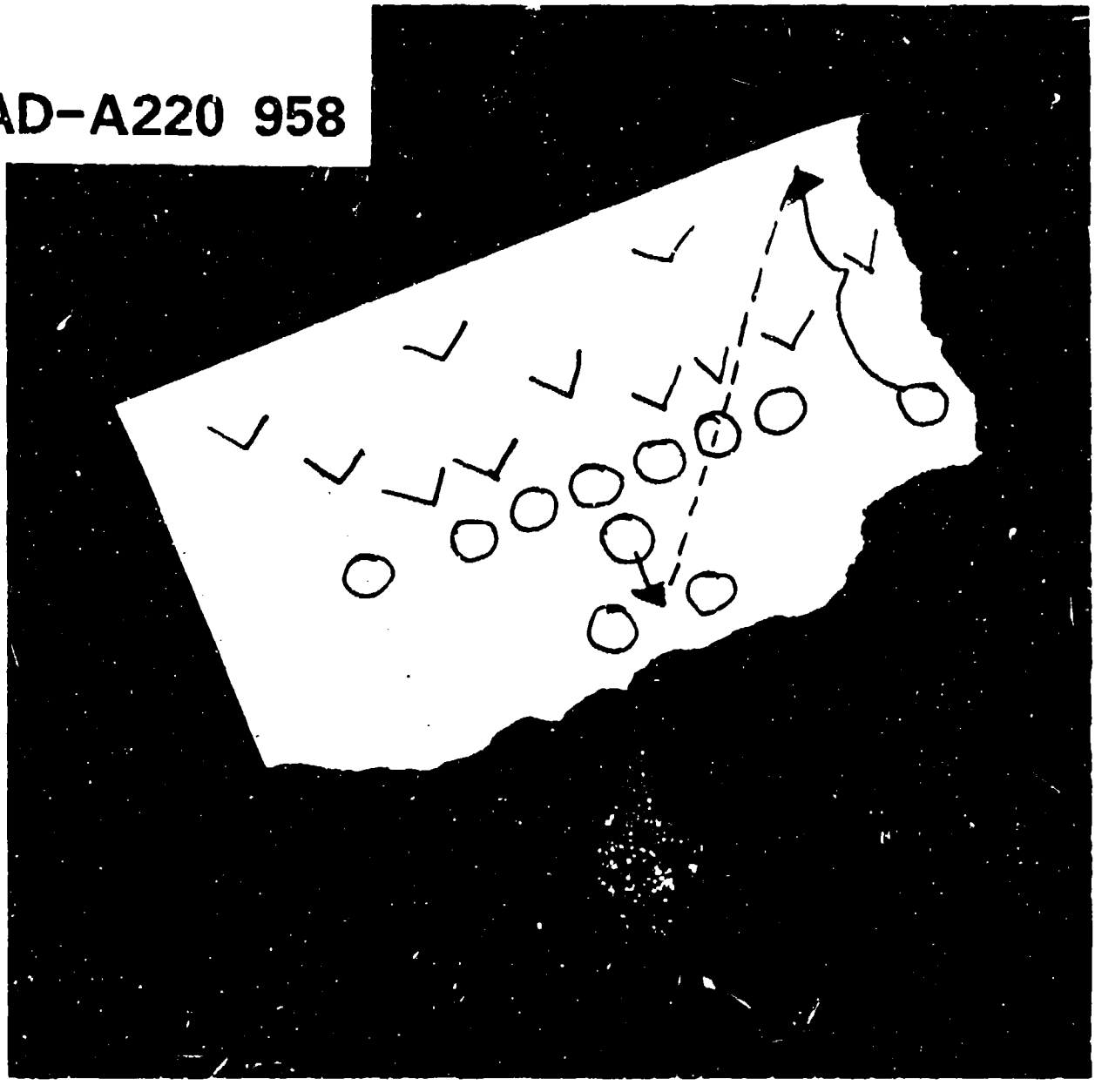
USING
COMMERCIAL PRACTICES
IN DOD ACQUISITION

A PAGE FROM INDUSTRY'S PLAYBOOK

DECEMBER 1989



REPORT OF THE DEFENSE SYSTEMS MANAGEMENT COLLEGE
1988-89 MILITARY RESEARCH FELLOWS

USING COMMERCIAL PRACTICES IN DOD ACQUISITION: A PAGE FROM INDUSTRY'S PLAYBOOK

Report of the Defense Systems Management College
1988-89 Military Research Fellows

Lieutenant Colonel Bruce D. Sweeny, USA
Commander Charles A. Perkins, USN, SC
Lieutenant Colonel Alan C. Spencer, USAF

December 1989

Views, findings and opinions in this Report are the authors and should not be construed as official Department of Defense positions, policies or decisions unless so identified.

