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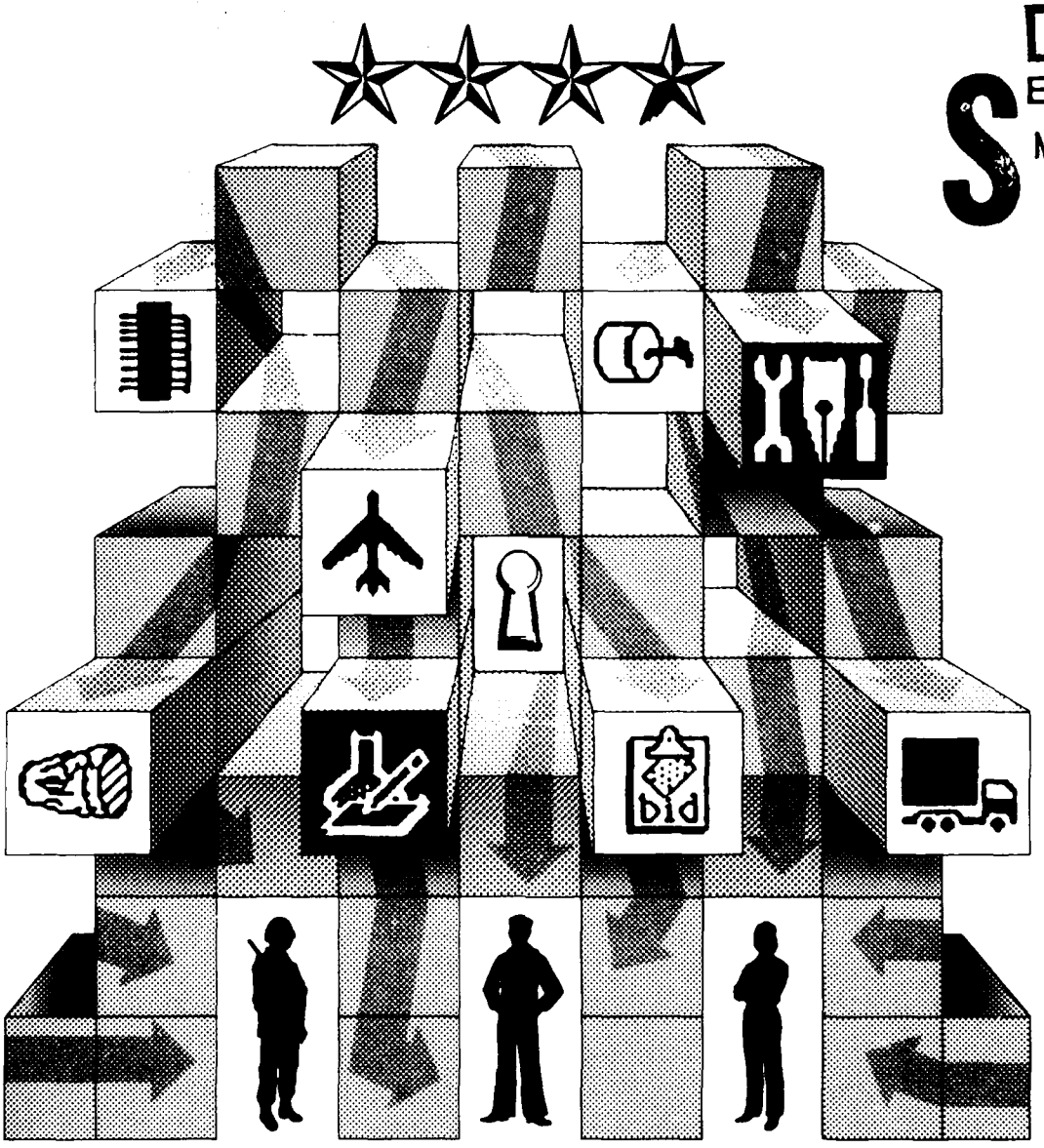
PROGRAM manager



Journal of the Defense Systems Management College

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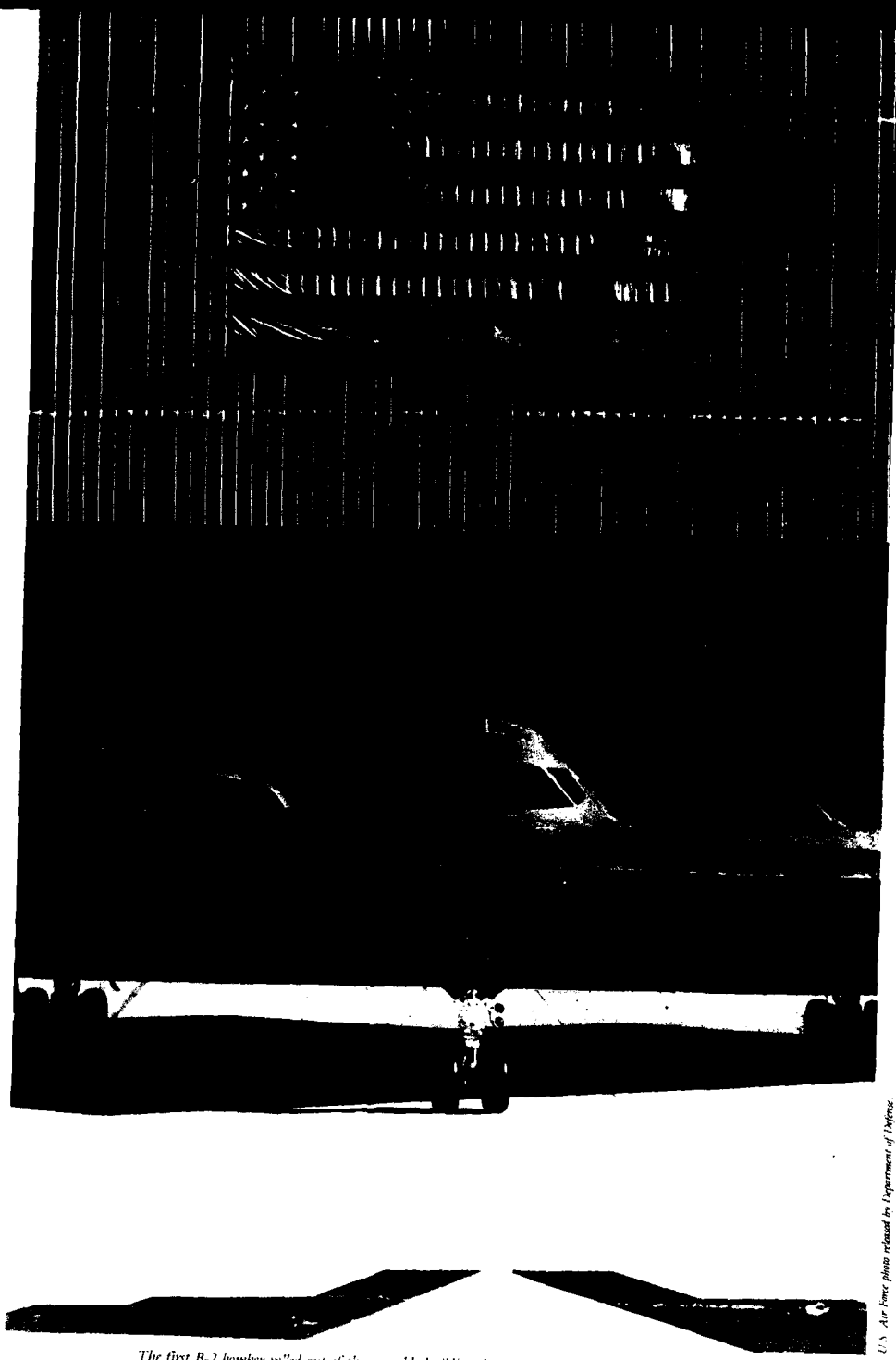


U.S. Air Force photo released by Department of Defense

The first B-2 bomber rolled out of the assembly building during ceremonies at Air Force Plant 42, Palmdale, California, culminating 7 years of development.

Bernard H. Rudwick, P.E.

In his Senate confirmation hearings, Dr. Robert Costello, Under Secretary of Defense (Acquisition) advocated a change in the way the Department of Defense does business, which would provide substantial reductions in the cost of developing and producing defense systems and military products. He calls this methodology "Could Cost." He tasked each Service department to initiate a demonstration project. The Army chose the Bradley Fighting Vehicle; Navy, the Trident D-5 Missile Program; Air Force, the B-2 Advanced Technology Bomber.

The Defense Systems Management College (DSMC) became involved in this effort when asked to assist McDonnell Douglas Helicopter Co. and the Army Aviation Systems Command (AVSCOM) to perform a could cost analysis of the eighth production buy of the Apache Helicopter. While this analysis has not been completed, I have received requests for information about how to perform a could cost analysis. In this report, I attempt to provide guidance by considering the following topics:

- —What is "Could Cost?"
- —How to do a "Could Cost" analysis
  - —Technical aspects
    - —Framework for analysis
    - —Need for cost baseline
  - —Behavioral aspects
    - —Need for dialogue between government and contractor
    - —Need for incentives to contractor

What Is Could Cost?

The first step I faced in assisting the Apache effort was to formulate an approach to doing a could cost analysis. This involved finding out how Dr. Costello defined "Could Cost"; formulating a "first cut," proposed approach to meet the objective; and networking among organizations to test, validate and improve this approach.

I read through Dr. Costello's testimony to the Senate Armed Services committee as part of his confirmation hearings. After formulating a tentative approach to such an analysis, I contacted members of Dr. Costello's office, specifically Rick Sylvester and Bob Davis who was designated the OSD point of contact. In addition, I contacted the OSD Cost Analysis Office, and arranged a visit with Rear Admiral Ken Malley, Program Manager of the Strategic Systems Program, to discuss his approach to performing a could cost analysis of the D-5 Trident missile system.

There are several essential points making could cost different from other related approaches to cost reduction.

Could cost, a cooperative effort between the government and a contractor, is aimed at improving the way we do business. It is a way to determine what a system would cost if we could write contracts to minimize the non-value, added work done by a contractor. It is a way to achieve advantages of competition when we are in a sole-source procurement environment (although the approach can be used in a competitive environment). It is more than the "should cost" approach DOD used in the past in sole-source negotiations with the contractor.

Basically, a could cost analysis consists of a reexamining the total acquisition process to improve this process and arrive at a lower-cost, quality product. The Apache team gives this definition:

> Could Cost is a cooperative government and industry process of eliminating all non-essential effort (labor, material and other costs) while ensuring at the same time product performance and quality.

The consensus for performing a could cost analysis is that we focus on three ways of reducing cost. The first is to reexamine system specifications to eliminate "gold plating" or unessential specifications contributing little to the accomplishment of the military task. The second is determining the most efficient, feasible way of performing the development or production work process, as opposed to continuing the previous work process. This is essentially the proper way of doing a should cost analysis, as shown in several DOD demonstration projects like those reported at the 1987 DOD Cost Analysis Symposium.

The third way involves "streamlining"; that is, tailoring or interpreting various directives and regulations associated with the way the government acquires systems.

Using the Could Cost Analysis Process

To examine these three analytical methods, let's refer to a structure I use at the Defense Systems Management College to model our current acquisition process; one I find helpful in generating system improvements. As shown in Figure 1, we acquire systems through a management control process which divides the entire system acquisition process into phases (concept exploration/demonstration, demonstration/validation, full-scale development, production deployment, operations and support). As each phase is completed, higher-level DOD management can review to validate the phase has been satisfactorily completed and, hence, the program can proceed.

Key principles in Figure 1 follow:

Starting with the concept exploration phase, a user objective must be satisfied. The objective is to provide a system to perform a given military task(s) by a given schedule (e.g., IOC).

Objective of higher-level management is to ascertain that user objectives are satisfied and the system is affordable.

Objective of the contractor is to perform necessary system design trade-offs so that the set of performance and the number of system units required will meet the user objective at lowest total cost (generally present value life-cycle cost), taking into account risks and uncertainties.

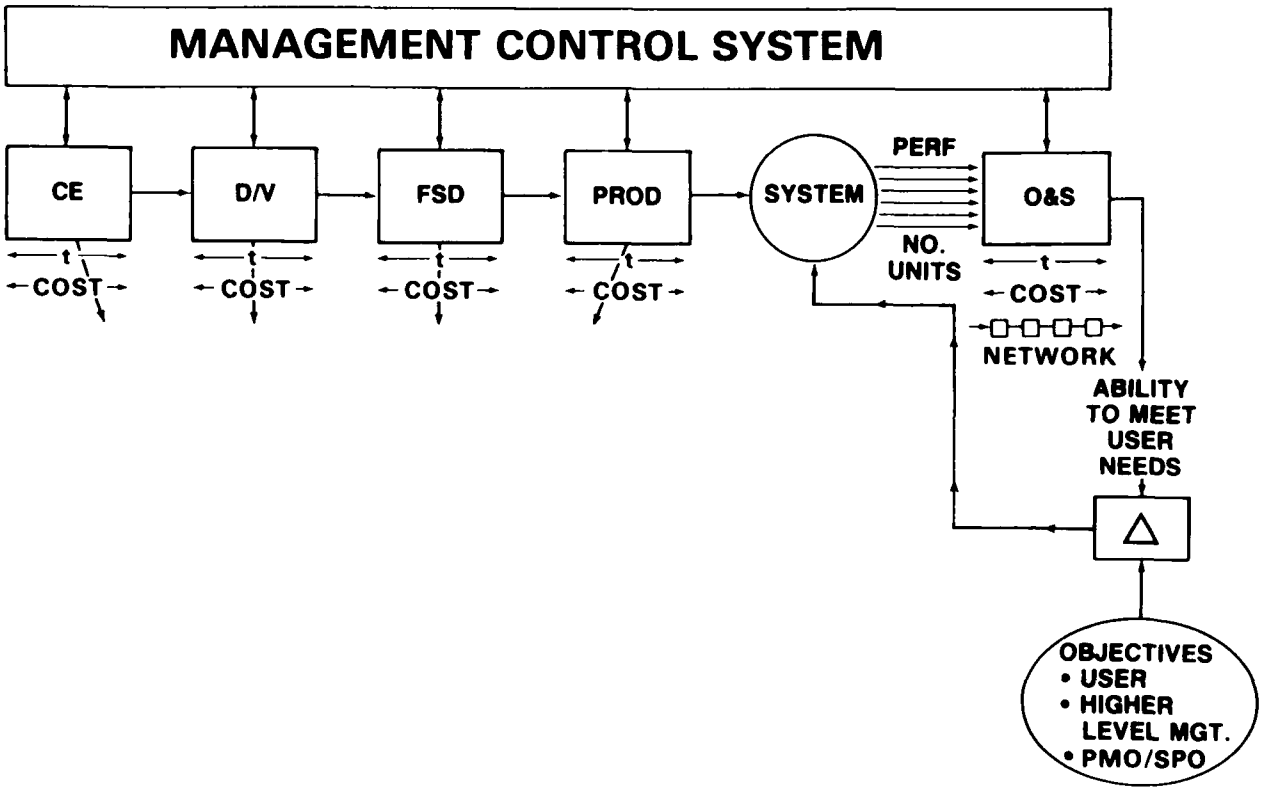
Objective of each succeeding phase is to continue the development and testing process to validate the specifications the system will ultimately provide in the field. If there are major changes in later estimates of achievable performance characteristics, it is the responsibility of the contractor to perform new trade-off analyses to arrive at the lowest cost to meet the user objective. Thus, the contractor is periodically modifying estimates of performance, schedule and cost for each succeeding phase in the acquisition process.

Supporting Models

One management requirement provided at the end of each phase is an estimate (or reestimate) of the time and cost of each succeeding phase in the acquisition process for purposes of program planning, budgeting and control. To aid in making such estimates, the contractor can use analytical tools, as shown in Figure 2.

—A work breakdown structure (WBS) listing in hierarchical form various hardware and software deliverables to

FIGURE 1. MANAGEMENT CONTROL SYSTEM WORK PROCESS IN SYSTEMS ACQUISITION



be furnished during this phase, and performance or quality standards associated with each deliverable.

—An organizational breakdown structure (OBS) listing in hierarchical form the contractor's organization to be applied to each phase.

—A set of work packages (sometimes called tasks or activities) needed to be accomplished to generate the contract deliverables.

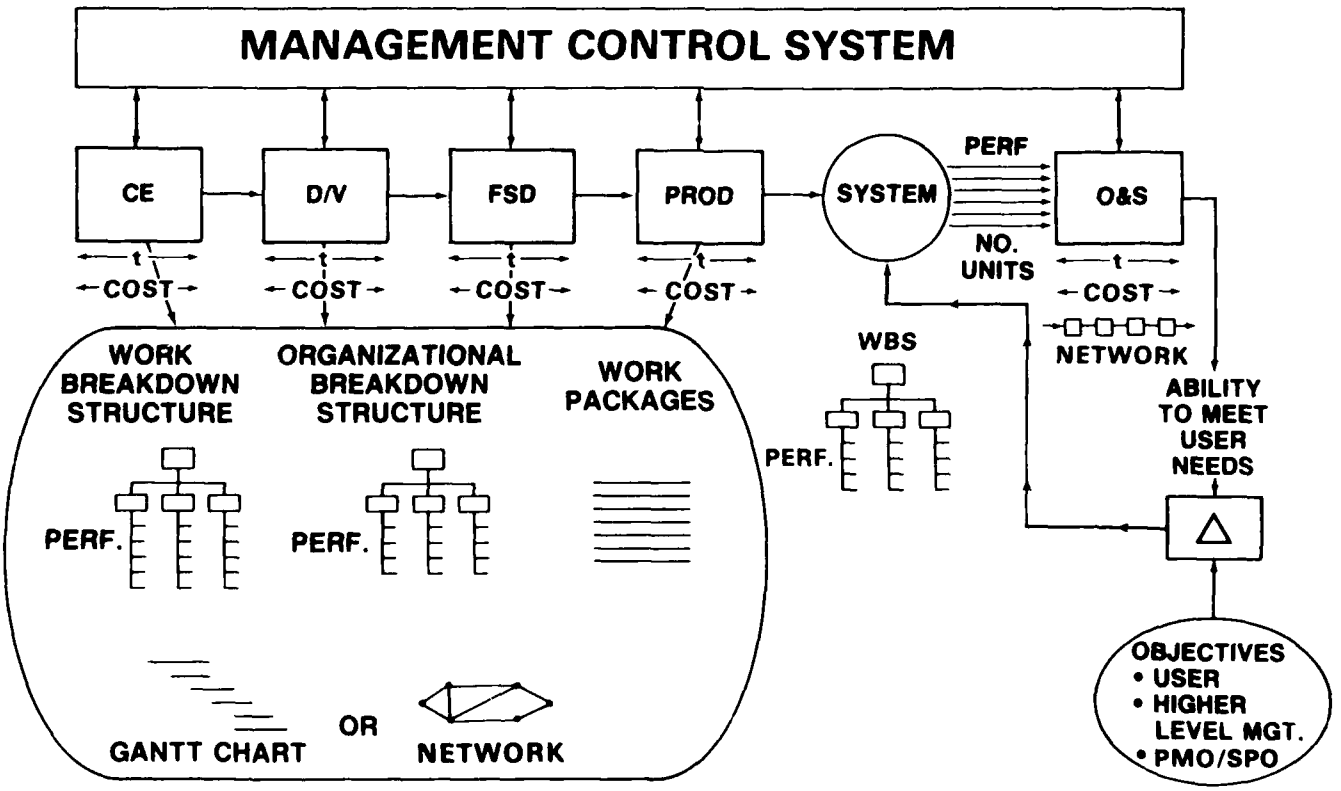
—A cost-estimating technique; the cost of each phase may be estimated in one of several ways, depending on available data. A "bottoms-up" cost estimate may be made by considering what elements must be purchased (e.g., subcontracts, new tooling, development, test and production equipment required). These can be identified from the organizational breakdown structure, and the set of work packages. Other bottoms-up costs may be obtained from work packages associated with the development or production process. These costs include cost of labor, material and other direct costs for each work package, and overhead costs. Operations and support costs can be estimated from a network representing the operations and support process to be followed. In certain early phases, analogy or parametric cost estimating techniques might be used to estimate costs.

—A program scheduling technique; delivery schedule of each phase may be estimated using a Gantt Chart or network which arranges work packages in time sequence (or by interdependencies). Having a network permits the use of critical path scheduling techniques. Alternatively, parametric equations may be used to estimate schedule if sufficient data relating performance characteristics to schedule are available.

Using the Structure

Figure 3 focuses on each of the three opportunities for reducing system cost, as previously described. The first step is to generate a system baseline since all analyses will be performed on a relative basis; i.e., comparing a proposed alternative course of action vs. the current system baseline to see if lower costs result. In the case of Apache, the specific baseline was defined as a proposal being currently generated consisting of the eighth production buy of Apache for FY 1989. Performance characteristics, including all government regulations and directives to be followed, have been specified by AVSCOM. The production process and a cost estimate for this production lot are being generated by McDonnell Douglas.

FIGURE 2. MANAGEMENT CONTROL SYSTEM WORK PROCESS IN SYSTEMS ACQUISITION



Revalidation of Performance Specifications

Consider the first thrust of a could cost analysis: revalidation of performance specifications. In the Apache production proposal, there is to be no change in performance specifications at this time. Improvements (changes in specifications) being placed will be proposed in 1989 as an Apache modernization program. Using a could cost analysis each of these changes in specifications could be analyzed in the following way: list improvements being proposed; indicate benefits over time associated with each change; indicate costs over time associated with each change; and relate benefits to cost. Let's consider examples of how benefits and costs can be quantified and evaluated against one another, using techniques described.

Parts Corrosion

Apache is considering a redesign of certain parts whose useful lives are being reduced through corrosion. Two types of benefits are available. First, existing corroded parts require replacement, or overhaul, more frequently than an improved part that does not corrode. Thus, comparing the improved part vs. the baseline part indicates cost savings in labor and parts due to a reduced frequency of replacement during an assumed life cycle. In addition, each time there is a repair or replacement action there is down-time in which the system is not available, thereby reducing operational availability or readiness rate of the system. Thus, the second benefit of an improved system is the increased availability rate that could be translated into less aircraft to be procured to meet a given specified availability rate than the baseline system. Down-time can be translated into additional effective savings of having to procure less aircraft to meet a given mission requirement.

