was not reviewed.

***The Defense Industrial and Technology Base* — October 1988 Vol. I, 55 pages, and Vol. II, 157 pages. Report completed by a Defense Science Board Task Force as requested by Secretary of Defense Frank Carlucci.**

The objective of the Task Force was to recommend a strategy and specific actions for government and industry to adopt that would ensure the defense industry's capability to provide the support required to fulfill national strategy objectives. The industrial and technology base faces new and difficult challenges, including global interdependence on resources, an impending loss of technological leadership, and insufficient long-term investment by industry because of a propensity toward short-term planning. The result is a significant difference between industry's capabilities and the tasks that national security plans assume it can perform. The Task Force makes ten recommendations for steps to reverse this situation:

1. Establish a permanent Cabinet-level mechanism to determine industrial, and technology, base capabilities, compare capabilities with national security objectives, and develop national policy initiatives to reconcile the differences.
2. Improve the planning mechanism affecting surge capabilities by integrating those capabilities into the acquisition process and selectively funding high-priority surge items chosen by the Joint Chiefs of Staff or the services.
3. Because the DoD technology base is being weakened by its inability to attract and retain high-quality management and technical personnel, DoD should immediately implement those policies and procedures necessary to compensate and adequately reward highly qualified technical experts and should propose an organizational structure that could enable private sector operation of select facilities under government control.
4. The Under Secretary of Defense for Acquisition (USD(A)) should develop and implement centralized and integrated policies to develop the industrial base, improve acquisition processes, and coordinate service implementation.
5. USD(A) should implement a set of consistent and integrated acquisition policies. USD(A) should review the services' acquisition policies to determine inconsistencies and variances with DoD policy. Direct actions should be taken to eliminate these differences and to impose specific objectives for industrial, and technology, base needs.
6. Because independent research and development (IR&D) has profound influence on the ability of industry to satisfy DoD's evolving needs, the Secretary of Defense should: (1) reaffirm the importance of IR&D to DoD; (2) determine IR&D ceilings in the context of the long-term assessment of technology requirements, not in relation to specific budget levels; and (3) endorse the existing method of IR&D bid and proposal cost recovery.

7. To ensure that competition provides DoD with the best value for each defense dollar, the USD(A) should ensure that procurement policies and the competition advocacy process base competition principally on total product quality and good business practices, and not on simple price competition.
8. DoD should undertake to reverse the deterioration of the maritime segment of the industrial base to ensure the credibility of America's conventional deterrent.
9. Further improvements should be made to the policies governing the use of best and final offers ("BAFOs"). The task force strongly supports DoD's recent efforts to reform these policies, but suggests that a greater effort should be made to reduce the use of BAFOs and eliminate second-and third-time BAFOs. Pricing data should be included with all request for proposals (RFPs), including those that now call only for technical work effort definition. To the greatest extent possible, responses to RFPs should become "Best and only offers."
10. Because current allegations of misconduct are diverting attention from efforts to implement improvements to the acquisition process, DoD should undertake specific actions to reduce the probability of similar future incidents.

DOD DIRECTIVES, INSTRUCTIONS AND OTHER POLICY DOCUMENTS

DoD Instruction 5000.38," Production Readiness Reviews (PRR)," 24 January 1979, sets forth general procedures and guidelines for conducting PRRs of defense systems. The objective of PRRs is to verify that the production design, planning, and associated preparations for a system have progressed to the point where a production commitment can be made without incurring unacceptable risk of violating established criteria regarding schedule, performance, cost, or other parameters. It is the policy of the DoD to require a PRR before production begins, including any limited production occurring during FSD.

DoD Directive (DoDD) 4245.6," Defense Production Management," 19 January 1984, is a DoD policy to plan production early in the acquisition process and to integrate actions ensuring an orderly transition from development to cost-effective rate production. The policy directive emphasizes the application of fundamental engineering principles during development and production, and calls for an assessment of production risks throughout the acquisition process. The directive also calls for a manufacturing strategy to be developed as part of the program acquisition strategy. Manufacturing technology projects are to be used to determine manufacturing voids,

deficiencies, and dependencies on critical foreign source materials during concept demonstration and validation. The directive states that producibility of each system design concept will be evaluated at the full-scale development (FSD) decision point to determine if the proposed system can be manufactured in compliance with the production cost and industrial base goals and thresholds. Formal assessments of production risks will be developed through industrial resource analyses and production readiness reviews. Risks shall be reduced to acceptable levels in accordance with DoDD 4245.7.

DoDD 4245.7," Transition From Development to Production," 19 January 1984, requires the application of integrated design and engineering disciplines in the construction and conduct of defense acquisition programs. Use of a formal risk-reduction program also is prescribed, along with a guidance manual (DoD 4245.7-M) containing 48 "templates." The templates cover the areas found through experience and by the Defense Science Board to be critical to success for the system. This "transition" manual treats acquisition as an "industrial process" and is a Total Quality Management (TQM) document in concept. It is written from both industry and DoD perspectives. Each template includes a timeline suggesting when the activity might best begin and be completed or operational.

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