PREFACE

"Instead of concentrating on the things that are being done wrong and trying to fix them with more laws, more regulations, more inspectors, DOD should concentrate on those things that are done right and use them as models."

(Packard Commission Report, p. 42.)

This report represents the efforts of the first group of military Research Fellows at the Defense Systems Management College. The 11-month senior Service, college-level fellowship included 3 months at Harvard Business School's Program for Management Development. Commercial practice was selected as the research topic area to capitalize on: 1) the apparent interest in having the Department of Defense (DOD) "do business like business"; 2) contacts and knowledge gained at Harvard; and 3) the strong, functionally diverse DOD acquisition backgrounds of the authors.

This volume is the full research report which includes the commercial case studies documented during industry site visits and the Mobile Subscriber Equipment (MSE) U.S. Army acquisition case study. A Summary Findings and Recommendations volume has been completed and provided to senior DOD acquisition leaders.

EXECUTIVE SUMMARY

INTRODUCTION

Using commercial business practices, or "doing business like business," is a recurring theme of the defense reform debate. The 1972 Commission on Government Procurement called for the "businesslike" operation of federal procurement. The 1984 Grace Commission sought to apply "private sector management tenets" across the entire federal government. More recently, the Packard Commission and the 1986 Defense Science Board (DSB) noted the potential advantages of adopting commercial practices in the Department of Defense and, in broad terms, identified some of those practices.

Despite the potential advantages that commercial practices offer, however, DOD has yet to implement them on a widespread basis. The exhibit below shows basic reasons for delay.

EXHIBIT 1.
INSTITUTIONAL IMPEDIMENTS TO THE GOVERNMENT USING COMMERCIAL PRACTICES

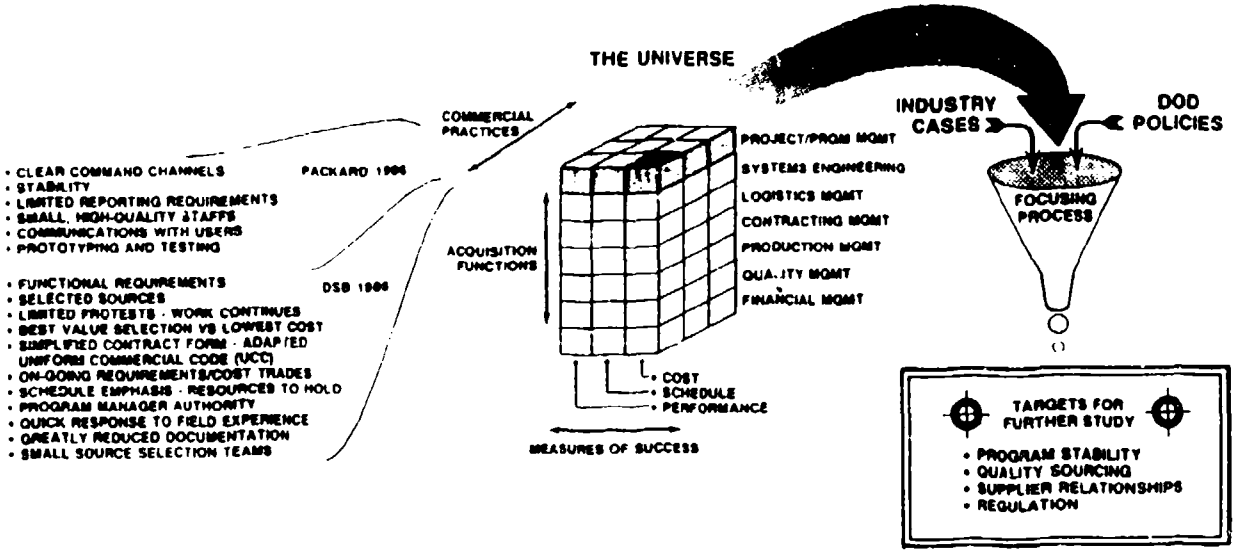
- —Confusion over specifically what they are
- —Sheer size of public sector
- —Inherent differences between the public and private sector

PRIVATE SECTOR	PUBLIC SECTOR
Single Constituency: "Shareholders"	Multiple Constituencies: "Stakeholders"
Singular Focus: "Efficiency"	Mixed Focus: "Efficiency" & "Equity"
Clear Measure of Success: "Bottom Line"	No Clear Measure of Success.

Some say these differences between the public and private sectors are so profound that government can never "do business like business." Others, notably the Packard Commission and the DSB, recognize these differences but feel DOD can still benefit from lessons of the commercial sector. Believing this, we investigated commercial practices for opportunities to improve the acquisition process in DOD.