Improved Fault Detection/Location Equipment

This improvement consists of sensors which detect a failed or failing part and give location of this part. Here we compare savings in maintenance time for an improved maintenance system vs. the baseline in terms of the manpower time saved in detecting and locating a fault. The false-alarm rate of replacing a wrong part also must be considered. As in the previous example, this savings in time can be converted to savings in labor cost as the primary cost savings. In addition, the improvement in availability rate also should be converted into effective savings in procuring less equipment as previously described.

To evaluate the cost effectiveness of each proposed change, the cost associated with each improvement must be considered and compared against benefits on a total life-cycle cost basis. Cost vs. time can be estimated by using tools shown in Figure 2 as addressed in following paragraphs.

What is the current status of the proposed improvement? Has it been completely developed and, hence, only needs to be produced and installed? Or, is additional development required? What cost savings will the proposed improvement provide during its assumed operational life? From these analyses we can develop a cost-benefit stream. From the development/production network we can construct the initial cost stream (development, production and installation) of investment costs to be incurred before operations. This is followed by a benefit stream of total estimated savings during an expected life of the improvement. From this, we can develop two cost-benefit measures. The first consists of the present value net savings of the entire cost-benefit stream, using a discount rate (say, 10 percent) provided by the Office of the Secretary of Defense. This measures total net benefits of each proposed improvement.

A second measure is the savings to investment ratio (SIR), defined as the ratio of discounted net benefits to discounted investment costs. This is a good way to rank proposed improvements where there is a limit on investment costs available.

While we have considered the impact of possible changes on cost, note that many times changes are proposed too late to have beneficial effects. For example, the Trident Program was asked how much savings would occur if missile accuracy were reduced. The answer is: There would be no savings! The development has been completed and the missile is in production. Savings in recurring production cost would be counterbalanced by the cost of additional development, testing and, perhaps, non-recurring production costs.

Extending this principle, when can maximum cost savings be achieved by "scrubbing requirements"? There is an old saying that 75-85 percent of all costs are locked in when the concept exploration phase is completed. It is important to place closest attention to scrubbing requirements early in the acquisition process. This involves focusing on the military task to be done and validating the operational constraints the user is placing on the system. Then, trade-offs are made to find the system requiring the lowest life-cycle cost to meet military task and operational and affordability constraints.

Should Cost Analysis

The second thrust of a could cost analysis involves a should cost analysis. I find difference of opinions regarding how this should be done. Some think should cost involves merely assuming the same work process will be continued into the next phase, and that the only improvement is the assumed learning or improvement curve extended out for later production quantities. This is an incorrect definition of should cost since it assumes the same work process will be followed. A true should cost analysis involves a team of trained industrial engineers and others critically reviewing the proposed work process

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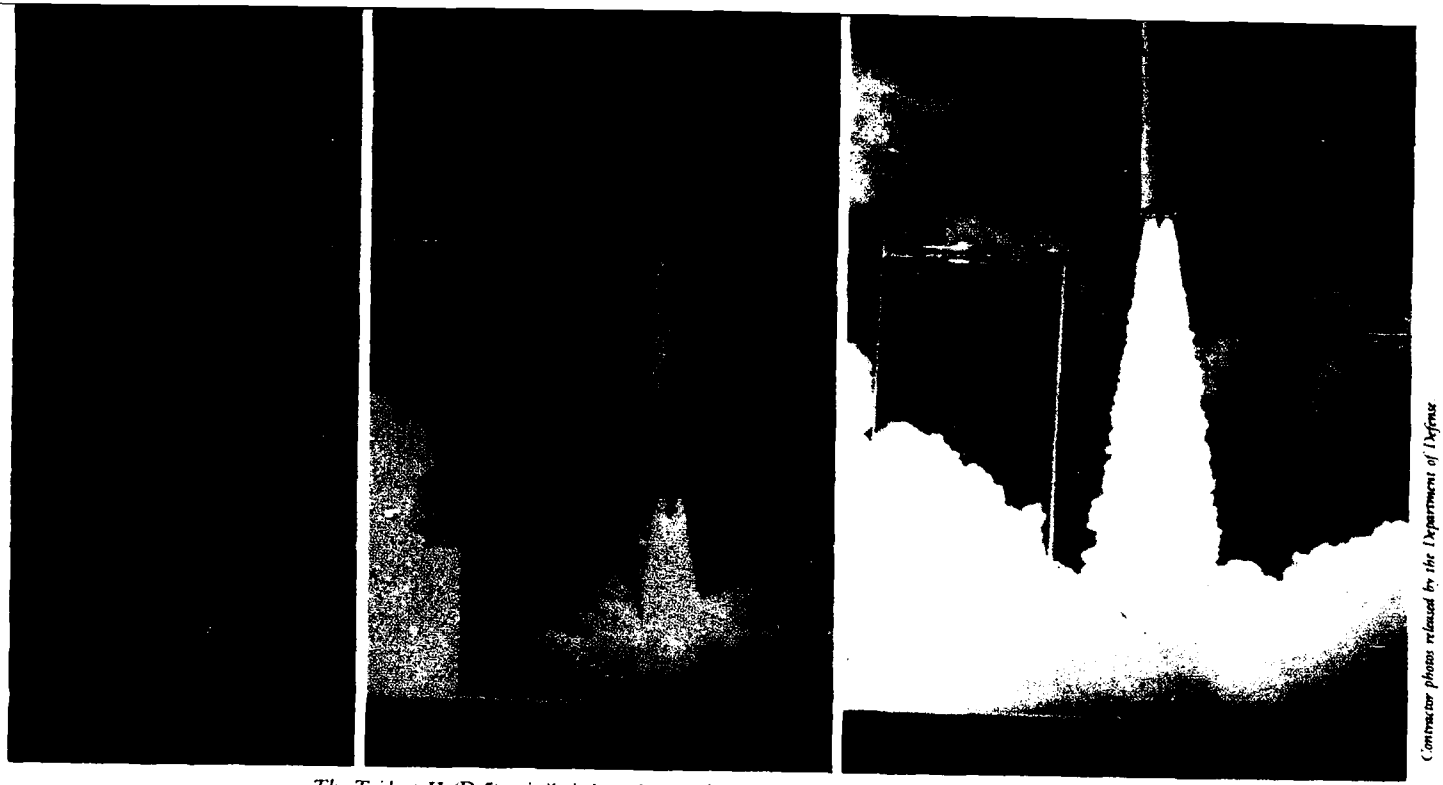
Mr. Rudwick presented this at the 22nd annual DOD Cost Analysis Symposium. He is a Professor of financial management at the Defense Systems Management College.



Contractor photos released by the Department of Defense

The Trident II (D-5) missile is launched at the Trident complex, Cape Canaveral, Florida.

(shown as the network or Gantt Chart of Figure 2) and identifying improvements that could be made to the work process so that perceived ineffeciencies will not be continued. Immediate reduction in recurring costs can be made in addition to future learning/improvement curve improvements for subsequent quantities.

Improvements From Streamlining

The third thrust of a could cost analysis involves a reexamination, tailoring and interpretation of acquisition directives and regulations which the government places on the contractor during the acquisition process. This is represented by the box labeled Management Control System in Figure 2. Examples of potential cost savings include the use of multiyear contracts permitting optimal production rates and economic ordering quantities. McDonnell Douglas indicated it was subject to 1,500 audits requiring an average of 25 contractor personnel to service each audit. Quality assurance inspections, being conducted first by the contractor, are repeated by the government. For their commercial work this is done once. Realizing that each inspection performed reduces risk to the government, McDonnell Douglas indicates a willingness to remove this risk by providing a contractual warranty for their quality; this would warrant performance and failure rates by paying for lack of performance and deficiency in operational availability rate. Such warranties would motivate the contractor to build quality into the work process to avoid extra costs.

The company claims certain reports they now generate as a contract data requirements list (CRDL) no longer are used, yet they still must provide them under the contract. Sometimes, data in the contract performance reports (CPR) have unnecessary detail; i.e., except for high risk elements, is it required to report below the third element of the WBS?

The contractor was able to propose ways to reduce the cost by better tailoring of government acquisition regulations, giving the contractor relief of low-value acquisition regulations. It was recommended the government can evaluate each alternative option in the following way.

—The contractor estimates cost of doing business using existing regulations and directives. (This is their baseline proposal responsive to the current request for proposal (RFP) for the 1989 buy).

—The contractor lists the changes or modifications in directives, etc., which would reduce contractors and, perhaps, government costs of doing business, and an estimate of cost savings that may be obtained.

—The contractor reviews proposed changes and costs savings with AVSCOM which decides ones worth pursuing in more detail.

—The contractor makes a final, more accurate, proposal of cost reduction associated with each acceptable option.

In the Apache analysis, McDonnell Douglas was able to generate some 147 high potential cost-reduction candidates, of which 58 were accepted by AVSCOM for further detailed analysis.

Behavioral Considerations

Let's consider behavioral aspects in obtaining improvements to the way we do business, including forces aiding or preventing these happenings.

The process described involves an effort from government and contractors. Full benefits can be obtained only if both sides are proactive in the process.

Modifying requirements appears to be a fairly continual process during the acquisition cycle as new ways of improving the system in a cost-effective fashion are generated. It is in the contractor's financial interest to generate such improvements and he will continue to do so. Remember that the most important time to scrub requirements is in the concept exploration phase before key system characteristics, and costs, are locked in.

COULD COST ANALYSIS

The contractor readily generates sensible recommendations for streamlining, particularly if involved in a commercial business like McDonnell Douglas Helicopter Company. It has a baseline of doing business commercially, which can be used to compare against AVSCOM directives. The company can estimate cost savings that could be achieved by tailoring such acquisition specifications, and feel they lose nothing in making such changes, which produce a new affordable product. The key is for the government to construct the contract to motivate the contractor to produce a quality product as lower cost; i.e., by making him pay for defects and loss of availability levels below what is normally expected using the current system baseline.

Let's consider the behavioral pressures that motivate a contractor to make changes to reduce the cost of the work process (should cost aspects). In a competitive environment the contractor is concerned with his proposed price, since this affects winning the contract and market share; the strong pressure is to improve proposed cost. In a sole-source environment (say, follow-on production contract), the current acquisition process may force the contractor into the following business strategy which is counterproductive to could cost:

—Don't look for cost-reduction improvements to work process before contract is signed

—Propose highest cost work process that is justifiable; i.e., continuation of previous work process used and the highest learning/improvement curve slope that is justifiable

—After a firm fixed price or incentive type contract is signed, make appropriate efforts to reduce cost.

Here are reasons pushing the contractor toward such a strategy. Given that the contract type is probably firm, fixed price or incentive type, the contractor would like the final price or target cost to be as high as can be justified, since final profit is based on negotiated cost and improvements made during implementation. The contractor knows the government will insist on negotiating a learning/improvement curve, which will require subsequent improvements to make target cost. Why propose many cost reduction improvements initially? Also, why should the contractor begin analytical efforts to improve his work process before starting the contract? Under the Truth in Negotiations Act, he must disclose improvements he might make later and this will be used against him in negotiations. It is to the contractor's advantage to delay the improvement analysis until start of the contract. For these reasons, in a sole-source environment I feel it is essential that a should cost analysis of the contractor's work process take place. The government should take a proactive lead in the should cost effort by reviewing the contractor's proposed work process and making recommendations for improvement based on government knowledge and experience in this area (including what other contractors are doing). In this way the government can drive the target cost down in a reasonable, acceptable fashion, and the contractor will share in additional cost reductions he can generate. However, this effort requires that the government have access to experts with experience in the areas being reviewed.

In the absence of a government should cost team, I believe we need to change our acquisition system to find some way of rewarding the contractor for reducing the cost of his work process as compared with a baseline of his previous (current) work process as audited by DCAA. In this way, the contractor could be motivated to generate cost improvements in time for making his initial proposal to the government. This would reduce the target cost of an incentive type contract and provide additional time for implementing the improvements, presumably reducing cost of a larger number of units.

There are times when a contractor-proposed cost improvement may not provide benefits originally planned. If we are to encourage creative thinking it is unfair for the contractor to assume all risks for such proposals. Perhaps such uncertainties in estimated reduced costs need to be included by adjusting the target cost and the incentive share line to reflect such uncertainies.

Conclusions

A could cost analysis can be an opportunity for government and contractor, as a team, to reexamine all facets of their current method of acquiring defense systems and products with the end-objective of generating lower-cost ways to obtain a quality system or product to meet the military need.

In this paper I have described three major ways of reducing such costs:

—Properly scrubbing requirements

—Performing a should cost analysis of the contractor's work process

—Properly interpreting or tailoring government directives and regulations required to acquire the desired system or product (streamlining).

There is nothing essentially new in the methodology of each of these approaches. What is new is Dr. Costello's challenge to consider all of these approaches in looking for better ways of doing our jobs.

Certain obstacles are identified which prevent us from meeting the full potential for cost improvement:

—The contractor needs incentives which will reward his efforts at cost reduction, or conversely will not reduce his revenues or profit.

—The government needs similar incentives for their efforts.

—Personnel with expertise in should cost analysis and streamlining must be made available to the SPO/PM office when needed.

TOTAL QUALITY MANAGEMENT:

A POWERFUL SOLUTION TO THE LOGISTICS CHALLENGE

General Alfred G. Hansen, USAF

The logistics business faces difficult problems in the years ahead, and *Total Quality Management* (TQM) is one of the most powerful solutions available.

New technology is pushing our military capabilities, and those of our potential adversaries, well ahead of where these capabilities were a few years ago. Additionally, with ratification of the Intermediate Nuclear Forces (INF) Treaty, the military equation that has maintained peace for more than 40 years has changed significantly.

Today, the challenge facing Western military forces is to confront potential adversaries with pre-INF-equivalent levels of risk by using conventional forces. However, our world is intensely competitive and there exists continual trade-offs between economic and defense needs.

It is no secret these trade-offs have been getting tougher. In fact, the past fiscal year was, perhaps, one of the toughest. Need truly is the "father of innovation," and we in the Air Force Logistics Command (AFLC) have learned a lot about how to deal with resource constraints and still get the job done. Perhaps the most important lesson we've learned involves *quality*. We appreciate the importance of a total quality management program, and we have demonstrated gains that can be made when you step forward and embrace new ways of doing business instead of doing "business as usual."

eed truly is the "father of innovation," and we in Air Force Logistics Command (AFLC) have learned a lot about how to deal with resource constraints and still get the job done.

In AFLC, we have found that quality logistics is the key to meet the military challenge and to compete in this tough environment. We must have the right goods and services—spare parts, engineering, and maintenance—in the right places at the right times. In the past, even with solid funding, this has not been easy and we have fallen short of the mark many times.

I believe the future viability of America's armed forces depends, in large measure, on our ability to inject, in a disciplined way, the concerns, controls, and capabilities necessary to put quality into all logistics processes. For AFLC, this translates directly into finding better and smarter ways to provide the kind of logistics our combat forces need.

In the past, we tended to limit quality efforts to manufacturing repair and distribution processes. We did not consider areas like acquisition and requirements, which, in many cases, drive the whole system. We tried to deal with quality shortfalls by "buying our way out," by modifying what fell short of the mark, or by replacing it altogether. We equated quality to inspections; the more we inspected the better the quality. The result was high cost and poor sustainability—the two things we can no longer afford.

To understand why we fell into this trap, it is necessary to look at what American industry did in the 1970s. As a rule, it put quality well down on its list of priorities behind milestone schedules, cost curves, and unit qualities. The industrial infrastructure was set up in the 1970s to produce more at less cost. What it did, however, was saddle this nation with reduced market shares, an unfavorable balance of trade, and loss of international prestige.

Cost savings we thought we were achieving were no more than hollow myths, especially considering the huge investments in people, plants, and equipment required to compensate for poor quality in the first place.

It is not surprising that our logistics infrastructure, built during that period, closely paralleled private industry. In AFLC, we succeeded in producing more, but it didn't count for as much. Mostly, we found parts or items we produced fell far short of our advertised maximum operating time.

Our efforts regularly ended up on the scrap pile or in rework, not in the hands of combat commanders. Cost savings we thought we were achieving were no more than hollow myths, especially considering the huge investments in people, plants, and equipment required to compensate for poor quality in the first place.

By the late 1970s, we knew we had a problem. Falling mission capable rates were indicative of a "paper tiger" Air Force not ready to fight and which could not be sustained in combat. We blamed logistics shortfalls on the lack of money we said was necessary to sustain our forces. Yet, we continued to produce weapon systems and spares which lacked reliability, maintainability, producibility, and quality.

During the early 1980s, we tried to compensate for quality deficiencies rather than redress their cause. Logisticians had the opportunity to become innovative heros; instead, we chose to be traditionalists, afraid to change our course.

Today, the good funding has stopped, violent peace in the world is a fact of life, and stockpiles of materials and surpluses of people are disappearing. We recognize the traditional approach of "inspecting-in" quality at the end of the process cannot and will not work. That's why we have changed to deal with the new environment.

No longer are we thinking of meeting the logistics challenge in a time of fiscal austerity by throwing money and people at the problem or offsetting deficiencies in quality by stockpiling spares, engines and other logistics items. We can't afford to pay the high cost of continually correcting deficiencies by trying to inspect in quality at the end of the process.

The AFLC has successfully broken away from the standard approach to quality and, thus, shifted its emphasis from evaluating goods and services provided at the end of the process, to improving the process by which they are provided. In effect, we are working to substitute an ounce of prevention for a pound of correction.

We started our quality effort about a year ago when we stepped back and took a hard look at ourselves. We saw a command with withered quality councils, tired quality circles and, as a service organization, constantly in the reactive mode with its customers. Our quality program focused only on initial customer acceptance and ignored how well the product performed in the long-term.

Knowing we needed a real quality program, we set out to put one together. We spent much time and effort trying not to "reinvent" the wheel and, in fact, found several good concepts to look at.

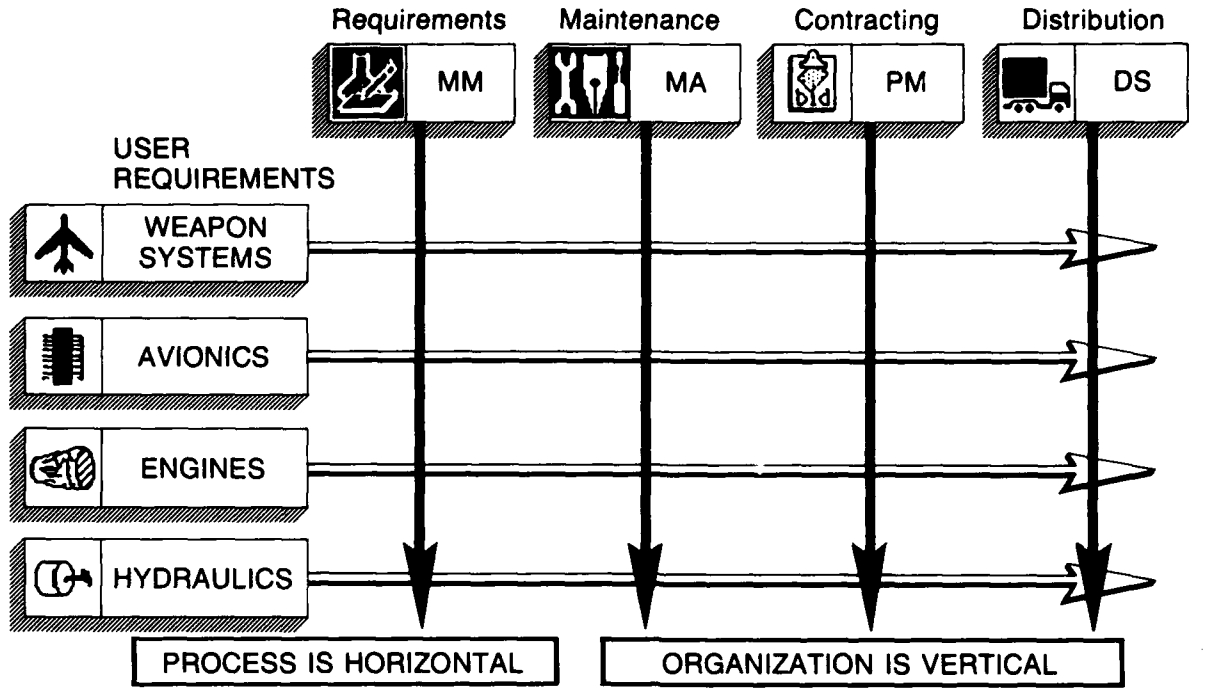
There was the Navy effort at North Island; the program at Lockheed that was people-oriented; and Inland's program, oriented more to process. We looked at quality efforts at Boeing's Commercial Company and IBM; and we talked to many chief executive officers to benefit from their wisdom and experience. Of course, we consulted teachings of various "quality gurus," including Deming, Juran, Crosby, and Taguchi.

We realized, however, that our mission and infrastructure didn't fit one approach. Each guru provided a piece of what we needed, but we wanted to combine people and processes, rather than emphasize one to the exclusion of the other. We found no easy solutions—just good ideas.

We thought we could pay someone to develop our quality program and teach us how to do it but, in the end, we found we could not buy a quality program "off the shelf." *The bottomline: We had to build our own.*

This meant many things, including developing and implementing a training program for managers and workers; taking a hard look at processes for where value was added, and

FIGURE 1. ORGANIZATION AND VISIBILITY OVER CUSTOMER SATISFACTION



where it wasn't; putting process action teams together to identify logistics processes, gather data, and make recommendations we could implement; and continually showing top-management commitment and raising awareness throughout our work force.