Principal methods of investigation were literature review and personal interviews. Using facilities afforded by the Defense Systems Management College (DSMC) and Harvard University, extensive readings were conducted of topics under the general heading of good business practice. The research model we developed as the framework for our investigations is shown below.

EXHIBIT 2.
RESEARCH MODEL



Target commercial practices were investigated for clearly successful applications and techniques which can be implemented within the authority of the Secretary of Defense, and would have high payoff if established in policy, communicated, implemented, and carried into general practice by DOD and the Services. Our selected target practices are: 1) program stability (aspects other than funding which remains largely in the domain of the Congress), 2) quality sourcing, 3) supplier relationships, and 4) regulation. Our investigation drew heavily on our interviews with industry representatives of the firms identified in Figure 1.

FIGURE 1. RESEARCH CONTACTS WITH INDUSTRY

WESTINGHOUSE •	• GENERAL ELECTRIC •
• GTE •	• DOW CHEMICAL •
• TEKTRONIX •	PUBLIC SERVICE GAS •
EASTMAN KODAK •	• BECTON DICKINSON •
ROCKWELL •	• PACIFIC BELL •
VALENTEC •	BOEING •
MARTIN MARIETTA •	• UNITED TECHNOLOGIES •
DIGITAL •	GEHL •
GENERAL DYNAMICS •	AT&T •
BRITISH AIRWAYS •	• HP •

• Interviews; • Commercial Case; • DoD Case

We developed seven commercial case studies comprising twelve successful, major, new product and capital plant/equipment programs by commercial business entities; the scope of these is shown in Figure 2; the full case studies are provided in the appendices. In addition, we developed a case study to document the experience of one of the Defense Enterprise Programs, the Army's Mobile Subscriber Equipment, because it utilized substantial commercial-like acquisition practices.

Case studies were also extracted from the 1985 DSB Summer Study on *Practical Functional Performance Requirements*. These provided additional opportunities to investigate commercial programs of similar scope and are identified in Figure 3.

FIGURE 2. COMMERCIAL CASE STUDIES DEVELOPED

Scope

Case#	1	2	3	4	5	6	7
Co	UTC	HP	Dow	Tektronix	GE	PacBell	BDIS
Proj	PW4000 Engine	Several	Several	Several	Several	Adv Digtl Ntwk	FAC-Star
New	Prod.	Prod.& Plants	Plants	Plants	Plants	Prod.	Prod
Time	4.5yrs	1-4yrs	18mos	1-2yrs	3yrs	27mos	18mos
Funds (ea)	~$1B	~$500M	~$500M	~$100M	~$100M	Not Released	~$10M

FIGURE 3. 1985 DSB COMMERCIAL CASE STUDIES

Scope

Case#	A	B	C	D	E
Co.	AT&T	Boeing	SBS	IBM	MITRE
Prog.	EES-4 Switch	767 Aircraft	Comm Sat'llte	360 Computer	FAA Nat'l Airsp Sys
All cases were new product development.					
Time	8 yrs	4 yrs	34 mos	3 yrs	Unk
Funding was not identified in cases by DSB.					

In our findings, specific techniques for managing successful major commercial programs are identified and attributed to these cases. These findings and suggested improvements are related to the target practices we investigated via Figure 4.

FIGURE 4. RELATIONSHIP OF STUDY FOCUS TO FINDINGS AND RECOMMENDATIONS

STUDY FOCUS	FINDINGS	RECOMMENDATIONS
Program stability	• Top management involvement • Organization commitment • Line acquisition mgmt authority • Schedule Primacy	- Prioritize among C,S,P objs at MS II - Subordinate PPBS to baseline at MS II - Reduce # and level of decision MSs - Empower PM/PEO/SAE - Improve mgmt profs' career mgmt system - Give personnel control to PM/PEO
Quality sourcing	• Selection basis quality & price	- Provide on-line Kr performance file - Use variable specs
Supplier relationship	• Cooperation vs competition	- Stop subcontract competition advocacy
Regulation	• Uniform admin systems	- Use Kr CAS - Apply reporting rqmts to company, not to contract

FINDINGS

There are no "gee-whiz" answers!

We observed little in the commercial acquisition environment new or different from what has always been known as good management practice. Correspondingly, little has not been associated with DOD policy, identified as a problem by the Department in the past, or is not being tried someplace in DOD. Many good ideas proposed by the Packard Commission and the Defense Science Board must overcome tremendous organizational inertia. As a direct result, many good business practices, though employed somewhere in DOD, are not used widely. The Department is like a supertanker—superb at accomplishing its primary mission but sluggish in changing course.

Finding 1. Active involvement of top corporate managers is essential to program success.

Successful major systems programs in the commercial acquisition environment are the product of unequivocal top-management approval and support. In projects reflecting the strategic emphasis of the company, there is clear linkage to organization business strategy and direct involvement of the Chief Executive Officer (CEO). Involvement does not mean micromanagement, but does mean awareness of the project's current status, active questioning, and willingness to commit organization resources to resolve problems.

Top management leads (e.g., promotes within) selected programs by: 1) communicating the vision, 2) reviewing programs often, and 3) solving problems beyond the control of lower-line managers. Once a decision is made to enter engineering development, the CEO commits to seeing it through.

Finding 2. Commitment to program success crosses organization lines.

In each company visited, there was a real organization commitment to the success of major programs. The commercial marketplace severely penalizes companies which do not bring new products on line once major resources have been committed (typically, entry into full-scale or detail engineering). The functional staffs, operational and program managers, exhibited shared goals and direction. Managers of functional departments (e.g., vice presidents of marketing, engineering, manufacturing) and staff directorates were responsible for providing resources (the right people and technology) and assisting the program/project manager (PM) to solve problems; they were not involved with program oversight and direction.

Finding 3. Program managers are afforded significant authority and resource control, and are held personally accountable.

Program management authority was assigned to a clearly-visible acquisition line manager whose title may be program manager (PM), vice president (VP) or general manager (GM), but this authority was not shared with functional managers. Acquisition line managers generally are "captains of their ships," held responsible and accountable for the success of the project but given the authority to make timely decisions and control critical resources (especially participating personnel).

Successful commercial programs also depend on focused decision-making up the line; PMs of major systems have and use direct access to top management to keep the CEO, or surrogate, informed and to resolve problems beyond the capability of the PM. Senior functional officers (e.g., VPs of marketing, engineering, manufacturing, etc.) are charged with providing support to line management but not direction of lower-line program management. They provide experienced, professional personnel to give the PM every opportunity to get it done right the first time.

Finding 4. Schedule is first among cost, schedule and performance.

Without exception, we found that schedule was the driving motivation, thus, the first priority in the commercial acquisition environment, once a program is approved for development and/or implementation. This practice is primarily market driven due to implications of late entry on long-term market share and need to recover investment and overhead costs quickly.

Performance features are the next priority. Sufficient performance (mission capability, supportability, life-cycle costs and unit costs, etc.) is ensured. But, stretch goals were used, with contingency developments to facilitate trade-offs

should the schedule be jeopardized or development costs become excessive. Preplanned product improvement, or evolutionary development, was the standard approach to pick up desired technology or features not available at planned schedule cutoff points.

Funding is the business tool to achieve on-time program completion. In all cases a 10 percent buffer was provided to the PM or his first-line general manager to use to stay on schedule and solve unexpected technical problems.

Finding 5. Price is but one element in the purchase decision.

Ownership cost and dependable quality were dominant variables in commercial buying decisions. Purchase price would be traded off for desirable features, uniformity and dependability in required products. Firms tended to have a strong technical (engineering) background in the purchase department so they knew the marketplace and could understand requirements.

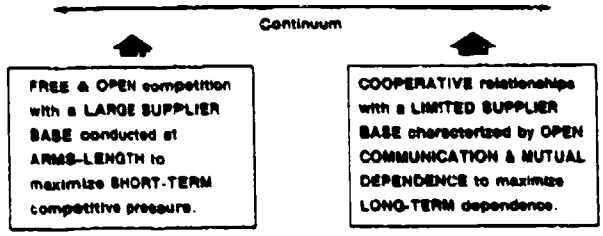
Companies prefer dealing with a few suppliers. They do not abandon competition, but recognize its limits. Practices like Just-in-Time (JIT) and Material Requirements Planning (MRP) depend on reliable deliveries of uniform quality from suppliers. Quality is becoming a total company commitment with access and input to data base information being made available to more organizations in the company. Firms are developing systems to factor past performance into their source-selection decisions and are communicating these systems to their suppliers.

Finding 6. Companies are adopting cooperative relationships with their suppliers.

There is a trend for companies to adopt cooperative relationships with suppliers, away from the traditional, competitive way of doing business. This new relationship goes by many names (partnering, strategic alliances, co-makers, value-added partnerships, etc.), but the central elements are common: long-term arrangements with a small number of high-quality suppliers; relationships characterized by mutual dependence and open communications.

Every company we visited was using partnering to some degree. Programs like Total Quality Management (TQM) and Just-in-Time (JIT) fuel

FIGURE 5.



the trend. Dr. W. Edwards Deming, of TQM fame, says that best value can be realized only through long-term, sole-source supplier relationships. Similarly, JIT often drives companies toward sole-source arrangements with suppliers.