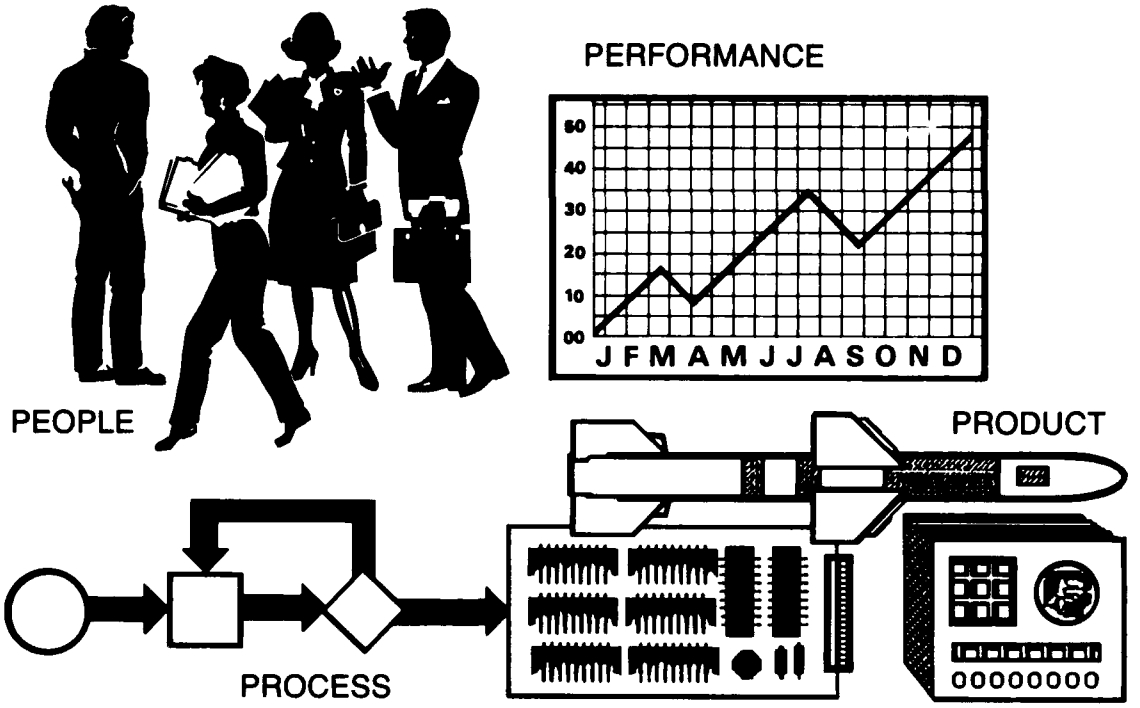
One of the primary thrusts of our quality program was to increase our organizations' visibility of customer satisfaction. There is an inherent problem in doing that because of the way we are organized. User requirements like engines, hydraulics, avionics, or entire weapon systems cross many organizational lines.

For example, for any one system, materiel management establishes requirements; contracting and manufacturing buys material; distribution transports and supplies it; and maintenance repairs and modifies. With this kind of arrangement, it is easy for several organizations to be blind to the activities of others where the same customer's needs are involved. The AFLC quality program deals with this problem because it crosses all organizational lines, involves everyone from the top down, and provides necessary visibility.

To achieve top-down involvement, we are strong advocates of the *cascading* concept. Cascading means the quality program starts with the Commander, and flows down through subordinate commanders, division chiefs, branch chiefs and, finally, to each worker. Responsibility for quality rests directly with people having the expertise and experience to get the job done. With authority of the Commander, and proper guidance and necessary tools supplied by senior management, we are ensuring people at each level have the authority, and are given the responsibility, to run their own quality effort.

With authority of the Commander, and proper guidance and necessary tools supplied by senior management, we are ensuring people at each level have the authority, and are given the responsibility, to run their own quality effort.

FIGURE 2. AFLC's QP4 QUALITY PROGRAM



Another key part of the AFLC quality program is continual refinement. The goal is not to be slaves to specifications as we have been in the past, or fall within a range of variance and accept anything in that range as good enough. Rather, we want to eliminate as much of the variance as possible by working for continuous improvement. I believe quality management of our processes can eliminate virtually any chance of failure by gearing itself not to an artificial set of specifications but, rather, to approach perfection.

The AFLC quality program is a combination of four main factors—what we call "QP4" for *people, process, performance, and product.*

It is *first and foremost* a program of people, the key ingredients. Management must trust people to perform right the first time and, in the end, abolish auditors and inspectors. Success depends on the involvement of everyone in the process, each supporting the Quality Program. Teamwork, commitment, accountability, motivation, and education are hallmarks of the AFLC program because total participation and acceptance are absolutely essential.

Second, the AFLC program is process oriented, because processes are how we get the job done. We know process improvement can provide big payoffs: about 80 percent of the quality problems we have experienced are due to process deficiencies. We know if we can make the processes right, the products will be right. Today, we have approximately 700 process action teams working to do that. Thousands of people, representing 10 percent of my command, are actively engaged in making our processes better.

Third, our program is keyed to performance—to how well we do the job. Making our goods and services right the first time is the only way because we cannot afford to react constantly to deficiencies after they occur.

Fourth, there is the product we provide. Logistics products are the bottom-line for AFLC because they are what combat capability is made of. That is why the goal of the AFLC quality program is customer satisfaction rather than the long haul—not just initial customer acceptance when we deliver the product.

People, processes, performance and *product* are what the AFLC quality program is all about. The QP4 is our cornerstone and supports a management commitment to include everyone, as well as all core logistics functions, along with many other functions supporting this core.

The QP4 represents basic process understanding and the desire to simplify and continuously improve the logistics business. Ultimately, it is a way to do things differently and, in the end, to cash in on available opportunities to effect positive change.

General Hansen is Commander of Air Force Logistics Command with headquarters at Wright-Patterson Air Force Base, Ohio, which provides logistics resources necessary to keep Air Force units and weapon systems in a state of readiness and to sustain their operations in peace, war and contingencies. The Command carries out this mission through five air logistics centers and 12 specialized centers, and employs more than 98,000 men and women throughout the world.

A DIRE ECONOMIC FUTURE?

MIT'S NATIONAL MODEL PREDICTIONS

Rolf Clark

Will the United States have two major recessions by 1995? A new model of the economy says we will. Defense planners and program managers—or, for that matter, people about to invest in townhouses—need perspective on the future of the economy. Prices, inflation, lead times, and labor availability depend on economic conditions. Five-year plans are directly affected by topline budget assumptions, which are dependent on economic trends.

Government perspective on the economy results from well-known trend analyses like the Wharton, Data Resources (DRI), or Chase economic prediction models. Currently, these models predict fairly consistent growth; DRI, for example, anticipates an average 2-3 percent real growth per year during the next few years. However, a model developed at the Massachusettes Institute of Technology (MIT) Sloan School of Management indicates a more dismal future. The MIT model is based on a "systems" logic totally different from econometrics. This difference makes the MIT model a potentially important influence in planning, as it provides reasonable logic resulting in a different future than occurs from trend analysis.

The MIT researchers, under the direction of Professor Jay W. Forrester, have been exploring the dynamics of the U.S. economy within a project called the System Dynamics National Model. The current model predicts two severe recessions by the mid-1990s, and real 1995 gross national product (GNP) possibly below the 1988 level.[1] These results derive largely from overcapitalization and its associated debt. The DRI model, on the other hand, predicts no major recession by 1995, and real GNP to be about 20 percent higher in 1995 than in 1988.[2] Clearly, planners and investors will have different strategies under the two scenarios.

Background

Econometric models like DRI's *U. S. Long-Term Review* are well known and widely used by corporate and government planners. These models have evolved over decades through the efforts of established economists. The MIT National Model, however, is not widely known and has been developed by a group of system theorists with engineering backgrounds. They are not "economists." Why should the MIT model be taken seriously?

Sponsorship could be one reason. For more than a decade, MIT has been funded to develop the model by an impressive list of corporations and agencies, including Citicorp, Hanover Insurance, Merrill Lynch, J. P. Morgan, the Government of Canada, Proctor and Gamble, Polaroid, and Digital Equipment. Currently, the contributed funding is almost $1 million per year. Yet, one can question Forrester's ability to do better than world-renowned economists who have been studying macroeconomics for lifetimes.

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Econometric models like DRI's *U. S. Long-Term Review* are well known and widely used by corporate and government planners. These models have evolved over decades through the efforts of established economists.

The MIT model might be taken seriously simply because of its different logic. Econometric models rely basically on statistical analysis, developed to project recent trends. These models evolved from macroeconomic theories stressing equilibrium conditions like supply equals demand, investment equals savings, and marginal productivity equals the interest rate. The National Model, on the other hand, is based on a causal, or "systems" logic, that assumes real-world disequilibrium. Here, supply does not equal demand, and the imbalances show up as unintended inventory changes. Labor markets do not clear, and the result is demographic migration between industries. Marginal product is not equated to the cost of funds, and overinvestment occurs.

The quantitative method behind the two approaches is totally different. Econometric models relate variables in a statistical sense. The MIT model relates variables in a causal sense. An econometric model might predict consumption to be a fraction of GNP because statistically that has been the case in the past. But, GNP does not cause consumption; it is merely correlated with it. Consumption is caused by population and appetites—more people with more wealth means more consumption. This is a causal relationship.

Econometric models have far fewer variables than the MIT National Model since relationships between variables are based on long-term analyses showing how two (or more) variables correlate, without explaining intermediary direct linkages resulting in the correlation. Causal models, on the other hand, describe linkages between variables. This requires more equations. A sense of the difference might come from the following example. A statistical model of an automobile's velocity might find a good correlation between the car's speed and the position of the accelerator: determine the position of the accelerator, and the car's speed can be approximated. A causal model would define all linkages from accelerator, to carburetor, to intake manifold, engine, transmission, drive chain, differential, axles and, ultimately, to the wheels. Change the position of the accelerator, and the change in each component leading to the wheels can be determined.

Generally, causal models are better at detecting changes to a trend by highlighting the underlying dynamics. Statistical models are better at recognizing patterns—they indicate the direction that general trends are going.

Generally, causal models are better at detecting changes to a trend by highlighting the underlying dynamics. Statistical models are better at recognizing patterns—they indicate the direction that general trends are going. Causal models, then, would seem better for detecting conditions that are precursors to change. The states of the system under study can be seen to be in or out of balance. They also are suited for long-term considerations, when existing trends lose validity and dynamic cause-and-effect relationships must be viewed instead. Statistical models are better for short-term predictions, if trends in existence continue. In a stable economy, most trends remain in existence for considerable periods, and econometric models gain validity. When dynamic changes are imminent, however, it would seem that a more dynamic approach is needed. Forrester would argue that the current economy is rife with dynamic forces of change not yet fully acknowledged.

More on Projections

Representative of the currently accepted economic predictions—as contained in newspapers, investment newsletters, and traditional econometric models—is that growth will average about 2-3 percent per year during the next few years, with the possibility of a mild to moderate recession in 1989 or 1990. The DRI May 1988 forecast, for example, of real GNP growth is for 2.8 percent in 1988 and 2.6 percent in 1989.[3] Beyond 1989, the econometric trend continues, not unexpectedly, somewhat along trend. Table 1 provides selected averages derived from the Winter 1987-88 DRI *U. S. Long Term Review.*

Year-to-year variability in these rates is not excessive. For example, cyclical unemployment rates behind these "average" predictions range from a low of 5.1 percent to a high of 5.6 percent.

The MIT National Model projects two periods before 1996 with unemployment rates worse than the 10 percent of 1982, and real GNP growth averaging closer to zero than 2 percent. More generally, the National Model indicates the economy may be about

to respond to forces that can lead to a major economic downturn.

It is noteworthy that recent DRI projections have edged in the more negative direction seen by the National Model. Unemployment rates for 1989 through 1995, as provided in the Fall 1988 DRI projections, now range from 5.2 to 7.0 percent, up from the 5.0 to 6.4 range projected in the winter of 1987-88.

National Model Dynamics

The major component of unfavorable forces, seen by Professor Forrester as accumulating during the last three decades, is overcapitalization.[4] This will lead to reduced demand for new capital goods, which causes unemployment, which feeds back as reduced consumer demand and once again reduced demand for capital goods. Other forces, resulting partly from overcapitalization and partly from the atttempt to maintain a high, perhaps unearned standard of living, are the selling of US assets, and excessive foreign borrowing. The former means profits flow out of the country, the latter means mounting interest payments flow out as well.

The overcapitalization results from overly optimistic expectations of future growth—a phenomenon now well understood in the Texas oil industry. One reason for planners to be interested in the National Model is that econometric models may be producing undue optimism about future growth, without acknowledging the dynamics of recent capital accumulation.

Overcapitalization does not necessarily mean having too much of the right capital equipment. It can mean having spent so much on capital—efficiently or not—so that new, efficient plant and equipment are unaffordable.

Examples of an impending downturn in capital growth, according to Forrester, are: oil tankers at anchor, excess office space in many cities, an interstate highway system now complete, excess schools and hospitals, and reduced valuations of farmlands and vacation properties.

It is important for present purposes to understand that overcapitalization, deficits, and debts are not assumptions or theories built into the MIT model, from which economic demise would naturally follow. Instead, they are results that emerge from the model. They result from modeling the policies followed in banks, industries, markets, and government. Modeling the underlying stocks and flows describing everyday actions of these institutions leads the National Model to the results observed.

In other words, Forrester concludes we are in the decline phase of a "Kondratiev" cycle, a 50 or so year cycle which has been observed historically, with troughs seen in the 1830s, the 1890s, and the 1930s. The last peak of the cycle may have occurred in about 1980. While this cyclical behavior has been observed previously, it has never been fully explained. The National Model, through documented causal relationships, explains why the Kondratiev cycle might be expected. The model does not begin with an assumption of Kondratiev cycles but, rather, *produces them as results.*

The model also produces 15-25 year "Kuznets"cycles, and well-known 3-10 year business cycles. It exhibits periodic stagflation, previously not well explained, but a phenomenon of the 1970s. These effects are determined from within the model, not from external inputs driving the model to such behavior.

In essence then, instead of basing results on statistical relationships between model variables, the National Model derives results by building the policies of economic institutions into the model equations, and simulating the results over time. It can be argued that this type of model logic will be more likely to detect changes to the economic dynamics than would a typical trend analysis. If major changes

> Equilibrium theory principally deals with steady state analysis, but the economy is never in a steady state. It is always in transient states.

TABLE 1. PROJECTED 1988-1995 ANNUAL AVERAGES

	Pessimistic	Trend	Optimistic
Real GNP Growth	1.9%	2.3%	2.8%
Unemployment			
Total	NA	5.4%	NA
Married Males	3.5%	3.3%	3.2%
Price Deflator	5.3%	4.6%	4.1%

are about to occur, a dynamic (feedback) model such as the National Model should be a welcome addition to our analytic capabilities. Let us try to understand the MIT model in more detail.

Theoretical Issues

Traditional macroeconomic models evolved from equilibrium theories which, in turn, were partly motivated by the desire for mathematically tractible solutions. Tractibility was essential before modern computers made large-scale simulation feasible. Equilibrium theory principally deals with steady state analysis, but the economy is never in a steady state. It is always in transient states. Transient state analysis is mathematically far more difficult than steady state "equilibrium analysis." Transient states contain feedbacks and lags, biases, and perception errors, all of which add complexity to a mathematical analysis. Furthermore, tractibility often demands that non-linear relationships be replaced by linear approximations.

The modern computer has made mathematical tractibility less relevant. Computer simulation easily handles transient states, feedback, lags, and non-linearities, all incorporated into the MIT model.

Transient state analysis derives from control theory, a discipline of the engineering community. That is why engineers such as Forrester, working in concert with National Model economists, have academic legitimacy in modeling the economy.

As to validation, the tradition of "validating" models through statistical time series analysis does not adequately recognize the feedback loop structure of economic systems,[5] and may have foreclosed other forms of validation, such as seeing if dynamic patterns observed in the "real world" are explained. The occurrence of a Kondratiev wave in a simulation's output may be more validating than predicting the value of a variable at a particular future time. It may be more important to understand that a major downturn is about to occur, than to predict exactly *when* that downturn will begin. An investor might hold funds in liquid assets until the downturn occurs—without needing to know exactly when that will happen. The MIT projections of two severe recessions before 1995 certainly might cause the investor to avoid purchasing illiquid real property while the economy is riding an economic crest.

Transient states contain feedbacks and lags, biases, and perception errors, all of which add complexity to a mathematical analysis.

Structure of the National Model

The National Model is a structural model built on the "stocks and flows" network of capital, goods, people, and money in the economic system, the flows of information about the state of the system, and the behavioral decision rules used by people in their institutional roles. The structure of the economy is represented at the microeconomic level, but by simulating microeconomic variables and decisions, macroeconomic results evolve. Decisions within the model— changes to the variables controlling the system—result from actual conditions not meeting desired levels. This means disequilibrium drives the model. Besides recognizing perception lags and feedback, the model also recognizes the "theory of bounded rationality," which, in essence, requires that decisions by firms, banks, agencies, consumers, etc., be made on the basis of partial information, rather than on fairly extensive knowledge of the overall economic situation.

The disequilibrium model structure in the National Model, and insight into its scope, may be clarified through a brief discussion of model specifics. The model consists of seven basic sectoral areas: production, finance, household goods, demographic, labor, foreign trade, and government. The sectors are interconnected by flows of information, people, money, goods, services, and orders. The model accommodates unconventional economic influences, such as expectations, labor mobility, and social stress.

The model is evolutionary, but a recent version includes about 15 production subsectors including soft goods, durable goods, capital equipment, construction, agriculture, food processing, resources, energy, services, transportation, secondary manufacturing, knowledge generation, self-provided family services, military operations, and government employment. The model acknowledges a way of determining labor and professional mobility between sectors, a demographic sector disaggregated by age groups, short- and long-term lending sectors, factors influencing savings variables, a monetary authority, government services and fiscal operations, consumption activity, and foreign trade and international payments.

Each of the 15 production sectors has about 12 factors of production; capital, labor, professionals, services, new technology, energy, buildings, land, water, transportation, and two kinds of materials. Activities for each factor include ordering and inventory control, and the effects of a factor's

marginal productivity. Also acknowledged for each factor are output deliveries and delivery delays, production planning, price setting, expectations, and borrowing.

One can see, perhaps, that the only way to build a model using so many variables and their complex interrelationships is through a simulation approach. Any form of analytic "solution" would be impossible. There are too many variables, and the feedbacks between them make solutions impossible. And the diverse non-linearities, feedbacks, lags, and goal discrepancies prevent correlating the model variables statistically—statistical methods for feedback situations are usually not mathematically feasible.

Clearly, the National Model differs from the more traditional macroeconomic methods. It highlights underlying dynamic changes, and if the model proves accurate, there will be a period of increasingly violent recession and expansion cycles.

Conclusion

The acquisition community is affected by future economic facts. A model developed at MIT is projecting a climate of economic decline during much of the next decade, a conclusion that varies from accepted planning assumptions. The model is based on causal microeconomic relationships between problem variables. A simulation based on microeconomic behavior in firms, banks, and agencies leads to macroeconomic results. There will be opportunity, during the next 2-3 years, to evaluate whether MIT's dynamic model is correctly detecting major unfavorable economic forces. If that model correctly predicts a major downtrend, that would not obviate the need for econometric models, but would indicate that both types of models are important—the econometric models for projecting trends when conditions are relatively stable, the dynamic model to foresee major trend changes.

Defense policy-makers should incorporate the MIT National Model into their data set. If the National Model's dire predictions are proved true, there may be less defense funding available than planned as GNP growth decays.

Defense policy-makers should incorporate the MIT National Model into their data set. If the National Model's dire predictions are proved true, there may be less defense funding available than planned as GNP growth decays. On the other hand, competition for manufacturing resources might then decrease, lead times shrink, and unit prices fall. The five-year plan can be made more responsive to economic trends, if trend changes are foreseen. The MIT dynamic analysis should foresee trend changes first, and it would seem prudent that planners have knowledge of such dynamics. Top-line funding will be affected, as will the stability of the plans themselves. For example, plans for a growth period such as occurred from 1980-83, can be tempered by a subsequent, inevitable decline. This will impact the costs, quantities, and schedules that impact acquisition, as well as most other components of the nation's economic life.

The Defense Systems Management College is becoming a subscriber to the National Model. The MIT insights into the economy, and their potential relevance to defense acquisition, will be reported to readers periodically. Of particular interest will be tracking the economic health of the economy, and whether it swings widely during the next few years as prophesized by the National Model. It will be interesting to see if its causal methodology correctly foresees a pattern of future dynamic changes.

ENDNOTES

1. Based on a telephone conversation May 9, 1988, Jay W. Forrester, director of MIT's System Dynamics Group.

2. Based on cyclical projection model in the Data Resource *U.S. Long Term Review*, Winter 1987-88, (Table 1).

3. Data Resources, *U.S. Forecast Summary*, May 1988, p. 2.

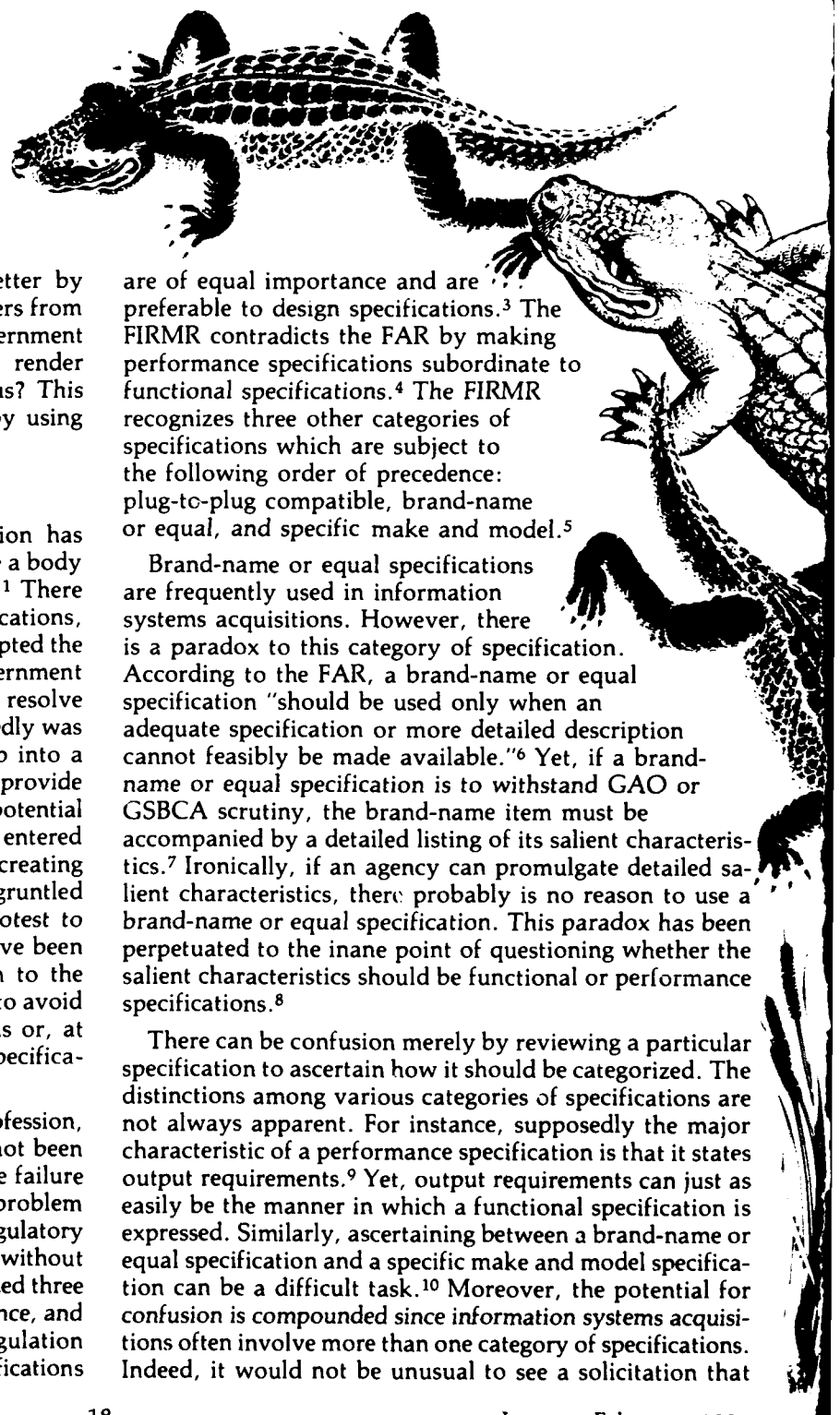
4. The following draws heavily from Jay W. Forrester, "The Economy: Where Is it Heading?" *(Los Angeles Times*, October 25, 1987), and from Forrester's January 1985 paper "System Dynamics National Model Program," (Sloan School of Management paper D-3690).

5. The following derives from John D. Sterman's "The Economic Long Wave: Theory and Evidence," *The System Dynamics Review* (No. 2, Summer 1986, pp. 87-125), and Jay Forrester's "An Alternative Approach to Economic Policy," *Daedelus, Journal of the American Academy of Arts and Sciences*. Fall 1977.

SPECIFICATIONS AND THE LAW

UNDRAINED SWAMPS, UNCOUNTABLE ALLIGATORS & UNDISCERNING LAWYERS

Major Jerome S. Gabig, USAF



Can the acquisition process be served better by reforming the existing system where lawyers from the General Accounting Office (GAO) and the Government Services Board of Contract Appeals (GSBCA) render decisions on protests to government specifications? This administrative function might be achieved best by using competition advocates within respective agencies.

The Undrained Swamp

Beginning as early as 1930, the legal profession has progressively used all the tools of its trade to create a body of law to circumscribe government specifications.[1] There have been judicial decisions, administrative adjudications, legislation, and regulatory rulemaking. What prompted the legal profession to venture into the "swamp" of government specifications? Beyond the immediate need to resolve pending challenges to specifications, there undoubtedly was a loftier goal of converting this uncharted swamp into a highly structured body of jurisprudence that would provide meaningful and enduring guidance to agencies and potential protesters. Fifty years ago, when the first lawyers entered this swamp, surely they idealistically envisioned creating definitive rules which would allow agencies and disgruntled vendors to predict accurately the results of a protest to questioned specifications. Certainly there must have been high hopes of making an important contribution to the acquisition process because agencies would be able to avoid protests by astutely structuring their specifications or, at least, minimize delays by quickly correcting the specifications when correctly questioned by the vendor.

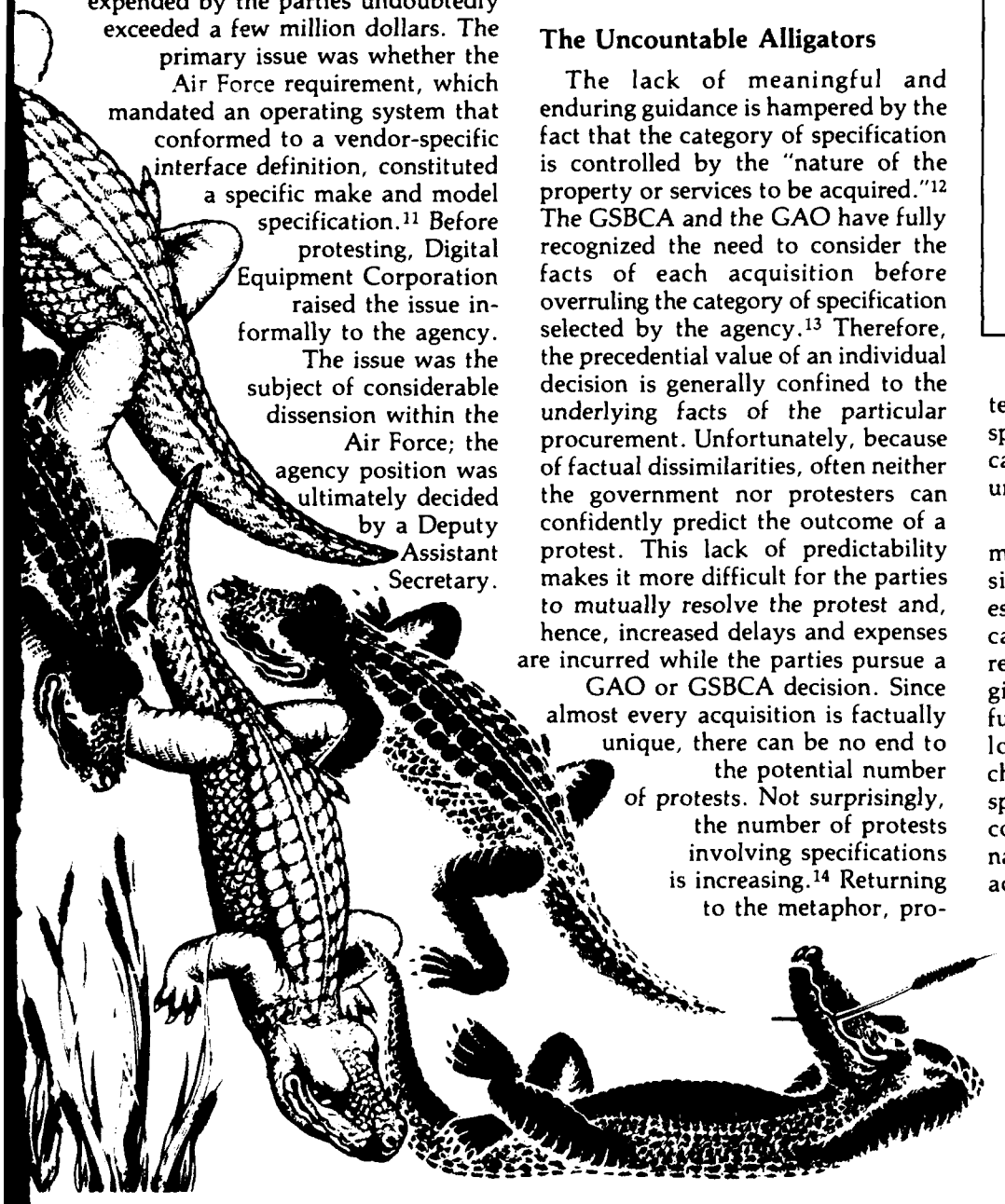
Unfortunately, despite best efforts of the legal profession, this lofty goal of establishing definitive rules has not been accomplished—the swamp remains undrained. The failure can be attributed to a variety of problems. One problem has been the confusion that plagues the statutory/regulatory scheme for government specifications. For instance, without providing any preference, the Congress has recognized three generic types of specifications: functional, performance, and design.[2] However, the Federal Acquisition Regulation (FAR) decrees that functional and performance specifications are of equal importance and are preferable to design specifications.[3] The FIRMR contradicts the FAR by making performance specifications subordinate to functional specifications.[4] The FIRMR recognizes three other categories of specifications which are subject to the following order of precedence: plug-to-plug compatible, brand-name or equal, and specific make and model.[5]

Brand-name or equal specifications are frequently used in information systems acquisitions. However, there is a paradox to this category of specification. According to the FAR, a brand-name or equal specification "should be used only when an adequate specification or more detailed description cannot feasibly be made available."[6] Yet, if a brand-name or equal specification is to withstand GAO or GSBCA scrutiny, the brand-name item must be accompanied by a detailed listing of its salient characteristics.[7] Ironically, if an agency can promulgate detailed salient characteristics, there probably is no reason to use a brand-name or equal specification. This paradox has been perpetuated to the inane point of questioning whether the salient characteristics should be functional or performance specifications.[8]

There can be confusion merely by reviewing a particular specification to ascertain how it should be categorized. The distinctions among various categories of specifications are not always apparent. For instance, supposedly the major characteristic of a performance specification is that it states output requirements.[9] Yet, output requirements can just as easily be the manner in which a functional specification is expressed. Similarly, ascertaining between a brand-name or equal specification and a specific make and model specification can be a difficult task.[10] Moreover, the potential for confusion is compounded since information systems acquisitions often involve more than one category of specifications. Indeed, it would not be unusual to see a solicitation that

uses a functional specification for the application software, a performance specification for the central processing unit, a brand-name or equal specification for the peripheral, and a specific make and model specification for the operating system.

A superb illustration of the failure of the present legal system to provide meaningful and enduring guidance can be found in the notable protest of Digital Equipment Corporation and Wang Laboratories, Inc., to AFCAC 251. Rarely in the history of federal procurement has there been such an arduous protest; resources expended by the parties undoubtedly exceeded a few million dollars. The primary issue was whether the Air Force requirement, which mandated an operating system that conformed to a vendor-specific interface definition, constituted a specific make and model specification.[11] Before protesting, Digital Equipment Corporation raised the issue informally to the agency. The issue was the subject of considerable dissension within the Air Force; the agency position was ultimately decided by a Deputy Assistant Secretary. Similarly, top management in Digital Equipment Corporation exhaustively pondered the issue before resolving to commit hundreds of thousands of dollars to seeking a Government Services Board Contract of Appeals decision. The point is a simple one. If the swamp had been properly drained—if definitive rules had existed that allowed both the Air Force and Digital Equipment Corporation to accurately predict results of the protest—millions of dollars could have been saved and need not have been risked in order to "do business" in an unnecessarily precipitous marketplace *cum* courtroom.



The Uncountable Alligators

The lack of meaningful and enduring guidance is hampered by the fact that the category of specification is controlled by the "nature of the property or services to be acquired."[12] The GSBCA and the GAO have fully recognized the need to consider the facts of each acquisition before overruling the category of specification selected by the agency.[13] Therefore, the precedential value of an individual decision is generally confined to the underlying facts of the particular procurement. Unfortunately, because of factual dissimilarities, often neither the government nor protesters can confidently predict the outcome of a protest. This lack of predictability makes it more difficult for the parties to mutually resolve the protest and, hence, increased delays and expenses are incurred while the parties pursue a GAO or GSBCA decision. Since almost every acquisition is factually unique, there can be no end to the potential number of protests. Not surprisingly, the number of protests involving specifications is increasing.[14] Returning to the metaphor, protests are the alligators in the swamp of specifications. How many alligators can the swamp hold? The number is uncountable.

> Unfortunately, despite best efforts of the legal profession, this lofty goal of establishing definitive rules has not been accomplished—the swamp remains undrained.

The requirement for sound judgment involving the facts of each acquisition deserves elaboration. The established order of precedence for categories of specifications does "not require that an agency sacrifice its legitimate requirements on the altar of full and open competition."[15] The following comment concerning a challenge to a plug-to-plug compatible specification illustrates the GSBCA commitment to give "due regard to the nature of the property or services to be acquired":

> We have no difficulty in concluding that DLA's massive investment in IBM and compatible systems made the idea of scrapping its entire system and starting over with another vendor's incompatible system about as logical as replacing a Chevrolet with a Ford to get a new fan belt.[16]

The most common challenge to a specification is that it is "unduly restrictive." The retort is that a specification is never unduly restrictive if it reflects the actual minimum needs of the agency.[17] Decisions on this topic are legion. Although having nothing to do with information systems, the GAO decision in B&B Boat Building, Inc., provides an excellent insight into why individual facts often dictate the results of a particular decision. The protest involved the Department of the Interior issuing an Invitation for Bid (IFB) for a 36-foot boat. The bid of B&B Boat Building, Inc., was rejected for offering a 38-foot boat. Recognizing that most mariners covet a slightly larger boat, it might initially appear that the Department of Interior had acted arbitrarily. However, the protest was properly denied after the agency established the boat was required to maneuver in a tight work area.[18]

There are a few Automated Data Processing Equipment (ADPE) protests that make an interesting contrast to B&B Boat Building, Inc. If the specification calls for dual floppies, must the agency reject a Winchester disk?[19] If the specification calls for DOS 3.0, must the agency reject DOS 3.1?[20] In summary, as illustrated by these examples, the outcome to protests that challenge specifications are not readily predictable without ascertaining the minimum needs of the agency.

Undiscerning Lawyers

Every profession has its failures. Economists cannot predict inflation; mathematicians cannot divide by zero; and physicians cannot cure the common cold. The legal profession has had its failures as well. An example would be the inability of the Supreme Court to define obscenity.[21] Government specifications are one of the other relatively few failures of the legal profession. Perceptively, the Government Services Board of Contract Appeals has noted the similarities between trying to come to grips with government specifications and trying to come to grips with obscenity:

> There is, we suggest, a certain lack of specificity in the regulations regarding the phrase "functional specifications"; however, we suspect that the writers of these regulations have had some difficulty with that concept as many courts have had with the definition of obscenity, even though the latter can be readily recognized.[22]

Unlike the Justices of the Supreme Court who were able to discern their failure to come to grips with obscenity, procurement lawyers have become so accustomed to "wrestling with alligators" that they have forgotten that their original purpose was to try to drain the swamp. Perhaps it is time for lawyers to get out of the swamp.

Every profession has its failures. Economists cannot predict inflation; mathematicians cannot divide by zero; and physicians cannot cure the common cold. The legal profession has had its failures as well.

Recommendation

"The law is a highly learned profession."[23] Are lawyers, by virtue of their legal training, the best qualified individuals to render decisions on protests to specifications? It is submitted that they are not. The most important prerequisite for the job is good judgment. (Hopefully, even the most arrogant members of our profession will concede that lawyers do not have a monopoly on good judgment.) The next most important prerequisites are an expertise in the technology of information systems and a familiarity with the needs of the agency. Legal training does little to render a person competent in the technology of information systems. Nor are lawyers from the GAO or GSBCA inherently familiar with the needs of the agency.

The Congress should consider excluding protests on specifications from the jurisdiction of the GAO and GSBCA. Instead, all protests on specifications should be lodged with the agency's Competition Advocate. Surely, Competition Advocates meet the prerequisite of having good judgment.[24] Additionally, they often have technical backgrounds. Even if a Competition Advocate personally lacks technical expertise, he is authorized the assistance of "specialists in engineering" and "technical operations."[25] Furthermore, as a member of the agency, the Competition Advocate is apt to be eminently familiar with the needs of the organization.

By virtue of superior qualifications in terms of technical expertise and familiarity with the agency's needs, the Competition Advocate should be able to render decisions in a shorter time than the GAO or GSBCA. Furthermore, the informality of agency protests can facilitate a quick resolution to the protest. Consequently, the Competition Advocate can better serve the CICA "goals of economic and efficient procurement."[26] The protester dissatisfied with the decision of the Competition Advocate may still seek judicial review pursuant to the Administrative Procedure Act. The judicial standard of review is whether agency conduct was arbitrary or capricious.[27]

Will vendors be disadvantaged by not having access to the GAO or GSBCA to protest specifications? Subject to one caveat, the answer is no. Actually, an advantage can be gained because a protest to the Competition Advocate should result in a *de novo* review by that official. Conversely, a protest to either the GAO or GSBCA concerning specifications does not receive much more than the "arbitrary or capricious" review that is otherwise available from a court. The GAO has consistently stated:

> A protester who objects to the requirements in a solicitation bears a heavy burden. The contracting agency has the primary responsibility for determining its minimum needs and for drafting requirements which reflect those needs. [Citations omitted.] It is the contracting agency which is most familiar with the conditions under which the supplies or services have been and will be used, and our standard for reviewing protests challenging agency requirements has been fashioned to take this fact into account. Specifically, our Office will not question agencies' decisions concerning the best methods of accommodating their needs absent clear evidence that those decisions are arbitrary or otherwise unreasonable.... Finally, it is also important to note that a procuring agency's technical conclusions concerning its actual needs are entitled to great weight and will be accepted unless there is a clear showing that the conclusions are arbitrary. [Citations omitted.][28]

Nor does the GSBCA extend a *de novo* review to protests involving specifications. The GSBCA has recognized that the Brooks Act cannot be construed so "as to impair or interfere with the determination by agencies of their individual automatic data processing equipment requirements, including the development of specifications for and the selection of the types and configurations of equipment needed."[29] Consequently, the GSBCA will not substitute its judgment for that of the contracting agency.[30] Instead, "We will accord deference to the agency's technical judgment, but will not slavishly follow it where the result is lacking in justification."[31]

> Surely, competition advocates meet the prerequisite of having good judgment. Additionally, they often have technical backgrounds.

Lawyers who frequently represent protesters may be skeptical about being denied access to the GAO or GSBCA. Their concerns might topically include discovery, stays, proposal preparation expenses and attorney fees. Each topic deserves a comment. Discovery generally is not consequential to protests that challenge specifications. Nevertheless, the protester can obtain relevant documents under the Freedom of Information Act.[32] Stays generally are not applicable to protests on specifications because a protest is untimely unless filed before the closing date for receipt of proposals.[33] Concerning proposal preparation expenses, if the protester prevails, he has acheived the opportunity to compete. His proposal preparation costs are routine business expenses which every offeror incurs to compete. There is no reason why the protester should receive a windfall when he has not been deprived of an opportunity to compete.[34] Finally, since the proposed change to protests on specifications is intended to make the process "lawyer-free," it would be counterproductive to compensate a protester for attorney fees.

Previously, a caveat was made as to whether protesters would be disadvantaged by not having access to the GAO and GSBCA. This caveat is that the Competition Advocates must have the fortitude and autonomy to render decisions adverse to their agencies when appropriate. However, it is reassuring to observe that Inspector Generals and Boards of Contract Appeals have been commendably successful despite being located with their agencies. Therefore, it is reasonable to expect that Competition Advocates can remain impartial while resolving protests.[35]

Conclusion

The legal profession has failed to provide any meaningful and enduring guidance on how protests to specifications should be resolved. Instead, each protest represents a unique "alligator" that must be wrestled with. Unfortunately, procurement lawyers have become so preoccupied with wrestling with alligators that they have failed to discern that the original goal was to drain the "swamp." It is time to recognize this failure; concede that Competition Advocates are better prepared to wrestle the alligators; and abandon the swamp.

This presentation was prepared for the American Bar Association by Major Gabig, Chairman of the Information Systems Committee ABA Public Contract Law Section. The author is Chief of Contract Law, Office of the Staff Judge Advocate, Headquarters Armament Division, Eglin Air Force Base, Fla. The views expressed in this paper are those of the author and do not reflect the official policy or position of the Department of Defense or the United States Government.

Endnotes

1. See Comp. Gen. 60 (1930) where the GAO General Counsel began using the test of whether a specification is "unduly restrictive."

2. 10 U.S.C. 2305(a)(1)(C) and 41 U.S.C. 253(a) (Supp. III 1985).

3. FAR 10.002(a)(4). The regulation makes no attempt to define functional, performance or design specifications.

4. FIRMR 201-30.013. The FIRMR fails to recognize design specifications.

5. FIRMR 201-30.013. The specific make and model specifications also has a statutory basis which causes the acquisition to be non-competitive. See 40 U.S.C. 759(i) (Supp. III 1985).

6. FAR 10.004(b)(3).

7. RMTC Systems, GSBCA No. 8756-P, Dec. 18, 1986 (WESTLAW, FGC-BCA data base); Radio Shack, GSBCA No. 7949-P, June 1, 1985 (WESTLAW, FGC-BCA data base); Lista International Corp., 63 Comp. Gen. 247, 84-1 CPD 665 (1984).

8. Analytics Communications Systems, Inc., B-220615.3, April 7, 1986, 86-1 CPD 335; Cerberonics Inc., B-220910, March 5, 1986, 86-1 CPD 221; Terex Corp., B-219243, Oct. 22, 1985, 85-2 CPD 436.

9. DFARS 70.200.

10. North American Automated Systems Co., GSBCA No. 9098-P, 87-3 BCA 20,203; North American Automated Systems Co., GSBCA No. 8638-P, 87-1 BCA 19,402; International Systems Marketing Inc., GSBCA No. 7948-P, 85-3 BCA 18,196; Wang Laboratories Inc., B-215589.2, Dec. 10, 1984, 84-2 CPD 642.