Commercial companies do not use sole-source on a wholesale basis. Rather, they apply business judgment to each situation, forming partnerships with a few suppliers for most items, but reserving sole-source arrangements for items of particular importance. Department of Defense contractors stop short of effective partnering with suppliers, seemingly because they perceive DOD desires full and open competition in subcontracting.

Finding 7. Companies adopt uniform administrative systems.

We visited firms doing defense and commercial business. Generally, these companies segregated their business units so commercial and defense business was not colocated or comanaged. In cases where the firm was producing a defense item and a commercial item on the same floor, they adopted the defense approach to sourcing, inspection and quality control for all items on the floor. The cost of managing two systems was deemed too expensive and confusing to the work force.

We found also that relaxing a standard for a given contract was, in many ways, ineffective. Generally, if the company had other defense contracts, it imposed the defense standard requirement on itself so it would not lose certification of its process. This has a significant policy implication because we may consider waiving certain requirements for a good contractor expecting cost savings to be applied to the contract. But, this may not be the case if the contractor has other govern-

ment business which will not be affected or may wish to compete for other business for which the waiver or the requirement may not be granted.

IMPROVEMENTS, INHIBITORS AND IMPLEMENTATION

Our recommendations are similar to those of previous studies; therefore, it is reasonable to ask why they have not already been implemented. We realize that overcoming institutional inertia is a major impediment to successful application of good ideas across a huge bureaucracy. In this section, we acknowledge certain environmental constraints inhibiting ready adoption of our recommendations and suggest some implementing steps we feel can begin overcoming the inertia.

The Department recently underwent a major acquisition reorganization in response to the Packard Commission recommendations. Therefore, we do not attempt to deal with organization issues but, instead, concentrate on people and process management issues. Nor, do we propose any manpower adjustments. We do sense strongly that most acquisitions professionals can be more effective and the acquisition process more efficient if these commercial management techniques are institutionalized in DOD.

Table 1 identifies specific improvements in acquisition practice, principle environmental inhibitors and suggested implementing approaches.

TABLE 1

SUGGESTED IMPROVEMENTS	INHIBITORS	IMPLEMENTATION
1. Establish at MS II (MS III for NDI programs) the relative priorities of program cost, schedule and performance in the baselines.	Institutional willingness to trade time for added funding or performance.	Revise DODD 5000.45 policy/principles.
	Historical failure to meet schedule objectives promotes excessive requirements.	Educate decision-makers and staff advisors on costs of requiring perfection and benefits of practical trade-offs.
—Give the PM/PEO flexibility and authority to make trade-offs within baseline constraints.	Institutional aversion to budgeting for risk and contingency.	Relates to Recommendations 2-6 below.
—Ensure there is maneuver room between stretch goals and practical minimum requirements.	Program development and production phases far exceed tenure of decision-makers; thus, decisions are reconsidered by later decision-makers.	
2. Subordinate PPBS funding decisions to approved program baselines at MS II and beyond.	Institutional aversion to reducing flexibility in future budgets.	Revise DODD 5000.1, para E.3. and flow-down to other directives/instructions.
—Recognize approval at MS II as commitment for life-cycle.	Lack of clear linkage between essential programs and military strategy objectives.	Build up the number of DEP programs with milestone authorizations.
	Tendency of senior military and civilian leadership to act as "judges" of programs instead of managers of the system.	

TABLE 1 (CONTINUED)

SUGGESTED IMPROVEMENTS	INHIBITORS	IMPLEMENTATION
3. Reduce the number and level of program decision milestones. —Only MS II need be a DAB-level decision.	Institutional tendency to overcontrol actions of subordinate layers. Institutional tendency for continuous management by committee.	Revise DODD 5000.1, para D.3. and flow-down to other directives/instructions.
4. Empower designated system acquisition managers (i.e., PM, PEO and SAE) to make program decisions within approved baseline constraints without interference from functional staff advocates at higher organizational levels.	Institutional tendency for functional specialists to appeal to staff advocates rather than compromise in the best interest of program as a whole. Lack of sufficient functional expertise in direct support of PMs and PEOs.	Relates to Recommendations 1, 3, 5-6.
5. Strengthen the professional functional support to program managers and reduce the dependency on staff functional oversight of program execution. —Change focus of functional staff managers from involvement in programs to professional development of acquisition specialists.	Institutional tendency to regulate and check vs. make long-term systemic improvements. Historical lack of institutional motivators for functional specialists to remain at operational levels of organization.	Strengthen DODD 5000.52 to include central career management for all functional specialists. Discontinue use of DAB acquisition committees and Service equivalents to "prepare" programs for MS decisions.
6. Ensure that matrixed, functional, program support personnel are dedicated to programs through organizational alignment and incentives. —To the maximum degree possible, matrixed personnel should work full time and be rated by the PM.	Myth that matrix management of programs can be effective on a part-time, indirect consulting basis. Lack of institutional trust in PM/PEOs to consider functional input which may compromise cost, schedule or mission performance. Institutional attitude that PMs should *compete* against each other for resources.	See Recommendations 1, 4-5. Ensure PMs have rating and reward control over assigned functional specialists. Make functional matrix managers responsible for ongoing execution of system introduced in Recommendation 5.
7. Develop an on-line contractor performance history file which is available to the contracting officer.	Information is not currently collected or maintained in a DOD-wide system accessible to the contracting officer. System of evaluation must be objective and open to review. Service and agency difference in the approach to performance monitoring.	Using the DLA system as a base, link all DOD contracting officers and major ACOs with a data network.