11. Digital Equipment Corp.; Wang Laboratories, Inc., GSBCA No. 9131-P, Oct. 20, 1987, 88-1 BCA 20,254.

12. FIRMR 201-30.013.

13. Amdahl Corp., GSBCA No. 8823-P, 87-2 BCA 19,700 (failure to use a functional specification was "reasonable and legitimate."); Eaton-Kenway, B-211724, Jan. 14, 1985, 85-1 CPD 35 (protest sustained because agency should have used a design specification). Viererk Company, B-209215, March 22, 1983, 83-1 CPD 87 (agency improperly used a design rather than a performance specification). Bowne Time Sharing Inc., B-190038, May 9, 1978, 78-1 CPD 347 (agency could require an on-site minicomputer rather than use a functional specification that would allow time sharing.)

14. According to the GAO, the percentage of defective specifications cases rose from 17.7 percent in FY 1986 to 24 percent in FY 1987. 49 Federal Contracts Report at p. 300.

15. TETRA Industries, Inc., GSBCA No. 8710-P, 87-1 BCA 19,558.

16. Memorex Corporation, GSBCA No. 7927-P, July 9, 1985, 85-3 BCA 18,289 at 91,779.

17. Gerber Scientific Instrument Co., B-197265, April 8, 1980, 80-1 CPD 263 where an existing magnetic tape library would have been unusable if a 96 aperture system was not acquired.

18. B&B Boat Building, Inc., B-220852, Oct. 28, 1985, 85-2 CPD 478.

19. No. See Management Systems Designers, Inc., B-219601, Nov. 13, 1985, 85-2 CPD 546.

20. No. See Rocky Mountain Trading Company, B-220925, March 3, 1986, 86-1 CPD 214.

21. This caused Justice Stewart to comment, "I know it when I see it." [Jacobellis v. Ohio, 378 U.S. 184 (1964)]. Obscenity proved to be a "swamp" that could not be drained. Ultimately, the Supreme Court exculpated itself from the problem by permitting "contemporary community standards." [Miller v. California, 413 U.S. 15 (1973)].

22. Digital Equipment Corp.; Wang Laboratories, Inc., GSBCA No. 9131-P, 88-1 BCA 20,254 at p. 102,506.

23. Sweatt v. Painter, 339 U.S. 629 (1950).

24. One may assume Competition Advocates enjoy the confidence of the Congress since they are required by statute. 10 U.S.C. 2304 and 41 U.S.C. 253.

25. FAR 6.501(c).

26. 40 U.S.C. 759(h)(5)(A).

27. In Re Smith & Wesson, 757 F.2d 431 (lst Cir. 1985).

28. Duroyd Manufacturing Company, B-213046, Dec. 27, 1983, 84-1 CPD 28. See also, Contel Information Systems, Inc., B-220215, Jan. 15, 1986, 86-1 CPD 44 and Four-Phase Systems, Inc., B-201642, July 22, 1981, 81-2 CPD 56.

29. Sperry Corporation, GSBCA No. 8208-P, 86-2 BCA 18,821 at p. 94,843 citing 40 U.S.C. 759(g) (1982).

30. Sperry Corporation, supra.

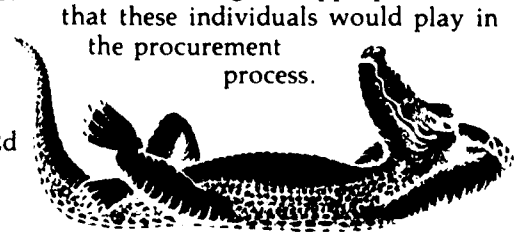
31. Memorex Corp., GSBCA No. 7929-P, 85-3 BCA 18,289 at p. 91,788.

32. More importantly, to assure objectivity and expedite the protest, the Competition Advocate should take the initiative to assure relevant documents are provided to the protester.

33. Digital Equipment Corp., B-219435, Oct. 24, 1985, 85-2 CPD 456; TETRA Industries, Inc., GSBCA No. 8710-P, 87-1 BCA 19,558.

34. This rule of reason was followed by the GAO for several years. See, Federal Properties of R.I., Inc., B-218192.2, May 7, 1985, 85-1 CPD 508.

35. A shortcoming of Competition Advocates might be that they perceive their duties have been properly performed when competition exists. Hence, a "goldplated" specification is apt to withstand a Competition Advocate's scrutiny provided ample competition exists. Unfortunately, duties and responsibilities of a Competition Advocate listed in FAR 6.502 fail to emphasize that he should be mindful of the minimum needs of the agency to prevent "goldplating." If, perchance, the Congress modifies the present system to allow Competition Advocates to decide protests on specifications, the legislation should emphasize that the duties include reviewing specifications to assure they do not exceed the minimum needs of the agency. A change of names from "Competition Advocates" to "Taxpayers' Advocates" might be one way of accentuating the appropriate role that these individuals would play in the procurement process.



DSMC IS HOST TO ARMY ACQUISITION CONFERENCE

Paul J. McIlvaine, Associate Dean
Joann H. Langston, Army Chair

Defense Systems Management College

The Defense Systems Management College was host to 36 senior-level Army people at an Executive Workshop in Acquisition Management (AAC II) from November 28 to December 2, 1988. General Louis Wagner, U.S. Army Materiel Command (AMC), and General Maxwell Thurman, Commanding General, U.S. Army Training and Doctrine Command, were the sponsors. Topics of interest were addressed by 85 guest speakers.

Purpose of the conference was to gain a better understanding of the ever-changing defense acquisition process, and to exchange ideas on how to improve execution of the defense acquisition business in today's environment. Specific objectives were to gain insight into workings of the Army acquisition process from cradle-to-grave, and to gain a better understanding of the government-industry relationship. A summary of key discussion items follows.

Acquisition Reform

This session opened with a spirited discussion about the tremendous pressure to change or "reform" virtually everything in the acquisition business. Many "reform" attempts favor more centralized control and operations at the Department of Defense (DOD) corporate level, as opposed to decentralized operations. One of the most notable examples is pressure for a centralized civilian acquisition agency. Other examples include a draft regulation for all technology base efforts to go through the DOD corporate level vice the Services. The ADA programming language is another example of a technical effort being managed at the Office of the Secretary of Defense (OSD) level. On the other hand, it was observed that if the purpose of the acquisition system is to provide the soldier what is needed to fight on the battlefield, then increased centralization, especially in a civilian acquisition agency, may be self-defeating. Conclusions generally were that today is not a time for complacency in the acquistion business, especially when we can expect a flat budget in the near-term. It is imperative to use our best "brains" and to achieve innovation in how to develop and field a system and to operate and to support it on the battlefield in more economical and effective manners. To do this, we need thinkers fully understanding the acquisition business and the operational environment—not automations.

Acquisition Career Field

Another major discussion centered on staffing needs of the Program Executive Officers (PEOs) and program managers. With a grand total cap of military officers in these specialities, it appears military officers in the acquisition business will not increase in the near-term. This presents an obvious problem with the pressures for a centralized civilian procurement agency. Suggestions to improve this situation included (1) making the acquisition business a more attractive career field for military officers; (2) providing a Program Management Transition Plan at Milestone III for transitioning a program manager from the PEO structure to the sustainment structure within AMC; (3) conducting post-fielding reviews involving the "write off" of any unsatisfied "requirements," waivers, and unconditional releases; (4) more appropriate methods to deal with the natural tendency of the financial community to take away dollars (and push a program into even more trouble) at the first sign of a problem in the program; and (5) ensuring that experienced people are in place within a Program Management Office structure at the Milestone 0 approval.

Software Management

A major problem area quickly becoming evident was software management. Software is the least understood and highest risk of a typical program. Virtually every modern system can expect to have a computer or processor in it which requires software. For example, in fiscal 85 a total of $11.4 billion was spent on software development, operation, and maintenance; in fiscal 95, it is projected that $34 billion will be spent. A software task force has been established by Lieutenant General Jerry Max Bunyard, USA, at Ft. Belvoir, Va., with 186 identified issues and 23 identified effects. The consensus was that software requires increased management, and we must improve our understanding of software to improve it.

Contractor Past Performance

Another discussion was the January 1988 establishment of an AMC past performance review team, addressing a consolidated rating system for past performance of defense contractors. Discussion centered around standardization of consolidated rating systems among all Services. Consensus was that more attention needs to be given to factoring past performance into current source selections.

Total Quality Management

Total Quality Management (TQM) was discussed as an area that can lead to constant improvements in government and defense industry operations. The TQM process has been in use in Japan for decades and is being selectively applied in the United States with considerable success. The consensus was that TQM must be applied to internal governmental operations and external DOD contractor operations to be fully successful. Any successful TQM program will take decades.

Prioritization of Army Needs

It was clear there is not, *or will not* be, adequate funds for everything the Army desires. Therefore, establishing clear priorities for Army programs is imperative. Slow modernization may have to be accepted as the natural consequence of this situation. Low-priority programs may have to suffer to pay for higher-priority programs; however, the goal of a trained and ready Army today and tomorrow must *never* be forgotten. Therefore, six major priorities were said to exist for the U.S. Army. Priority number one is to attract and retain quality soldiers. Priority number two is attention to Army doctrine which must be right, refined, and adjusted to meet the future. Priority number three is to ensure that the force structure is right, and that the correct mix of active and reserve components are available and able to do the potential job. This involves the right mix of heavy, light, and special forces, and the right mix of forces stationed in the Continental United States and overseas. Priority number four is training, the cornerstone of readiness. Priority number five is developing leaders, at *all* levels and in *all* Army organizations. This is acccomplished through institutional training, operational assignments, self development, and self-discipline activities. Priority number six is modernizing the Army force to improve combat capability. Improving combat capability, the sole reason to modernize, is the *primary* purpose of the acquisition process. This requires a clear modernization strategy starting with the Army long-range planning system.

Acquisition Challenges

Long-range planning must result in clearly stated priorities for fielding and equipping our armed forces. The acquisition process must utilize the best business practices to produce a system smartly. The three most pressing acquisition challenges are (1) the integration of requirements both within and external to the Army, (2) managing our programs right the first time and (3) ensuring affordability by clearly stating what we want and what we are willing to pay, and making sure these are compatible.

Test and Evaluation

The testing aspect of the acquisition business is of extreme importance. Our equipment must work in the hands of the user and in the intended operational environment. The four major test and evaluation (T&E) challenges are (1) gaining agreement on the purpose and focus of a test, (2) minimizing the time it takes to test, (3) minimizing the cost to test and (4) most important, accommodating realism in these tests. Consensus was that successful testing yeilds soldier confidence in the equipment.

Source Selection

The source-selection process was discussed in detail. While cost is a factor in the source-selection process, it frequently is not numerically weighted. Cost effectiveness, the bottom line in any selection, must be recognized as a judgment—just like the best value is a judgment made in the consumer sector of our economy. However, it is essential that all programs have a rational basis for selecting one concept rather than the other, strictly adhering to stated evaluation factors for contract award and following the source-selection plan from statutory and regulatory points of view. Two major goals in the source-selection process are (1) buy item in accordance with conditions previously set out and (2) maintain integrity and fairness of the process.

Product Improvement Programs

One Army major problem today is that 2-3 different configurations of equipment to operate and support results from Army modernization that is incomplete to date. This will not go away and must be dealt with head-on. Staged fieldings, locating the same configuration in a specific geographical area, and other methods must be pursued. Priorities for product improvement and modernization programs must include reducing operating and support costs. User requirements must be prioritized along three lines: what the system *must* do (absolutely essential for the current battle force to win); what the system *ought* to do (to cope better with an evolving threat or protect a precious investment); what the system *should* do (what is smart to do, what will result in savings, what is more efficient, and what will enable us to cope better with the future). We heard that priority of "nice-to-have" items ceased long ago.

Non-developmental Item Acquisition

Utilization of non-developmental items in the acquisition process involved a case study of the Army Mobile Subscriber Equipment (MSE) program. It was obvious that acquisition of non-developmental items requires a cultural change to be successful, since an extremely careful distincition must be made between the "must haves" and the "nice-to-haves." Without this distinction, non-developmental item acquisition will not be successful. Up-front involvement of testers, users, supporters, producers, even the General Accounting Office, is essential to preclude internal polarization in the conduct of a non-developmental item program. Everyone's concerns must be addressed up front. The mobile subscriber equipment case was dramatically illustrated by the fact that the contract for MSE

was signed December 1985, and the first systems were delivered February 1988, 26 months from contract award to the first ones rolling off the production line. Non-developmental item acquisition is a strategy that can be selectively and successfully applied to the Army but, obviously, not in all cases.

Congressional Issues

The number-one issue in the 101st Congress will unquestionably be the budget, how to reduce outlays to bring the deficit within Gramm-Rudman ceilings. To do this, the total government budget must be reduced by $35 billion; it was theorized that the DOD should expect to "eat" one-half of that amount, assuming there are no other problems. The number-two congressional defense issue centers around conventional arms control. Could the Army handle a radical alteration in force structure that would be required under a conventional arms control agreement?

Congressional Interface

One interesting topic was how the Army can best sell its case to the Congress. The four major answers surfaced were better stability within the requirements generation process (the Army aviation master plan was cited as a good example of this stability and rationality); improved execution of Army contracts and programs, such as achieving demonstrated performance from operational test before entering full-rate production; more workable and realistic acquisition strategies (It was generally agreed that the government has great difficulty in being the systems integrator, since the government often lacks the talent and quantity of people, and is unwilling, unable, or restricted from recruiting necessary people); and empathy—know the mind of the Congress before setting foot on Capitol Hill. Virtually no Senators within the new 101st Congress were present when The North Atlantic Treaty Organization (NATO) was formed, or when we fought in Korea. Hence, there may be little understanding of *why* we need a large standing peacetime Army ready for war.

Media Relations

Media relations proved to be lively session. Why does the military get so much attention in the press? The answer: because it gets more than $200 billion a year. One primary way for the military to account to the public is through the media, whose representatives have pointed out that the Services tend to oversell their programs; any time a program falls short, the media has a newsworthy event. Good reporters are willing to talk to you and to hear your side of the story. Good reporters and good media want to be accurate. If a situation exists when the media does not have correct facts, this should be pointed out first to the reporter, second to his boss, then to the competitor if satisfaction has not been gained. Responsible reporters correct themselves. Probably the most interesting comment was that things are supposed to work, the public experts things to work, and that is why the media writes about things when they do not work.

International Armaments Cooperation

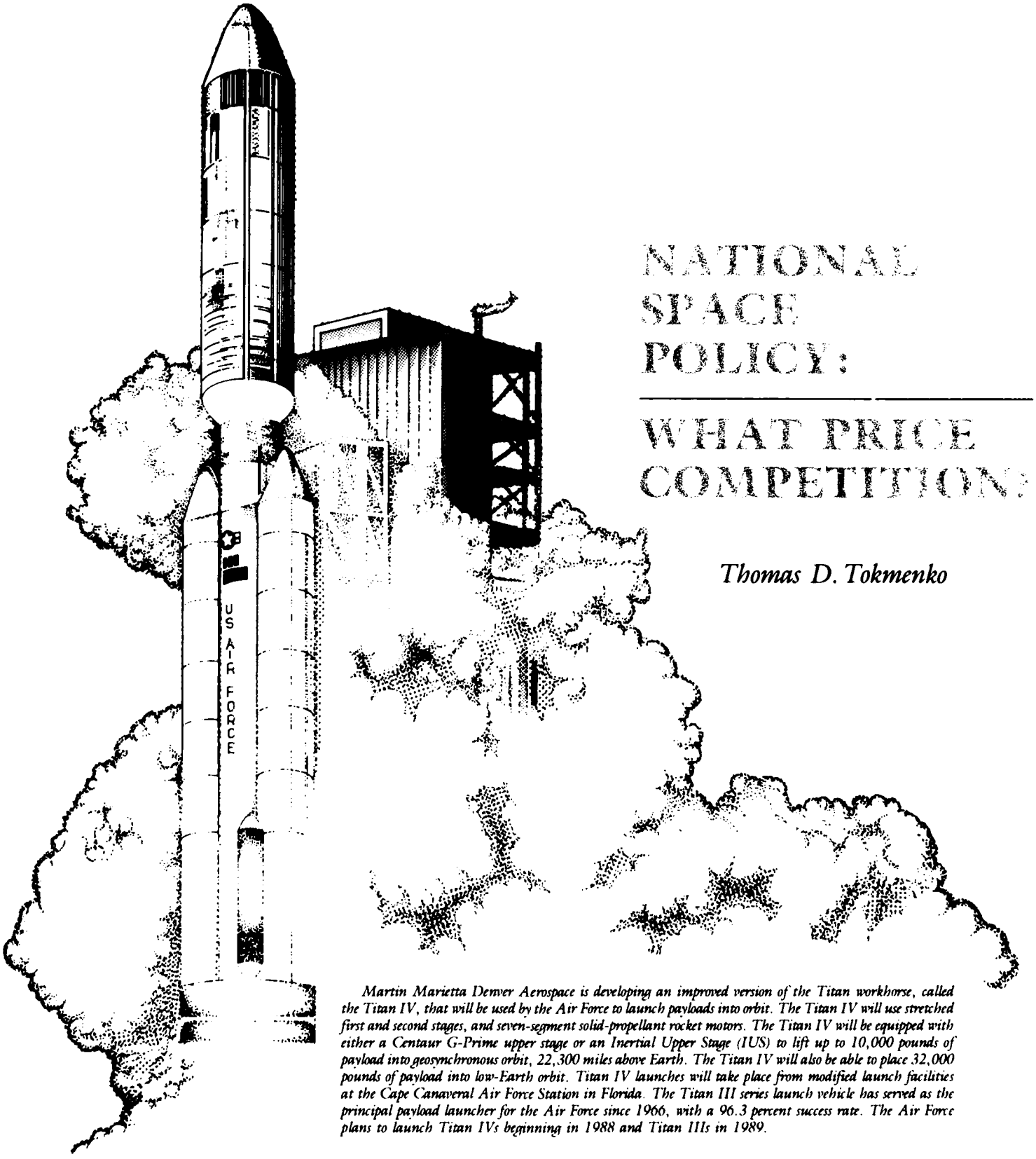
A session on international programs cited the tremendous increase in international efforts. By 1996 it is expected that 10 percent of all DOD research and development will be under international cooperative agreements. It is expected that by the year 2004, 25 percent of all DOD research and development will be international. Legislation, however, exists that states cooperative programs must not adversely impact our U.S. industrial base. Resolution of these difficult items will not be easy in the next several decades. International programs and armaments cooperation is an area where we can gain greater economy and value for our dollars during a time of a "flat" DOD budget.

Defense Industry Interface

Significant time was devoted to discussions with industry on ways to improve the governmental/defense industry relationship. Dual sourcing was described as a successful manner to improve quality and cut costs, but depends totally on the assurance of adequate quantity and adequate program duration. In most cases studied, improved quality has reduced costs and improved schedule performance. Dual sourcing increases costs because prime contractors are willing to invest in productivity improvements. Prime contractors dual-source all of their suppliers who, in turn, invest in productivity improvements. Industry does, however, ask for a degree of indemnification against an arbitrary program cancellation (through no fault of the contractor) to offset the risk of investing in productivity improvements. Sole-source contracts with considerable instability and a perceived lack of Army, DOD and congressional support that are offered on a 1-year basis, clearly and unequivocally do not encourage defense industry productivity investment. The secret is to go after the cost of programs and not center on contractor profit, which is a minor amount of the total budgetary picture. The SINCGARS program was cited as an example of intelligent second-sourcing. The Army second-sourced this program not on a build to print basis but, rather, on performance, in which the contractor was permitted to make design changes to reduce costs and improve producibility.

Summary

The AAC II Conference provided an excellent exchange of ideas, and pointed out clear and unequivocal challenges to be faced by the Army and DOD. Change will continue during the next 4 years, and scrutiny of the acquisition process in the Congress and DOD and by the media will probably increase. The job will be tougher and resources to do that job in terms of money and people, will not increase.



NATIONAL SPACE POLICY:

WHAT PRICE COMPETITION?

Thomas D. Tokmenko

Martin Marietta Denver Aerospace is developing an improved version of the Titan workhorse, called the Titan IV, that will be used by the Air Force to launch payloads into orbit. The Titan IV will use stretched first and second stages, and seven-segment solid-propellant rocket motors. The Titan IV will be equipped with either a Centaur G-Prime upper stage or an Inertial Upper Stage (IUS) to lift up to 10,000 pounds of payload into geosynchronous orbit, 22,300 miles above Earth. The Titan IV will also be able to place 32,000 pounds of payload into low-Earth orbit. Titan IV launches will take place from modified launch facilities at the Cape Canaveral Air Force Station in Florida. The Titan III series launch vehicle has served as the principal payload launcher for the Air Force since 1966, with a 96.3 percent success rate. The Air Force plans to launch Titan IVs beginning in 1988 and Titan IIIs in 1989.

Since the space shuttle Challenger accident and subsequent failures of Titan, Delta and Atlas expendable launch vehicles, the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD) have developed a launch vehicle policy based on the concept of a "mixed fleet" strategy for procuring launch services from four classes of domestic expendable launch vehicles (ELVs), to augment the limited shuttle payload and launch manifest capability.

Manufacturers of the small Scout, medium-size Delta, intermediate-class Atlas, and large Titan (LTV, McDonnell Douglas, General Dynamics and Martin Marietta, respectively), market their commercial launch services to satellite customers in the government and in the private sector. McDonnell Douglas has six contracts to furnish launch services; General Dynamics has three contracts to provide launch services (one with NASA, one with USAF, and the other with Eutelsat); Martin Marietta has four contracts for the Titan III, the commercial line of its Titan ELVs. In addition to burgeoning commercial launch services business, all three ELV producers have government contracts with the Air Force for launch vehicles to support military applications and national security payloads. In place are agreements among major players to use government production tooling and launch facilities for commercial operations on a maintenance and direct cost basis.

Against this backdrop, administration space policy, and congressional legislation, this article examines public-policy issues that are emerging. Adequacy of competition, extent of government insight, and applicability of government regulations will be addressed and practical solutions will be presented.

At issue is whether National Space Policy and law can further commercialization and privatization in space activities or whether recent government initiatives subsidize three major sole-source suppliers of classes of launch vehicles. Can a fledgling commercial expendable launch vehicle industry evolve within a truly competitive arena when the federal government is still the primary customer and user of launch services? Established companies with a guaranteed market have a competitive advantage because making additional launch services available to potential commercial satellite customers is financially less risky than maintaining a production base for only prospective commercial users. The non-recurring development and start-up costs of opening up a production line can be shared with current ongoing government programs. Newer entrants into commercial launch service also must compete with flight-proven track records of success and reliability obtained by the larger companies working with NASA and Air Force space programs and missions during many years. Late arrivals will face more stringent requirements and skepticism before gaining permission to use government range facilities and access to launch pads. Double standards may be applied by the insurance industry via prohibitive premiums for property and third-party liability insurance to inexperienced operators of launch vehicles.

Another public policy issue generating debate centers on government roles and responsibilities as a user of commercial launch services where the cost to taxpayers is billions of dollars annually. Where is the line drawn between responsible government insight and involvement for the public good (e.g., management, decision-making, and participation in launch services for weather satellites, national security, and science); and, government intrusion and intervention in the proprietary information, management practices, and trade secrets of a private corporation? Should the government expect to be denied its right to protect the public interest where the success of the launch of a government payload represents an investment of hundreds of millions of dollars and, more importantly, the mission of the payload is for the national welfare? How can we justify, on one hand, denying government access to contractor-sensitive technical or cost records in the name of "hands-off" commercial space policy and, on the other hand, entrusting sole responsibility to the launch service provider for mission success and wise management of public funds and resources? Should the government be expected to make personnel, tooling and facilities available? Should it indemnify or cap the liability of private expendable launch vehicle operators against potential claims arising from catastrophic accidents involving commercial launch operations, without a voice in how those operations are planned and managed?

A final issue deals with how the government conducts procurements and contracts for commercial launch services. Federal government contracting is carefully guarded and closely governed by Federal Acquisition Regulations (FAR) and statutory requirements which differ radically from standard commercial contracting practices. Federal procurement practices must comply *strictly* with myriad regulatory and statutory principles, policies and procedures. They must *conform* to departmental and agency guidelines. Conversely, commercial contracts are simple and free of red tape. Is it practical, feasible or necessary to apply principles of government contracting to the private expendable launch vehicle industry and impose burdensome and costly requirements on contractors, thereby restricting competition?

The opinions and ideas expressed in this article are solely those of the author and do not represent the official policy of the National Aeronautics and Space Administration, the Defense Systems Management College or the Department of Defense.

Background

Since the beginning of this decade, the formation of National Space Policy has been shaped by the principles of commercialization.

In August 1981, President Reagan directed the National Security Council (NSC) to initiate a review of national space policy, led by the Office of Science and Technology Policy.[1] In July 1982, based on a 10-month interagency review, the President issued a National Security Decision Directive citing the expansion of U.S. private sector investment and involvement in civil space and space-related activities as a national goal.[2] The National Space Policy, promulgated by NSC-42-1982, identified the Space Transportation System (STS) as the primary launch system for the United States. As Space Transportation System capabilities become sufficient to meet its needs and obligations, the President's space policy initiated phasing out current expendable launch vehicle operations; i.e., Delta, Titan, and Atlas launch systems.[3] The directive established a Senior Interagency Group (SIG) on space, which was asked to make recommendations to the President on U.S. commercial expendable launch vehicle capability. After a 4-month interagency study, SIG Space concluded that U.S. commercial expendable launch vehicle capability would offer substantial benefits to the nation and be consistent with goals and objectives stated in the National Space Policy.[4] The SIG Space study found that a viable commercial expendable launch vehicle industry would:

—Add to the general economic vitality of the United States
—Provide the United States with a more robust space launch capability
—Maintain a high-technology industrial base
—Provide jobs for thousands of workers
—Add to the tax base of the United States and a number of states
—Improve our international balance of payments
—Spawn numerous spinoffs and supporting activities
—Strengthen the United States position in a growing commercial market, providing long-term economic benefits
—Benefit NASA and the Department of Defense through continuing commercial expendable launch vehicle production and launch
—Offer a domestic backup for the shuttle at essentially no cost to the U. S. government
—Provide a market for unutilized or underutilized U. S. Government facilities, equipment, hardware and propellants, thereby reducing close-out costs for discontinuing U. S. Government expendable launch vehicle operations.[5]

On May 16, 1983, the President announced a National Security Decision Directive stating that the U. S. Government fully endorsed and would facilitate the commercial operations of expendable launch vehicles by the U.S. private sector.[6] This policy was to apply to expendable launch vehicles previously developed for U.S. Government use and new space launch systems developed specifically for commercial applications.

On February 24, 1984, the President signed Executive Order 12465, "Commercial Expendable Launch Vehicle Activities," instructing the Department of Transportation (DOT) as lead federal agency to encourage and facilitate commercial expendable launch vehicle activities and coordinate their development by private U.S. enterprises.[7]

The Secretary of Transportation, Elizabeth Dole, established the Office of Commercial Space Transportation as focal point for assuring private industry would have access to space. Primarily, this office would endeavor to remove regulatory barriers and provide a climate in which an expendable launch vehicle industry could grow and develop.

National Space Strategy

In August 1984, the President issued a National Security Decision Directive on National Space Strategy.[8] The section on the commercial space program stated that government policies would promote competitive opportunities for commercial expendable launch vehicle operations and minimize government regulation of these activities. During the same period, the Congress affirmed and expanded upon these actions. Hearings were held on H.R. 3942 during the spring and summer of 1984 by the House Subcommittee on Space Science and Applications and the Senate Subcommittee on Science, Technology and Space. The bill passed on October 9, 1984.[9]

On October 30, 1984, the President signed the Commercial Space Launch Act, Public Law 98-575, and designated DOT to carry out the Act and encourage, facilitate, and promote commercial space launches by the U.S. private sector.[10]

On August 15, 1986, President Reagan announced that (1) the United States, in fiscal year 1987, will start building a fourth space shuttle to take the place of Challenger which was destroyed January 28, 1986; and (2) the commercial expendable launch vehicle industry will play an increasingly important role in the American space program, and NASA will discontinue launching private satellites. This announcement was followed in December by a National Security Decision Directive.[11]

On August 18, 1986, Secretary Dole said the greatest barrier to successful commercialization of a private-sector space transportation industry was not excessive regulation, but a highly subsidized shuttle system.[12] In other words, representatives of the expendable launch vehicle industry were ready, willing, and able to enter the commercial launch market, according to DOT, if the government provided concrete assurances it would no longer compete for routine, commercial satellites.[13]

The administration's policy regarding expendable launch vehicles and commercial launch services planning is stated in National Security Decision Directive 254:

—Critical mission needs will be supported by both the shuttle and expendable launch vehicles to provide added launch assurance, where necessary
—The NASA will phase out launching commercial and foreign payloads not requiring a manned presence or shuttle-unique capabilities
—The NASA will not maintain an expendable launch vehicle adjunct to the shuttle
—The NASA is authorized to contract for necessary expendable launch vehicle launch services if any additional NASA capacity is required.[14]

Space Efforts

On January 5, 1988, the President approved a revised national space policy that will direct future U.S. efforts in space. The resulting presidential directive reaffirms the national commitment to the exploration and use of space in support of our national well-being. It acknowledges that U. S. space activities are conducted by three separate and distinct sectors: two strongly interacting governmental sectors (civil and national security) and a separate non-governmental commercial sector. The directive enumerates policy guidelines and implementing actions through which policies in the directive shall be carried out. The directive states numerous intersector guidelines including:

—The U.S. commercial launch operations are an integral element of a robust national space launch capability. The NASA will not maintain an expendable launch vehicle adjunct to the STS
—Civil government agencies will encourage, to the maximum extent feasible, a domestic commercial launch industry by contracting for necessary expendable launch vehicle launch services directly from the private sector or with DOD[15]

On February 11, 1988, President Reagan announced comprehensive "Space Policy and Commercial Space Initiatives to Begin the Next Century," which recapitulates the reliance on private launch services to fulfill the needs of federal agencies.[16]

During the last 24 months, the Department of Transportation has struggled with interim regulations governing licensing policies and procedures designed to fulfill executive and congressional mandates. It has been conducting preliminary studies to determine what third-party liability limits should be set to reflect potential losses that commercial launch policies may cause; examining environmental issues surrounding impact associated with commercial launch operations; defining terms and conditions of agreements for commercial companies use of government range facilities and services; and applauding a business-as-usual Air Force MLV I procurement as a textbook example of how commercialization can work.[17] Meanwhile, the National Aeronautics and Space Administration has taken positive steps toward supporting, fostering, and encouraging development of a commercial expendable launch vehicle industry by:

—Signing an agreement between NASA and General Dynamics Corporation for private sector operation of Atlas/Centaur expendable launch vehicles
—Preparing and developing a complete solicitation and evaluation request for proposal package and contract for the National Oceanic and Atmospheric Administration GOES I, J, and K missions for expendable launch vehicle transportation services
—Recommending a NASA mixed fleet to provide and ensure an adequate production base, an essential foundation upon which a successful commercialization space program can grow[18]
—Establishing guidelines for implementing NASA procurements for launch services on a commercial basis
—Awarding the first government contract for commercial launch services on May 20, 1988.

Procurement Philosophy

The procurement philosophy that evolved out of the NASA Lewis Research Center (LeRC) Source Evaluation Board proceedings, and activities associated with expendable launch vehicle transportation services for the National Oceanic and Atmospheric Administration GOES missions, represents a significant departure from the traditional NASA way of doing business. In the past, the acquisition process involved a sole source supplier of expendable launch vehicles for particular missions. The contracting method was based on the multicontract structure, separate but interrelated contracts with the sole source for major components of the total effort required; i.e., design and production, management and engineering, launch operations, and hardware support. Due to the different nature of the work and various levels of cost risk involved in each contract, individual contract types were selected, as appropriate, to fit the contractor effort. On the Atlas/Centaur program, a fixed-price, incentive-type contract was used for the production effort; a level-of-effort cost-plus-award-fee contract was most advantageous for the management and engineering and launch operations portion; a cost-plus-fixed-fee contract was deemed most appropriate for the hardware and spares support. In addition, an associate contractor arrangement was utilized with manufacturers of major launch vehicle system components such as engines and guidance control. In this capacity, NASA Lewis Research Center was the integrating agency and subcontract manager, responsible for overall program management and mission integration activities.

The GOES launch services procurement was conducted by the NASA Lewis Research Center under authority in the fiscal 1987 Supplemental Appro-

priations Act. The request for proposal was issued to 14 prospective offerors; representatives from five companies attended the preproposal conference; and offers were received from two firms. Competition was restricted to domestic sources based on unusual and compelling urgency, a lack of data on foreign sources, and national security considerations. The French firm, Arianespace, expressed an interest in the procurement and objected to the reasons cited for restricting competition, but admitted it couldn't satisfy the original delivery schedule requirements for the first two missions.

The GOES launch services procurement is the first bona fide government procurement of launch services in the "commercialization" era which is consistent with presidential policies regarding the commercialization of expendable launch vehicles. The GOES procurement sought launch services rather than launch vehicles; solicited proposals competitively on a firm-fixed price basis; sought a single, comprehensive contract for the total effort rather than multiple contracts; provides that the contractor, rather than the government, will have systems integration responsibility; provides for limited, rather than detailed, government oversight; provides that the contractor, rather than the government, will make arrangements for use of government (or private) facilities; and provides that acceptance will occur at proper orbit conditions rather than at the contractor's plant or launch site. The most important element separating the pseudo-commercial purchase from the truly commercial buy is the requirement, or lack thereof, to build to a government system specification. In the GOES launch services contract there is no requirement to build to a launch vehicle system specification. The Air Force is still requiring strict compliance with government specifications on all its launch vehicle programs.

The GOES launch services contract is the first government contract containing special provisions with commercial features such as reflight or refund in case of a mission failure, advance payment based on a quarterly payment schedule beginning 27 months before launch, postponement fees paid to the government for contractor delays, a 120-day call-up for accelerated delivery, a partial refund in the event of government termination, and a waiver of requirement for certification of cost or pricing data. Many provisions were only possible by obtaining authorization to deviate from the requirements of the Federal Acquisition Regulations.

Policy Issues

The major criticism voiced by industry in response to NASA's approach to commercialization was the amount of technical and cost information required by the request for proposal, and the resultant size of the proposals.

One proposal contained more than 12,000 pages of documentation while the other proposal contained more than 3,000 pages. The primary reason for the disparity between proposals can be traced to the multifaceted requirement of the request for proposal. Instructions were given to propose a standard commercial launch service baseline, but to propose delivery into geostationary transfer orbit with ascending node injection if not standard commercial practice. The request for proposal asked for delta proposals for descending node injection into GTO, perigee velocity augmentation, and low earth orbit with spinning deployment.

In the case of the smaller proposal, the standard commercial practice was what the government was looking for; the other standard commercial practice, unfortunately, was not. Interestingly, most of the proposal documentation was not originally generated in response to the GOES request for proposal requirements, but in response to an earlier Air Force procurement for medium launch vehicles. Much criticism levied at the GOES request for proposal failed to mention a substantial portion of the contractor proposal documentation required no more than massive reproduction and collation. For example, nearly 1,000 pages of the 3,000-page proposal was an unsolicited computer-generated printout of government tooling.

The other major volume driver was the statutory requirement for the submission and certification of cost or pricing data. When the GOES request for proposal was released, a determination that adequate price competition or an established market within the commercial launch vehicle industry existed would have been unwarranted and premature at best, irresponsible and in violation of federal acquisition regulations at worst. There were two viable candidates capable of meeting the requirement, and competing with vastly different launch systems. From the start, price was not considered the only or most important selection criterion. The only solution the system offered was to require cost or pricing data in sufficient detail to establish price reasonableness, on the one hand; and to waive the requirement to certify it accurate and current and complete, on the other, on the grounds that some proposed costs, inevitably, are part of a total commercial program and are not allocated or directly traceable to individual contracts. As it turned out, the award was not made to the lowest bidder nor did the government receive two offers responsive to the request for proposal expressed requirements. Adequate price competition, according to the Federal Acquisition Regulation, did not exist.

There were three fundamental reasons for the substantial volume. First, the procurement for commercial launch services was a pathfinding effort. The procurement philosophy adopted was based on belief that it was better to have too much information on which to make a decision, rather than too little. Those with proposals were asked to explain in detail how they would successfully manage a program that had been exclusive government domain for 25 years. A desire to win the award probably compelled offerors to succumb to government demands including much data.

The second factor contributing to the size of the proposals was the Federal Acquisition Regulation, which requires much paperwork for proposed contractual actions exceeding a certain dollar threshold. More important than the conservative approach of moving cautiously and the imposition of FAR requirements was the process of source evaluation and selection that created a legitimate need for useful information, as opposed to unstructured and irrelevant reproduction of data. Even 15,000 pages of proposal documentation resulted in more than 333 clarification questions during oral and written discussions and another 150 questions during fact-finding.

Credibility

The bottom line regarding the size of proposal documentation is how much information is necessary to give the government a reasonable assurance that a commercial launch service contractor can do what it promises; i.e., to establish technical and management credibility. Upon what basis is the government to select one contractor over the other for launch services? The Air Force selected General Dynamics as the winner of the MLV II competition rather than the Martin Marietta/McDonnell Douglas team, announcing that both proposals were excellent but General Dynamics met all the requirements at the cheapest price. If American Rocket Company or E Prime Aerospace had submitted the lowest bid, would they have "met all the requirements?" It would appear out of kilter for the Defense Department, that controls most of the nation's launch-related infrastructure, to run a quasi-competition only among defense contractors with parallel government expendable launch vehicle business, production lines, and government resident oversight, and declare commercialization alive and well when making awards to the lowest bidder.

Suppose you need a package shipped from Cleveland to Los Angeles and it must reach its destination undamaged in 3 days. Two reputable trucking companies exist that can meet the schedule. Company A can deliver the package for $3,000; Company B, for $2,000. Both have solid reputations for reliable, on-time service. Company A uses a fleet of small trucks; consequently, your package will be the only load carried on the truck to Los Angeles.

Company B uses a fleet of larger trucks. By using Company B, you save $1,000. Company B, to be price competitive, must place two loads on the same shipment to Los Angeles and must rely that a load from Washington D.C., to Cleveland is on time or departure from Cleveland will be delayed or cancelled. Once in Los Angeles, Company B will unload your package at a freight warehouse with the other cargo, and you must make other transportation arrangements to get your package to its final destination. Of course, Company B can deliver your single package to its final destination in Los Angeles with the larger truck, but it would cost $4,000.

It appears both companies are competing on equal footing and offer the same service. In reality, each serves a particular market segment, and is not in a position to compete with the other.

Market definition and competition are sophisiticated concepts within the realm of antitrust legislation and their treatment in this article only scratches the surface. It should be clear from the trucking analogy that two bidders do not make a competition; the other point is that there is no basis upon which to determine whether either price is fair and reasonable for a delivery service. Company A and Company B could be fleecing their markets or enjoying the healthy profits of a monopoly.

Politically motivated advocates of commercialization espouse the tremendous cost savings to be realized through commercial purchases of launch vehicles. Presumably, these savings are achieved through economies of scale, economic order quantities, and learning-curve methods. We could draw the conclusion that NASA, in spite of past triumphs, was financially naive and demonstrated poor fiscal management; that contractors had "taken advantage." Are we to believe claims that the "sticker price" of a brand new launch vehicle going out the commercial contractor's door is 25-50 percent less than a comparable government purchase? These claims are untrue. The most current analysis at NASA indicates the government is paying about the same now for a launch service as it did in the past. For years, contractor plants ran at full capacity and economies of scale that could have been achieved were passed on to the government. One of the larger commercial launch service providers promotes itself in a marketing brochure that its ELV has been launched 492 times. Future commercial expendable launch vehicle operators will be fortunate to attain the same build and launch rates that existed then. The NASA is paying around the same price for a launch vehicle under the GOES launch services contract, as recent Air Force medium launch vehicle estimates. What we are not told about is the hidden "option package" for mission peculiar, launch operations, non-recurring development costs, logistical support, and reflight protection. Commercialization is supposed to create thousands of jobs. The same is being said about the space station; the last time I checked, that was a NASA-managed program.

The basic premise of expendable launch vehicle commercialization rests on the solid ground American firms cultivated with NASA oversight. Major American expendable launch vehicle firms have more than 25 years of experience in building and launching expendable launch vehicles. The combined NASA-industry launch team has placed hundreds of satellites in orbit and has established success and reliability track records that are unsurpassed. The time has come for the commercial expendable launch vehicle industry to become independent. The underlying theme in the procurement philosophy of commercialization is that expendable launch vehicle manufacturers have developed mature expend-

able launch vehicle systems requiring little, or limited, design changes and minimal research and technical development activity. In theory, NASA can reduce its dual function of technical overseer and overall systems/mission integrator to a level commensurate with a major acquisition system that has evolved into a stable design, and where the technical risks are not excessive.

No Mass Production

An important, even critical, point for proponents of commercialization to consider is that the basic premise above may be seriously flawed. Expendable launch vehicles are not mass produced or procured in "lots," such as tanks, trucks, and helicopters are in the Department of Defense. Each expendable launch vehicle is an individual item with unique characteristics making it adaptable for a particular use and purpose. Lot buys of tanks and rifles are not individually configured for particular missions. General Issue (GI) means what it says; launch vehicles are not ready-made, off-the-shelf items. On the contrary, a factor major launch vehicle producers are experiencing is the unexpected level of design and configuration changes to their commercial fleets. Without a major government-sponsored investment in new technology and a guaranteed production base, market entry will be difficult for newcomers to achieve. More importantly, past performance records compiled by the top major expendable launch vehicle manufacturers contain an important and constant element in all the statistics cited as proof of the viability of commercialization—government technical insight and program management oversight.

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Will the insurance industry offer premiums to commercial expendable launch vehicle operators based on their records that include NASA oversight when, in fact, commercial expendable launch vehicle operators have no past success record that excludes NASA oversight?

Stability and maturity of the expendable launch vehicle systems, when coupled with flight-demonstrated reliability and past success, have led the commercial expendable launch vehicle industry to draft agreements offering launch services on a firm-fixed price basis. Commercial companies and the U. S. government would pay the same fixed price for having payloads inserted into the proper mission orbit conditions. The focus shifts from acceptance of supplies (expendable launch vehicles) via DD250 at the contractor's plant, to acceptance of on-orbit services. Therefore, a single, comprehensive contract for the total effort necessary to manufacture and deliver the expendable launch vehicle to the launch site, perform and coordinate activities necessary to assemble, test, and launch the launch vehicle and satellite, will replace the multicontract structure and associate contractor arrangement. The commercial expendable launch vehicle manufacturer, now in the role of prime contractor with management control over his subcontractors, and as overall systems integrator, assumes total systems performance responsibility for the overall mission success. (Full systems performance responsibility is defined and discussed in detail in another section of this article). Suffice it to say, for now, the expendable launch vehicle contractor will be ultimately responsible for making arrangements for using facilities and services; controlling resources; protecting data rights and proprietary information of subcontractors; ensuring necessary spacecraft interface agreements are satisfied; determining suitability for use of all property, services, materials, and facilities; ensuring they are integrated properly; acquiring satisfactory liability and insurance protection for all parties involved; and responsibility for mission success.

Roles and Responsibilities

The most significant feature of this procurement philosophy and contract structure centers on roles and responsibilities of the government as commercial customer. Technical, financial, contractual, and program management oversight is minimized while the government plays the role of spacecraft mission manager.

The GOES Statement of Work (SOW) was designed to be mission performance oriented—broad in scope and outlining major, top-level functions; e.g., design, production, program management, mission integration, launch operations. Admittedly, the GOES SOW was structured, to the maximum extent practicable, to identify important areas of emphasis for cost evaluation and selection purposes. On the other hand, a launch reservation agreement in some cases, need only contain a one-sentence SOW to provide launch services in accordance with the appropriate Interface Control Document (ICD), since commercial expendable launch vehicle contractors need not conduct competitive procurements in the same sense NASA seeks competition. For instance, NASA can select only one winner; a commercial expendable launch vehicle contractor offers its service to all customers who can afford the price. A clear, and concise Work Breakdown Structure is of great value in understanding and assessing each cost proposal, and inclusion as an RFP requirement is encouraged by government source evaluation procedures.