TABLE 1 (CONTINUED)

SUGGESTED IMPROVEMENTS	INHIBITORS	IMPLEMENTATION
8. Establish the variable specification method of source selection.	Complicates the source selection process for non-systems procurements. Dependent on good specification definition with levels of acceptability. While no legal or regulatory restriction, it will be difficult to overcome institutional emphasis on acquisition price.	Select 25 developmental or upgrade contracts as a pilot test.
9. Adopt, communicate and enforce a policy of complete neutrality with regard to subcontract competition, including a cessation of data gathering.	Defense contractors react to what they perceive to be DOD's desire for full and open competition in subcontracting. This severely restricts effective partnering with suppliers and inhibits full application of TQM and JIT implementation.	Adopt, communicate and enforce the policy.
10. Use the contractor's cost accounting system and eliminate any duplicate reporting methods.	DOD's cost reporting system has become paper bound. The current CSCS system can provide information important to managing a program. The regulatory dilemma, companies decry the cost of regulation while exploiting the advantage of "knowing the system."	For all contracts which are not Firm Fixed Price, use the contractors data system for Cost schedule and control information. This information should be the same as that which is fed into the company's financial reports.
11. Waivers of policy and reporting requirements should be granted for an entire commercial activity for an extended period of time, not on a contract-by-contract basis.	Waivers on individual contracts are considered ways of bypassing costly elements of standard systems. Difficulty of startup implementation and determining how to react to poor performance on a single contract. Contractors performing on multiple government contracts adopt the standard.	Disapprove any deviation or waiver which is not company-wide.

CONTENTS

I

INTRODUCTION

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INTRODUCTION

Background

There is a longstanding public debate over how the Department of Defense (DOD) acquires it's weapons; a debate fueled by periodic "breakdowns" in DOD's acquisition system. Recent, highly-visible breakdowns have eroded public and congressional confidence in DOD acquisition to, perhaps, an all time low; and the defense reform debate has increased in fervor and pitch.

One recurring theme of much of that debate is, why can't DOD simply "do business like business?"; in other words, why can't DOD adopt commercial ways of doing business in buying? Early thrusts in this direction centered around recommendations that DOD adopt the use of commercial products whenever possible. Some feel that if DOD would eliminate unnecessary specifications, it could purchase readily-available, off-the-shelf items, and by doing so, enjoy the benefits of the commercial marketplace (competitive pricing, the latest product development, and rapid availability, to name just a few). Arguments to this effect go back at least to the 1972 Commission on Government Procurement which acknowledged the merit of buying commercial products in lieu of items manufactured to federal specifications. That Commission called for a"...shift in the fundamental (DOD) philosophy relative to commercial product procurement...." Although the primary emphasis during this period was on the use of commercial products, the 1972 Commission seemed to have commercial ways of doing business in mind as well when they stated, "The system we advocate will enable the executive branch to ensure that procurement operations are businesslike and orderly and that goods and services are acquired efficiently."[1] The "busiesslike" operations referred to here are the forerunners of what later came to be known as "commercial practices."

It is important at this juncture to better define the semantical difference between "commercial products" and "commercial practices." While the two are closely related and often confused, they are distinctly different. "Commercial products" are off-the-shelf items developed to commercial standards for the commercial marketplace. "Commercial practices" is a much broader term, meaning the entire process by which commercial companies conduct their business. In the latter case, the focus on the business *process* rather than on acquiring the end-product.[2] While DOD's use of commercial products has been the subject of multiple studies since the 1972 Commission, the use of commercial practices suffers from a dearth of focused study. Accordingly, our research emphasis here will be on the use of commercial practices by the Department of Defense.