Assume, for sake of argument, as a minimum, a SOW was not composed of broad categories of work that scope the effort according to a work breakdown structure for purposes of proposal analysis but, rather, consisted of a one-sentence instruction to deliver the payload to a specific orbit. It could be argued that the NASA Source Evaluation Board Manual could be ignored and selected solely on bottom-line price. On the contrary, commercialization is not even close to sealed bidding. Bottom-line price may be difficult to estimate accurately when an attempt is made to factor in such things

as government-owned equipment and facilities provided on a direct-cost basis (less wear and tear damage), postponement fee schedules, profit, incentive, bonus and failure fee provisions, replacement launches, refund offers, reflight guarantees, liquidated damages, launch schedule adjustment flexibility, payment schedules versus the time value of money, insurance protection, hold harmless agreements, and indemnification. Even under a fixed-price arrangement, cost need not necessarily be considered the most important evaluation factor. However, a fixed-price arrangement is appropriate for the type of contract, and the contractor should assume maxium risk and full responsibility for all costs and resulting profit or loss. It provides maximum incentive for the contractor to control costs and perform effectively, and imposes a minimum administrative burden upon the contracting parties. However, placing cost risk upon the commercial expendable launch vehicle contractor for manufacturing inefficiencies, production overruns, or for maintaining standing armies of engineers, is one thing. The contractor should not have to assume, and may not be able to burden, financial risks involved with launch operations. It seems likely, however, that any evaluation of launch services proposals will gradually shift the focus away from technical to management issues and, ultimately, to price. Mission suitability factors will no longer concentrate heavily on technical concerns like excellence of the proposed design but, rather, consider management approaches to schedule, control and availability of resources, program management, and a balanced assignment of risk.

Proposals from newer entrants would entail a more stringent set of technical evaluation criteria than those from established manufacturers. Mission suitability factors and/or qualification criteria need to be structured to prevent a "buy-in" from commercial expendable launch vehicle enterprises just emerging on the market. Cost should never be considered the most important evaluation criteria for evaluation purposes when conducting a full and open competition for a government payload. Government contracting officers are responsible for more than taxpayer dollars. Financial loss suffered from an expendable launch vehicle failure in terms of both the spacecraft and launch vehicle may be astronomical, yet insignificant, compared to the possible compromise in national security or threat to public safety resulting from losing a key environmental or military satellite. Should there be an attempt to consider the unrealized scientific advances, medical breakthroughs, and technological benefits that might have occurred but for failed missions? Government responsibility extends beyond revenue and profit and commitment to the shareholder.

Risks

There will always be risks associated with space exploration. The nature of launch vehicle systems and launch operations render it virtually impossible to eliminate all technical risk and to guarantee success. This is the price of progress. The fact that all launch systems are not totally risk free should not put all launch vehicle manufacturers on an equal footing. The cheapest price is not the primary selection criterion. How much are we willing to pay, for the highest probability of success? The point is that, barring a rapid technological transformation of the industry, government insight is a legitimate activity when shopping for launch services, and for operations afterward.

Another issue surfacing when debating the type of contract best for a government procurement of commercial expendable launch vehicle services concerns the applicability and interpretation of government procurement regulations. What funding and payment arrangement is most appropriate? Should the contractor be paid in one lump sum only after the service has been completed; i.e., after successful delivery of the separated spacecraft to the proper mission orbit conditions? Should the contractor receive payments based on progress, or does the contractor impose a payment schedule on the customer and receive the final payment, in full, before launch? Do we pay for services rendered upon determination of mission success, or does a launch service mean we pay for a best-efforts launch upon intentional ignition? Does contractor cash-flow requirements and capital investment necessary to offer launch services commercially oblige the government to make advance, progress, or milestone payments? Government procurement regulations prescribed by FAR or law were not designed for use in launch service contracts. The FAR requires a contractor's accounting system to track costs to individual contracts, which may be impractical when the government, one of many satellite customers, is buying only its share of a total commercial program. The available FAR clauses are not appropriate for use in launch service contracts. New provisions need to be drafted in line with the commercial approach to payment.

What about Federal Acquisition Regulations governing small business plans, equal employment opportunity compliance, affirmative action, make or buy, safety and health, quality assurance, and myriad General Provisions and FAR clauses incorporated as mandatory in all government contracts? It is unreasonable to expect these requirements be applied to the contractor's total commercial program which may be in place long before a government customer places an order or enters into a contract. The contractor's good faith acceptance of these provisions in government contracts for launch services must explicitly recognize that their commercial program was underway before execution of the contract with the government. The retroactive application and enforcement of such requirements would be costly and burdensome, and should be avoided.

Right to Terminate

Other examples include the government right to terminate contracts for convenience and default. These standard arrangements can be disruptive, extremely costly, and impose an administrative burden on the government and the commercial launch service operator. Under the standard FAR Termination for Convenience of the government clause, a notice of ter-

mination requires contractor, in part, to stop work, place no further subcontracts, terminate all subcontracts, assign to the government title of work-in-process, and to store, transport and dispose of all termination inventory in accordance with cumbersome property disposition procedures. This provision is inappropriate and does not make good business sense for either party. A more practical alternative can be found in the GOES contract; i.e., the fair value of property to which the government would presumably take title under ordinary circumstances has been predetermined at the outset, and would be refunded in the event of a termination for convenience, less fair value of contractor sunk costs or non-recoverable investment. Another problem involves strict literal interpretation of the FAR Inspection Clause entitling the government to automatic reflights in the event of a launch vehicle failure, at no extra charge. Government rights and remedies under this clause and extent of contractor liability need to be examined against the backdrop of commercial launch service contracts. It is an extreme and one-sided view to demand reperformance of a launch service under pain of default for launch failures without paying for reflight insurance.

Apart from FAR requirements, there must be preparation to decide, up front, how much data and documentation are sufficient to assure interests of the government and taxpayer have been protected; also, ensuring a fair and equitable price has been paid for services having a reasonable chance of being performed correctly.

Allocation of risk is important from the perspective of procurement philosophy. Will a technical direction under a cost contract or change order under a firm-fixed-price contract subtly alter the delicate balance of the allocation of risk? Can the contractor always come back and say a launch failure was due to government meddling, tinkering, or revision? The contracts between government and commercial expendable launch vehicle contractor for launch services must be crafted carefully to accommodate changes and clearly delineate responsibilities and procedures for allocating risk.

System Performance Responsibility

As part of the GOES request for proposal, NASA asked those responsible to describe how they propose to adopt full system performance responsibility (SPR) for GOES in accordance with mission performance requirements and schedule. Recognizing the importance of mission requirements and the need for maintaining critical manufacturing, testing, qualification, checkout, and launch schedules to satisfy acceptable launch dates, SPR envisioned that the prospective contractor would be ultimately responsible for:

—Delivery of separated, undamaged spacecraft to the proper mission orbit conditions after launch within stated environmental parameters
—Management of major subcontractors and lower tier subcontractors
—Necessary spacecraft interface agreements
—System integration of all property, service(s), material and facilities obtained from the government, spacecraft manufacturer(s), and subcontractors
—Determination of suitability for use of such property
—Definition of a liability plan to cover the above relationships.

The GOES contract contains separate provisions delineating five main areas of responsibility for satellite customers seeking favorable contract terms and conditions not biased toward the launch vehicle manufacturer.[19] They are:

Schedule and Performance Liability. Requires compensation to the government and deferral of payment for contractor schedule slippage which impacts contract launch dates.

Responsibility for Total Systems Integration. The contractor's envisioned responsibilities include, but are not limited to:
—Ensuring integrated flight vehicle system, including hardware and software interfaces, has been designed, analyzed, fabricated, and tested before launch to meet program requirements.
—Determining suitability for use, integration, and operation of any government-furnished property, facilities, and services. The prospective contractor shall agree that the incorporation into the commercial expendable launch vehicle design of government-furnished property, facilities, and services would not relieve him of total system integration responsibility.
—Integrating activities of all subcontractors at the expendable launch vehicle assembly and maintenance shops and complexes at launch site.
—Responsibility for proprietary or confidential data from spacecraft manufacturer(s) and subcontractors to the extent that such data is received from the spacecraft manufacturer(s) and subcontractors for the performance of this contract.

Flexibility to Accommodate Late Spacecraft Delivery. A late payload delivery plan should identify the consideration (postponement fees) to the contractor for accommodating late delivery of government or commercial spacecraft, the latitude inherent in permitting the customer to notify the contractor of late delivery of the spacecraft, the point in time at which the contractor would expect consideration, and the consequences of one or multiple payloads being late, not ready, or qualified for launch. In the GOES contract, there is a parity between the liquidated damages paid to the government and the postponement fees paid to the contractor.

Third-Party Liability Insurance for Launch Operations. Recognizing that expendable launch vehicles are to be manufactured and launched under contract, the contractor should prepare an insurance plan covering liability to third persons (insurance or self-insurance reserves), for loss of, or damage to, property or death or bodily injury, as a result of any accident occurring throughout the performance of the contract. The government will not provide indemnification under Public Law 85-804. The Department of Transportation and the Congress are considering capping the liability at the maximum level of insurance obtainable in the market at reasonable premiums.[20]

Mission Success/Failure Plan. The failure liability plan addresses failure of the expendable launch vehicle to complete the mission to the orbital conditions prescribed in the appropriate ICD. The failure liability plan covers remedies to protect the government

interests in the event of mission failure and may include reflight guarantees, replacement launches, price reductions, or other equitable adjustments. Mission success is defined as delivery of the payload to specified orbit and separation conditions without exceeding environmental conditions specified in the appropriate ICD. The contractor is responsible for providing confirming data and the government will make the final determination of mission success.

Before delivery to and final acceptance by the government of the expendable launch vehicle transportation service, the contractor bears risk of loss for costs incurred in the performance of tasks necessary to deliver payloads to orbit conditions prescribed by the appropriate ICD.

Conclusion

For presidential directives, national space policy, and congressional legislation to work and "usher in a new era of commercialization," a greater awareness of the private launch vehicle industry and an appreciation for the technical and financial risks involved is needed; also, a more thorough understanding of federal procurement regulations, before policy can be put into practice and supported by government and business, and implemented by government agencies. Before we again place all our technological eggs in one basket, this time a commercial one, let's be sure we are aware of all consequences.

To summarize the first issue, the government has a responsibility to require as much information as it deems necessary until it is satisfied that the commercial U.S. launch service arena can generate adequate price competition. Apart from the obvious fact that each rocket is sized for a different part of the market and that the government is the primary customer of the "big three," Government contracts to smaller firms reveal the tenuous fetal relationship rather than serve as testimony to a robust commercial industry.[21]

Secondly, there is no empirical data to support the contention that commercialization will save public and private customers millions of dollars per launch. True, mass production of any commodity will generate savings to either the producer or the customer. The government will, in theory, realize savings if it continues to buy in ones and twos from launch vehicle manufacturers producing and selling on a much grander scale. It is also true that, for the most part, the government has not ordered launch vehicles in large quantities. But is commercialization the impetus for the substantial savings or the government's ambitious mixed-fleet requirements? What is revolutionary is not the principles of commercialization but the strategy of the mixed-fleet procurement. Even with large government buys, no one can take seriously the claims that launch vehicles will be cheaper in the 1990s than in the 1960s. Productivity improvement, modernization programs, and upgrades always seem to be offset by interest and inflation.

Finally, government contracting needs revamping in order to accommodate some of the sound business practices and streamlined features of commercial launch service contracts. The GOES and MLV II represent a good start, but only the beginning.

General Dynamics and NASA deserve to be commended for their courage and innovation displayed by signing the government's first commercial launch services contract. General Dynamics drifted far from their standard commercial "bluebook" contract in the GOES contract. The NASA, as well, departed far from its traditional business-as-usual launch vehicle contract. In a spirit of compromise, both General Dynamics and NASA are standing way out on separate limbs of the same tree of commercialization. Perhaps by leaning on each other, General Dynamics and NASA can maintain their balance during the strong political storm.

Endnotes

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Captain M. E. Kearney, USN

"Without effective leadership, the organization loses sight of its reason for existence. Its corporate vision is confused or non-existent. Management, no matter how competent, cannot overcome a cloudy vision.

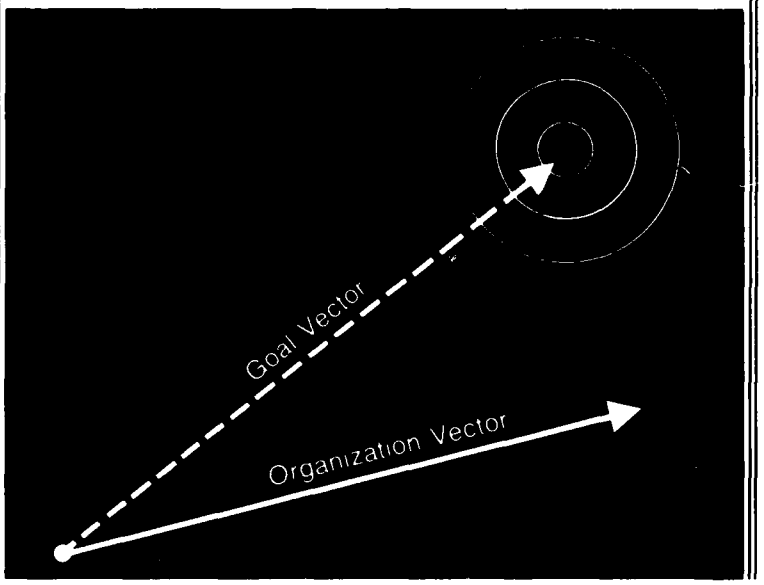
In July 1987, Captain Kearney assumed command of the A-6/EA-6 Weapon Systems Program (PMA-234), Naval Air Systems Command.

Some best-selling authors accuse us of management ills of epidemic proportions. An entire industry has sprung up to provide training that is represented as the "cure" of our problems. Possessing foresight and knowledge not available to normal managers, these experts pummel us with strident exhortations to revitalize American management. Are we truly facing a management crisis of monumental proportions, or is this just a marketing technique for their services? It is evident that some large companies share systemic problems reducing their effectiveness. Is poor management to blame for these ills? I would argue that management is not the culprit. For the most part, our problems should be attributed to a specific sub-set of management—leadership.

Examples of effective American management are common. Small companies often score major successes in our highly competitive environment. Although size seems to be a burden that most organizations don't handle well, there are a few large organizations that are touted as examples of "excellence." There are many cases where large organizations have "lost touch with their customers," "pursued nonproductive business opportunities," or "lost their competitive edge." I believe these failures reflect a loss of focus on their corporate "vision"; a failure in leadership, not in management. Without effective leadership, the organization loses sight of its reason for existence. Its corporate vision is confused or non-existent. Management, no matter how competent, cannot overcome a cloudy vision.

Yet, how could leadership be the problem? We speak of it with authority and knowledge. Every management class emphasizes that leadership is a prerequisite for personal and organizational success. It is feverently and frequently discussed and analyzed by most managers. Even the genesis of this skill is hotly debated: "Are leaders born or are they made?" Despite the emphasis, I believe the most critical facet of leadership, its relationship to team success, is often addressed obliquely at best. It is not enough to be able to describe a leader's characteristics. To perform this skill

FIGURE 1.
MAGNITUDE AND DIRECTION



well, a manager must understand the function a leader performs in an organization and must accept his responsibility to perform it.

For example, how can one professional football team, with players essentially equal to those on opposing teams, dominate the entire league and win the Super Bowl? Leadership! They have a stronger vision and a stronger personal commitment to the success of the team. Each player's role and his value to the team is clear and there is a personal bonding that supercedes racial differences, peer competition, and individual interests that would otherwise detract from team performance. While the physical difference is imperceptible, the phychological difference is almost tangible. A team with these characteristics wins. Performance is not degraded by the presence of depolarizing personal objectives. The entire team plays as one. Synergy is maximized.

Motion, created by the energy invested by members of an organization, should propel an organization toward its goal. This motion can be visualized as a vector having magnitude and direction as shown in Figure 1. The organization vector represents the forward progress of the organization. The goal vector represents the direction and distance to the organization's goal.

Clearly, the challenge of leadership is to align these two vectors. To accomplish this, the leader must synthesize a vision of the organizational goal by integrating his understanding of the mission or corporate goals with direction provided by the supervisor. To be an effective leader, the vision must be one that he can relate to and can commit to without reservation. However, it need not coincide exactly with the supervisor's vision. There are two reasons for this.

First, a vision that is accepted without internalizing is sterile. It must be personally relevant to the leader and it must be communicated with passion, zeal and sincerity. These traits are difficult to arouse by repeating someone else's vision.

Second, if an organization's goals are to stimulate commitment by its members, the goals must have grown out of a participative process that allows each individual to feel they've contributed to, and are in consonance with, the end-result. Each leader's vision must be unique, but it must be influenced by subordinates' visions and must, in turn, influence formulation of his supervisor's vision. This process sustains the vitality of the corporate vision.

This conclusion leads to an understanding of what a leader must do to create a well-led organization with the four characteristics I described. Once he synthesizes his vision, the leader must communicate it to superiors and subordinates, and must be receptive to and encourage feedback to assure two-way interactions. Most importantly, the leader must allow this feedback to evolve his vision so that it becomes "infectious"; that is, the vision is reasonably consistent with values prevalent in the organizational culture and is capable, if achieved, of producing organizational success. This outcome can be achieved only by communication that facilitates evolution of an acceptable common goal through feedback. People can relate to an objective to produce quality products. Properly led, the organization can be infected with a commitment to quality where a commitment to profits would be unlikely. Quality products stimulate sales and, therefore, profits. The organization remains healthy through profits and, yet, it's members can still feel committed and valued.

DSMC EDUCATIONAL INITIATIVES

IN INTERNATIONAL ARMAMENTS COOPERATION

Richard Kwatnoski

The Secretary of Defense issued a memorandum in June 1985 to the military departments, the Joint Chiefs of Staff, directors of defense agencies, and Under/Assistant Secretaries of Defense, placing renewed commitment and emphasis on NATO armaments cooperation.[1] The Secretary requested new steps be taken toward this end, the seventh of which bears direct relation to the mission of the Defense Systems Management College (DSMC). This step requested an education program "...to develop and maintain appreciation for the significance of, and individual role in, furthering of collective security through armaments cooperation."

What Is International Armaments Cooperation? How Does It Differ from Security Assistance?

Before elaborating on the DSMC role in supporting international armaments cooperation education, the meaning and background of "armaments cooperation" needs explanation. International defense programs fall broadly within two categories, although sometimes there exists overlap. The first is the Security Assistance Program, which is a group of programs authorized by the Foreign Assistance Act and Arms Export Control Act whereby the United States provides defense articles, military training, and other defense related services in furtherance of national policies and objectives. Furthermore, the Security Assistance Program comprises specific programs, the better known of which are the Foreign Military Sales (FMS) program, Military Assistance Program (MAP or Grant Aid Program), and International Military Education and Training (IMET) program.[2] Aspects of the Security Assistance Program are taught at the Defense Institute of Security Assistance Management (DISAM), Wright-Patterson Air Force Base, Ohio.

International Armaments Cooperation (used synonymously with International Defense Cooperation), vice Security Assistance, is emphasized at the Defense Systems Management College, Fort Belvoir, Va., which is the only institution providing extensive education on this subject. International Armaments Cooperation is not a specific program per se, but a collection of programs and cooperative concepts/approaches taking many forms (Table 1). See Reference 3 for detailed explanations of terms in Table 1.

What Is the Legislative Support?

International Armaments Cooperation, a fairly recent approach, continues to evolve. The first significant legislation to support this was the Culver-Nunn Amendment to the DOD Authorization Act for FY 1977. It provided for the waiver of the Buy American Act, and associated foreign product price differentials, for the higher goal of rationalization, standardization and interoperability (RSI).[4] After stressing RSI as the primary rationalization for international armaments cooperation for a number of years, the Congress began taking new legislature initiatives beginning with Public Law 99-145, Nov. 8, 1985, "NATO Cooperative Research and Development" (Nunn Amendment).[5] This legislation authorized funds for cooperative research and development projects and side-by-side testing of defense equipment with our NATO Allies. It established a new requirement for DOD to assess opportunities for international cooperation for major defense programs at each formal milestone. An Amendment to the FY 1987 Defense Authorization Act extended the Nunn legislation to major non-NATO Allies as determined annually by DOD.[6] The list, at this writing, includes Australia, Japan, the Republic of South Korea, Israel, and Egypt. Another significant legislative initiative occurring in 1985 was the Quayle Amendment (actually two separate pieces of legislation), which amended the Arms Export Control Act to facilitate cooperative projects, particularly at the production level.[7,8] Most importantly, the Quayle Amendment allows for waivers to U.S. contracting law to allow, after meeting certain provisions, the use of a NATO partner's contracting procedures and designation of a particular subcontractor by the Secretary of Defense in furtherance of a cooperative project. Like the Nunn Amendment, the Quayle Amendment was subsequently extended "to friendly foreign countries" beyond NATO.[9]

TABLE 1. FORMS OF INTERNATIONAL ARMAMENTS COOPERATION

1. Exchanges
   - —Scientific and Technical Information
   - —Scientist and Engineer
2. Test and Evaluation
   - —Foreign Weapons Evaluation
   - —NATO Cooperative Testing
3. Codevelopment
   - —Single Project
   - —Family of Weapons
4. Coproduction
   - —Licensed Production
   - —Production Sharing
5. Opening Defense Markets
6. Packages

What Is the DOD Support?

The DOD has been actively promoting International Armaments Cooperation. Department goals have evolved beyond simply promoting RSI through the buyer-seller relationship of FMS. In his FY 1989 Annual Report to the Congress, Defense Secretary Frank Carlucci states "International Armaments Cooperation serves an array of coalition strategy goals."[10] These goals are to:

—Reduce needless duplication of R&D

—Promote commonality and interoperability

—Improve incentives for our Allies to assist in force modernization and burdensharing

—Achieve economy of scale.