COMMERCIAL PRODUCTS	V.	COMMERCIAL PRACTICES
Off-the-shelf items developed to commercial standards for commercial markets.		Commercial ways of going about the full range of business activities.
Emphasis on PRODUCT		Emphasis on PROCESS

In the decade of the 1980s the defense reform rhetoric has been building to a crescendo, with recommendations to "do business like business" as an essential element of much of the debate. In 1981, then Deputy Secretary of Defense Frank C. Carlucci introduced a comprehensive reform package known as the Acquisition Improvement Program (although probably better known as the Carlucci Initiatives). This program embodied a number of recommendations, many of which are

based on commercial business models, such as the call for more responsibility, authority, and accountability for DOD program managers.[3] In 1983 President Ronald Reagan was so interested in the idea of running the government like a business that he asked industrialist, J. Peter Grace, to lead a study of how to achieve that objective. That study, known as the President's Private Sector Survey on Cost Control, or the Grace Commission, came up with 2,478 specific recommendations that would yield projected savings of $424.4B over 3 years if implemented government-wide (not just DOD). In their report the Commission said these savings could be realized by applying "private sector management tenets" across the broad spectrum of the federal government.[4] Similarly, in 1986, the President's Blue Ribbon Commission on Defense Management (the Packard Commission) strongly advocated the use of commercial products, then went on to say, "Even when commercial products are not suitable for DOD's purposes, it can still use commercial buying practices to real advantage."[5] A 1986 Defense Science Board that was chartered to focus on the use of commercial products in DOD stepped outside their charter to reach a similar finding. They said, "...although the increased use of commercial equipment (in DOD) is good, the increased use of commercial *practices* could be even better."[6]

FIGURE I-1. "DOING BUSINESS LIKE BUSINESS"

Packard Commission 1986	"Even when commercial products are not suitable for DOD's purposes, it can still use *commercial buying practices* to real advantage."
Defense Science Board 1986	"...although the increased use of commercial equipment (in DOD) is good, increased use of *commercial practices* could be even better."
Grace Commission 1984	...apply "*private sector management tenets*" across the broad spectrum of the federal government.
Commission on Government Procurement 1972	We seek to "enable the executive branch to ensure that DOD procurement operations are *businesslike*."

The Congress apparently shares the belief that there is potential payoff in DOD's expanded use of commercial practices, enthusiastically embracing the findings of the Packard Commission. More recently, Dr. Robert B. Costello, while Under Secretary of Defense for Acquisition, identified commercial practices as an important element in the far-reaching Total Quality Management (TQM) initiative for the Department. At this point, it should be clear that there is a developing consensus favoring the use of commercial practices as a solution for some of the seemingly intractable problems facing defense procurement. Of course, this should not be viewed as a panacea, but rather a source of good ideas for selective application within DOD.

Institutional Impediments to Adopting Commercial Practices

Given this developing consensus for the use of commercial practices in DOD, why doesn't DOD simply adopt them and be done with it? Granted, some laws and regulations would have to be changed, but the lawmakers and regulators as parties to the consensus should be willing to do so. In reality, however, many of the impediments to DOD's adopting commercial practices are not based in laws or regulations, but are rooted deeper, in a more basic, institutional foundation.

Perhaps the most basic of these reasons is confusion over exactly what commercial practices are. At the macro level people seem to have a reason-

FIGURE I-2. INSTITUTIONAL IMPEDIMENTS TO THE GOVERNMENT USING COMMERCIAL PRACTICES

- —Confusion over specifically what they are
- —Sheer size of public sector
- —Inherent differences between the public and private sector

PRIVATE SECTOR	PUBLIC SECTOR
Single Constituency: "Shareholders"	Multiple Constituencies: "Stakeholders"
Singular Focus: "Efficiency"	Mixed Focus: "Efficiency" & "Equity"
Clear Measure of Success: "Bottom Line"	No Clear Measure of Success.

able understanding of what is meant by "doing business like business." They tend to think of less bureaucracy, faster, cheaper development cycles, more flexibility in decision-making, and, finally, greater accountability for results. But these factors are really benefits emanating from the idealized commercial acquisition system, rather than actual characteristics of such a system. What then are the specific business practices used in the commercial sector that yield these desirable characteristics? We must have this level of specificity before we can implement commercial practices in DOD, but it is here that the definition of these practices is unclear. It is not surprising that this lack of definition has worked against DOD's wholesale adoption of commercial practices.

Another factor that mitigates against adoption of commercial practices in DOD is the inherent difference between a public activity and a commercial one. A commercial activity has essentially a single constituency (the stockholders), and a singleness of purpose in pursuing their chosen business endeavor in the most efficient, effective manner possible. They have the bottom line of their profit and loss statement to objectively assess their performance toward that goal.