The report projects that 10 percent of the RDT&E budget will be in cooperative research and development, with 25 percent by the year 2000! Furthermore, Department of Defense Acquisition Procedures require a Cooperative Opportunities Document be prepared at each milestone decision point. This document will examine possibilities for cooperation with allied nations regarding acquisition of the defense program, and assess advantages and disadvantages of a cooperative approach.[11]

Therefore, it can be seen that, through recent Legislative and Executive Branch initiatives, international defense programs have evolved beyond simple buyer-seller relationships or giveaways in furtherance of RSI.

What Is DSMC Doing?

The Defense Systems Management College has been on the leading edge of the educational program for international armaments cooperation.

Multinational Program Management Course

The Multinational Program Management Course (MPMC) is the foundation of the DSMC international armaments cooperation educational program. Part of the DSMC Executive and International Department, the course has matured to offer distinguished lecturers from the Office of the Secretary of Defense, Service staffs, congressional staff, other related government agencies, and industry and allied representatives. The development of hard skills in defense cooperation are stressed with lectures by the DSMC faculty, extensive application exercises, and case study.

The MPMC is designed for the student to develop an understanding of the competencies one must possess to participate effectively in an international defense acquisition program. Emphasis is placed on the U.S. policy of encouraging armaments cooperation and enhancing rationalization, standardization, and interoperability with our Allies. Key national, DOD and Service policies on international codevelopment, coproduction, and logistics are explored.

Students gain a knowledge and appreciation of problems and issues associated with the following:

—Social, political and economic factors affecting an international program

—International financial, contracting and management arrangements

—Information and technology security

—The NATO and non-NATO acquisition processes and infrastructures

—Programs for foreign weapons evaluations

—Roles of defense attaches, offices of defense cooperation or equivalents

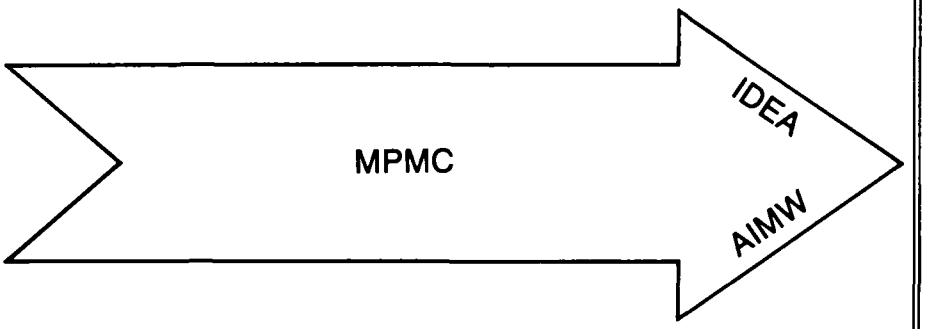
—International Memoranda of Understanding (MOUs)

—U.S. industry involvement

—Roles of other government agencies in international defense programs (State Department, Commerce Department, Treasury Department and White House).

Mr. Kwatnoski is a Professor of Engineering Management and Director of the Advanced International Management Workshop.

FIGURE 1. DSMC EDUCATION PROGRAM FOR INTERNATIONAL ARMAMENTS COOPERATION



Who May Attend?

The MPMC is open to military officers of rank 0-3 and above, and DOD civilians in grades GS-11 and above who occupy, or have been selected to occupy, the following types of positions impacting international defense acquisition programs:

—Program managers and program management staff

—Key personnel at government laboratories and centers

—Defense and Service headquarters staff personnel

—ODC personnel and attaches

—Appropriate personnel from non-defense agencies

—Equivalent positions in defense industry

—Equivalent positions from allied governments and industry.

International Defense Educational Arrangement

The International Defense Educational Arrangement (IDEA) is a grouping of national defense educational institutions with similar goals whose mission is to improve the economy, efficiency, and effectiveness of international training and education for acquisition/procurement management.

Current members are the United States (represented by DSMC), the United Kingdom (represented by the Royal Military College of Science, Shrivenham), and the Federal Republic of Germany (represented by the Federal Academy of Defense Administration and Technology, Mannheim). An IDEA principle is that all nations sharing these goals join (See Table 2).

The IDEA group has identified short-term (March 1989), medium-term (Sepember 1989), and long-term targets, or specific tasks. Meeting these targets by the next annual meeting in September 1989 will go a long way toward satisfying the goals of this unique educational agreement.

Advanced International Management Workshop

The Advanced International Management Workshop (AIMW) is a joint OSD/DSMC initiative. While the genesis for this may be said to be the previously cited Secretary of Defense Memorandum of June 6, 1985, real emphasis began during a meeting of the Defense Cooperation Working Group in August 1987. At that time, the need was identified for "formal training (provided by DSMC) on the procedures for negotiating Memoranda of Understanding."[12] About this time, the Defense Systems Management College completed an internal marketing survey of 155 past graduates of MPMC indicating a desire for more focused international short courses/seminars.[13] Subsequent classroom surveys of hundreds of MPMC students have indicated a strong desire for training in various aspects of MOUs. Further OSD impetus was added in November 1987 when the Deputy Assistant Secretary of Defense for Procurement identified the need for "practical training and hard skills for the people who must plan and manage international programs.[14] The Commandant of the Defense Systems Management College responded formally to OSD on two oc-

TABLE 2. GOALS OF IDEA

1. Improve understanding of other nations' acquisition/procurement environment, structure, and processes
2. Determine and help develop common skills
3. Conduct and encourage joint analysis and dissemination of information
4. Contribute to the harmonizing of acquisition/procurement process
5. Interchange staff and educational material to promote understanding of each others educational methods
6. Improve communication, reception and trust among members
7. Enhance openness and promote credibility of acquisition/procurement practices of members
8. Understand better the relationship among governments and industry
9. Contribute to harmonizing preparation and negotiation of MOUs
10. Improve the education system for those involved with international defense cooperation

Photo by Greg Caruth

The International Defense Educational Arrangement (IDEA) Group met at DSMC in September of 1988. They are, from the left, DSMC Professor Richard Kwatnoski and Christopher W. Nygren and DSMC Commandant Maj. Gen. Lynn H. Stevens; United Kingdom delegates, Professor R. Miller, LTC A. Mieville and Mr. F. Stott; and Federal Republic of Germany delegates, Mr. J. Hoeveler, Mr. J. Saueressig and Mr. P. Roller.

casions. In December 1987, he proposed enhancements of a general nature to international program management education.[15] In March 1988, the Commandant formally proposed the AIMW to enable participants to obtain detailed knowledge of and practical skills in:

—MOU composition and purpose

—Preparing, negotiation strategies, and staffing MOUs

—The MOU specific negotiation issues such as cost share, work share, etc.

—Factors resulting in successful international program management, like steering committee composition, requirements, harmonization, etc.

—Congressional interaction in cooperative programs, and legislation, like the Nunn and Quayle amendments, as well as protectionist legislation.[16]

Progress on developing the AIMW has continued at a rapid pace. In May 1988, Phase I funding was received from OSD (financing for approximately half the effort). In July, the Commandant of DSMC signed the AIMW Charter. In the spirit of international cooperation in defense education, the IDEA Group was briefed in September 1988 on the proposed workshop. The Request for Proposal for contractor support was published in the *Commerce Business Daily* in November 1988. A pilot offering of the workshop is planned for early in fiscal 1990, pending receipt of the full amount of Phase II funding from OSD. Currently, the workshop is targeted for an experienced audience and will have as prerequisites the MPMC and Basics of Defense Acquisition, or equivalent experience.

Where Do We Go from Here?

The Defense Systems Management College has lead the way in developing and executing the education program in armaments cooperation requested by the Secretary of Defense. Our international program management overall objective remains to reinforce and advance principles of collective defense through armaments cooperation, and to present a balanced viewpoint of attendant topics. To further these aims, future international management acquisition workshops might include the foundation of cooperation (understanding key factors for success in the identification, design, implementation, and management of a successful international program); also, role of the Congress in international program management (understanding protection versus cooperation). Perhaps DSMC could serve a greater role in supporting MOU negotiations by becoming the DOD repository of knowledge of past negotiations and maintaining a data base on current negotiations. Ultimately, an interactive computer support system might be developed to support U.S. negotiations. We welcome ideas from readers.

Currently, the workshop is targeted for an experienced audience and will have as prerequisites the MPMC and Basics of Defense Acquisition, or equivalent experience.

ENDNOTES

1. Memorandum from Secretary of Defense, Subject: Emphasis on NATO Armaments Cooperation, June 6, 1985.

2. *The Management of Security Assistance*, 8th ed., Defense Institute of Security Assistance Management, February 1988.

3. *Guide for the Management of Multinational Programs*, 2nd ed., Defense Systems Management College, Fort Belvoir, Va, 1987.

4. DOD Directive 2010.6, "Standardization and Interoperability of Weapons Systems and Equipment within the North Atlantic Treaty Organization," March 5, 1980.

5. Public Law 99-145, dated November 8, 1985, Section 1103 of the DOD Authorization Act, "Cooperative Research and Development."

6. FY 1987 Defense Authorization Act Section 1105, "Cooperative Research and Development with Major Non-NATO Allies."

7. Public Law 99-83, Section 115, Amendment to the Arms Export Control Act, "North Atlantic Treaty Organization Cooperative Projects," 1985.

8. Public Law 99-145, Section 1102, FY 1986 DOD Authorization Act, "Acquisition of Defense Equipment under North Atlantic Treaty Organization Cooperative Projects."

9. Public Law 99-661, Section 1103, FY 1987 Defense Authorization Act, "Cooperative Projects."

10. *FY 1989 Annual Report of the Secretary of Defense to the Congress*, Feb. 18, 1988.

11. Department of Defense Instruction 5000.2, "Defense Acquisition Program Procedures," September 1, 1987.

12. Memorandum from Chairman Defense Cooperation Working Group, "Meeting of the Defense Cooperation Working Group, August 13, 1987," dated August 17, 1987.

13. *Multinational Program Management Course Survey Report*, Richard Kwatnoski, DSMC internal document, August 1987.

14. Letter from Deputy Assistant Secretary of Defense for Procurement to Commandant DSMC, Nov. 6, 1987.

15. Letter from DSMC Commandant to Deputy Assistant Secretary of Defense for Procurement, Dec. 22, 1987.

16. Letter from DSMC Commandant to Deputy Under Secretary of Defense, International Programs and Technology, March 24, 1988.

Students learn program management skills at DSMC.

DSMC STUDIES PROGRAM MANAGER COMPETENCIES

Dr. Owen C. Gadeken

As part of its research mission, the Defense Systems Management College (DSMC) is undertaking a major study of the competencies (technical expertise, management and leadership skills) possessed by effective program managers in the defense acquisition process. The study is based on the premise that the best way to find out what it takes to be a good program manager is to analyze the job's outstanding performers and identify what they do that makes them so effective. The study includes in-depth interviews with more than 50 DOD program managers and a follow-on survey of more than 500 acquisition professionals. Results of the study will be used as a guide to upgrade the DSMC curriculum. This research also can be useful to acquisition organizations in their selection and career development decisions and to explain their goals for effective performance.

The Competency Approach[1]

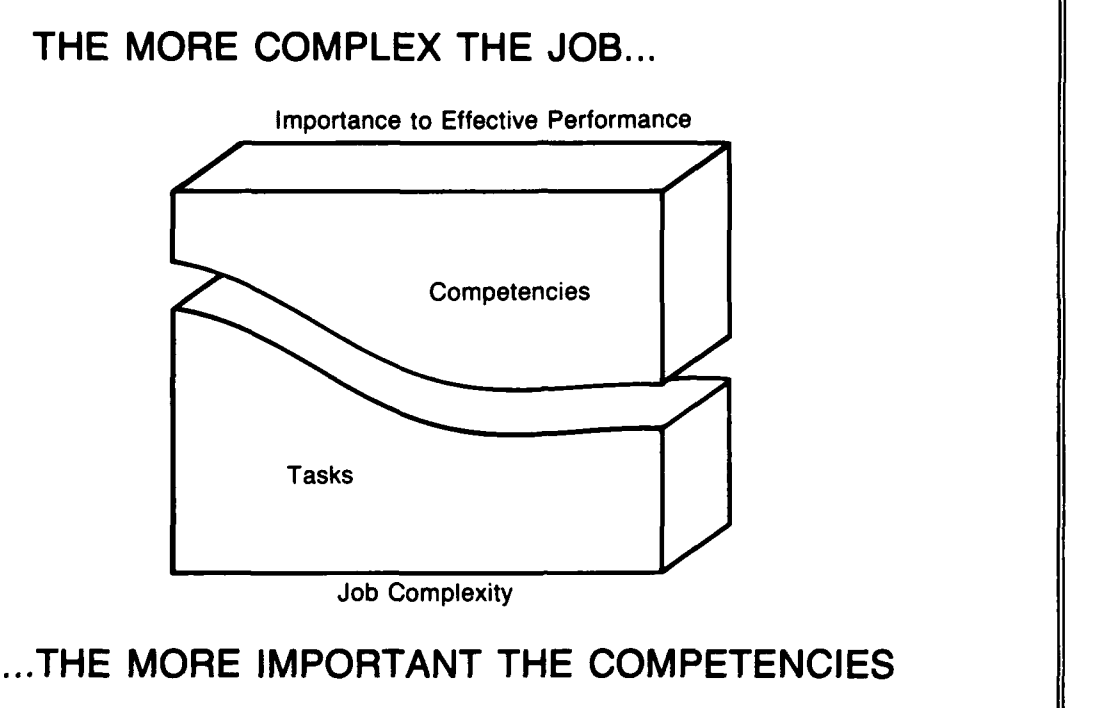
What are competencies? Any job can be considered from two perspectives: tasks and competencies. Tasks are characteristic of the job itself. Tasks usually are defined as the minimum or threshold requirements for effective performance. By contrast, competencies are characteristics of the person. They describe what the person brings to the job that allows him or her to do the job in an outstanding way. Competencies may include motives, traits, aptitudes, knowledge, or skills. For any given job, competencies are what superior performers do more often and more completely to achieve superior results. A systematic approach to job analysis should consider both tasks and competencies. The inclusion of the competency dimension pushes beyond the minimum job requirements to what makes for superior performance.

The DSMC selected the competency-based approach rather than traditional methods like task analysis and expert panels because of the complexity and variety of program manager jobs in the defense acquisition process. The more complex the job, the more important it is to study what each program manager brings to the job that results in outstanding performance. This concept is illustrated in Figure 1. As an example, consider the difference between a capable pilot and a fighter ace. The basic skills of flying could be considered of moderate complexity on the Figure 1 diagram and are probably amenable to a task-analysis approach. On the other hand, a fighter ace or "top-gun" pilot would be difficult to characterize based on tasks alone. This is especially true if you were interested in what differentiates the ace from the other capable pilots in the squadron. This is where competency analysis is of most value. Clearly, a program manager's job is on the right of the complexity scale in Figure 1[2] along with the fighter ace and, therefore, is also most appropriate for competency analysis.

Five-Step Approach

The DSMC is using the five-step approach to job competency assessment developed by McBer and Company in the early 1970s.[3] These steps are described in the following paragraphs. To assist with the research, DSMC selected Charles River Consulting of Boston, Mass., as a supporting contractor. Charles River Consulting has extensive experience with job-competency assessment, including public- and private-sector jobs.

FIGURE 1. THE COMPETENCY DIMENSION



1. Meet with a resource advisory panel. Resource panels, made up of people with program-management experience, were convened within each Service to advise the DSMC research group. During the initial meeting, panel members were asked to discuss critical program-manager tasks and knowledge areas, key performance measures, and environmental and organizational factors that contribute to, or interfere with, job performance. These panels will later be convened to review the DSMC research group's preliminary and final results.

2. Select the program managers to be interviewed. Two groups of program managers were selected for interviews: a group of outstanding (top) performers along with a contrasting group of effective or more typical performers. Nominations were received from the major acquisition commands in each Service. In addition, a competency survey was completed on each nominee by several peers and subordinates. These two groups will be used to identify the minimum competencies required of program managers (those shared by both groups) as well as those competencies that distinguish the top performers from their contemporaries. The identity of the groups is kept confidential; neither the interviewers nor interviewees are given this information.

3. Conduct in-depth interviews. As part of a three-hour interview, each program manager was asked to identify several significant past job situations and then describe these situations in detail. The logic of the interview process is that the situations described by the program managers are the most critical parts of the job. The knowledge, abilities and other qualities these individuals demonstrate in these situations are therefore the competencies required for the job. All interviews were audiotaped and later transcribed for in-depth analysis.

4. Develop the competency model. The interview transcripts and notes were combed to identify competencies relating to effective performance as program managers. The research group also identified competencies that distinguish the most effective (top) performers. The competencies along with specific examples observed or reported in the interviews were grouped into a preliminary competency model.

5. Validate the competency model. Of necessity, the interview sample is relatively small. Therefore, to validate the model for the general population of program managers and test its relevance to a broader group of acquisition professionals, a written survey was developed based on the preliminary competency model. This survey was distributed to more than 500 acquisition managers in related disciplines such as engineering, logistics, test and evaluation, contracts, and budgeting. Together, the interview and survey data allow a more powerful statistical analysis of the key features of the program manager's job. From analysis of this data base, the final program manager competency model will be developed.

Interview Sample

The interview sample is shown in Table 1. It was developed to cover a wide spectrum of programs and program manager types.

Project Schedule

Interview and survey data are still being collected from program managers and other acquisition professionals to develop and validate the

TABLE 1. INTERVIEW SAMPLE

		Army	Navy	Air Force	
Major Programs•	Military Program Managers	6	6	6	
	Civilian Deputy Program Managers	6	6	6	
Non-Major Programs	Military Program Managers	6	6	6	
	Total	18	18	18	54

•Designated by Secretary of Defense based on projected funding greater than $200 million RDT&E or $1 billion production or special interest.

model of program manager competencies. After the competency model is validated, two additional tasks will be performed. An in-depth review of the DSMC Program Management Course curriculum will be conducted for comparision with the competency model. Differences will be highlighted and recommendations made for how missing competencies can be incorporated with minimum modification into the curriculum. The second and final study task will be to develop a competency assessment instrument. This checklist can be used by both faculty and students to identify strengths and weaknesses for more tailored development both at DSMC and after students return to their jobs.

A future article is planned to discuss the competency model and other findings of the study in detail.

Summary

The job competency assessment process used in this research project will have several benefits for DSMC and the Service acquisition organizations they support.

—The research process will distinguish the competencies of outstanding program managers from their contemporaries. This will help DSMC to train potential outstanding performers rather than people who can just do the job.

—Job competency assessment gets beneath espoused theories about what it takes to do a job, to what the best performers actually do. Past studies have shown that even the best job experts are often wrong in their assumptions about what it takes to do a job well.[4]

—Job competency assessment focuses on the fewest number of competencies that make the most difference. This will help DSMC use its limited training resources most efficiently.

—Competencies are defined in terms of observable job-related behavior instead of abstract concepts.

—A program manager competency model will provide DSMC and service acquisition organizations with a valuable communication tool to explain their standards and goals for effective performance.

ENDNOTES

1. G. O. Klemp, Jr., "Assessing Training and Development Needs: A Competency-Based Approach," Briefing to the Faculty, Defense Systems Management College, Fort Belvoir, Va., January 24, 1986.

2. Ibid.

3. Ibid.

4. G. O. Klemp, Jr., "Job Competency Assessment: Defining Attributes of the Top Performer," *Pig and the Python and Other Tales*, American Society for Training and Development Research Series, No. 8, 1982.

Dr. Gadeken is Director of Educational Research at the DSMC.

PERFORMANCE MANAGEMENT CONFERENCE IN APRIL

The Performance Management Association's Fifth Annual Conference will take place April 17, 18, 19, 1989 at the Hyatt Islandia, San Diego, California.

The theme will be "Program Management—A Broad Spectrum." The four main areas of emphasis will be: scheduling, surveillance, training and subcontracting. There will be keynote presentations by senior executive managers from government and industry, panel discussions on topics of special interest, and a vendor trade show (displays and demonstrations by suppliers of performance measurement consulting services and software.) The Point of Contact: Susan Palumbo, Humphreys and Associates, (714) 837-9830.

DSMC ALUMNI

The DSMC Alumni Association's 6th annual Program Managers Symposium will be May 16-18, 1989, at Fort Belvoir, Va. The theme is "The Program Manager: Present Challenge and Future Opportunities." To receive registration information, call (301) 294-8714.

1988 PM ARTICLES

JANUARY-FEBRUARY

- **Development As a Precursor to Production**—Dr. Michael N. Beltramo, p. 2.
- **How to Achieve a Competititive Edge in Production**—Troy V. Caver, p. 10.
- **The People's Republic of China**—David D. Acker, p. 17.
- **Production Management**—Jerry Reeves and Joseph Maddock, p. 29.
- **Contractor Self Management**—PRT Report, p. 34.
- **Streamlining the Process**—Fred L. Adler, p. 38.

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- **Data Management: A Statistical Perspective**—Dr. Jack B. ReVelle and Dr. Lane B. Blank, p. 38.
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- **Dispelling Myths of Test and Evaluation**—Dr. H. Steven Kimmel, p. 8.
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- **A Capital Crisis in the Defense Industry?**—Dr. Fred Waelchli, p. 31.
- **Program Manager's Guide for Monitoring Contractor Overhead/Indirect Cost**—Ronald L. Baker, p. 37.
- **Procurement Reform Initiatives: Competition**—The Honorable Bill Nichols (D., Ala.), p. 38.
- **Use of Production Rate As Independent Variables In Cost Models**—Dr. Michael N. Beltramo, p. 40.
- **Total Quality Management: A Department of Defense Example**—Commander J.C. Boudreaux, USN, p. 42.

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- **Live Fire Testing: Planning Implications for Acquisition Process**—Colonel Larry R. Sanford, USA, p. 44.
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PROGRAM manager

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