A typical government activity, on the other hand, serves a multitude of constituencies (the stakeholders), many of whom have different, often conflicting, expectations of that activity. A government activity does not enjoy the clarity and singularity of focus customary for a commercial activity. The focus of the government activity is likely to be ambiguous and rapidly changing, with changes made for political reasons rather than efficiency. In addition, the service provided by the activity may be abstract, making measurement of that service very difficult.[7] As such, an activity's success can not be measured easily by a single quantitative parameter such as the commercial firm's bottom line but, rather, by a general feeling of goodness.

Finally, commercial and government activities differ significantly in the flexibility they have in expending funds. The commercial activity is primarily concerned about the efficiency of an expenditure in furthering the objectives of that activity. On the other hand, since a government activity deals with public funds, there is a need for fairness or equity in their expenditure, as well as the need for some level of efficiency. Most Americans believe government funds should be expended in a forthright, fair, and accountable manner. They believe all citizens should have an equal chance to compete for a portion of those government expenditures. This longstanding principle of equity was reaffirmed by the Congress in 1984 with passage of the Competition in Contracting Act (CICA) requiring "full and open competition" in DOD procurement.[8] However, equity is sometimes achieved only at the expense of efficiency. The two concepts often conflict. Procurement procedures that ensure equity may be patently inefficient.[9] As Plato observed many centuries ago, a democracy is an inherently inefficient form of government, primarily because it is a government of compromise and consensus.[10] Consistent with that observation, in this country we routinely trade off efficiency to ensure that equity is preserved in government spending.[11] An example might be the mandate that a portion of government business go to small business firms. While arguments supporting this mandate are compelling from a equity standpoint, buying from small business may not necessarily be the most efficient way for the government to do business. Another example might be the CICA requirement that most government purchases be competitive, since competition connotes the fairness and equity the public expects. There are instances, though, when a competitive purchase may not be the most efficient, or even the most prudent way of doing business. Again, the concept of equity overrides what might be the best business practice.

This is not to imply that the public does not want efficiency in DOD procurement. Quite the contrary, Dr. F. Ronald Fox, speaking of the Packard Commission's 1986 survey of public attitudes, said, "The commission's survey made clear (that the public feels) that inefficiency in DOD spending is a problem of major proportions."[12] Many would argue that at this point in the defense reform debate, the public is *demanding* efficiency in defense procurement. However, they have not abandoned their desire for equity in order to achieve it.

These institutional differences between private and public activities are indeed significant; some

feel so significant that the government can simply never do business like business.[13] Others, notably the Packard and Grace Commissions, recognize the deep-seated differences, but still believe there are areas where the government can borrow selected business practices from the commercial sector to great advantage.

Commercial Practices: A System Worthy of Emulation?

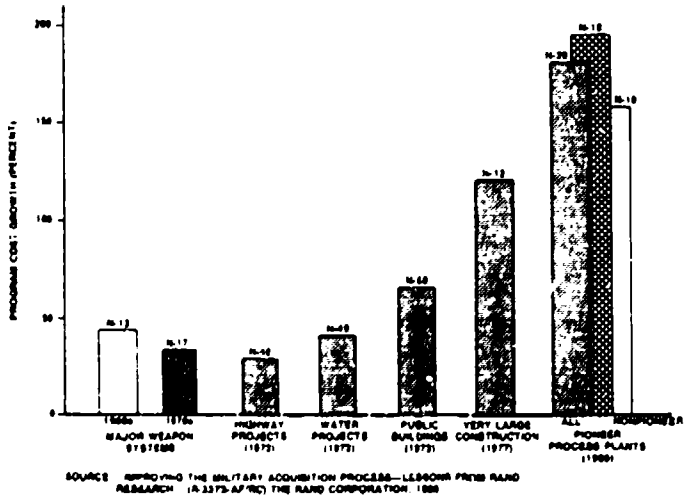
Finally, it is interesting and instructive to look at the actual performance of the commercial sector that the Department of Defense is being encouraged to emulate. In doing so it is important to recognize the technical complexity of many DOD acquisitions, with the typical program pushing the state-of-the-art in several technologies simultaneously. The findings of a study by The Analytic Sciences Corporation and another by the Rand Corporation suggest that given roughly equivalent project complexity (a large facility project for example), the commercial sector does no better than DOD in delivering a project within budget.[14,15]

The Packard Commission said of these studies, "The good news...is that DOD is no worse than other large bureaucratic organizations in managing major programs." However, Packard then identifies a number of specific commercial ventures that were, in fact, "models of excellence" worthy of emulation.[16]

Notwithstanding this conflicting evidence, the general perception persists that the government can benefit from adopting commercial ways of doing business.

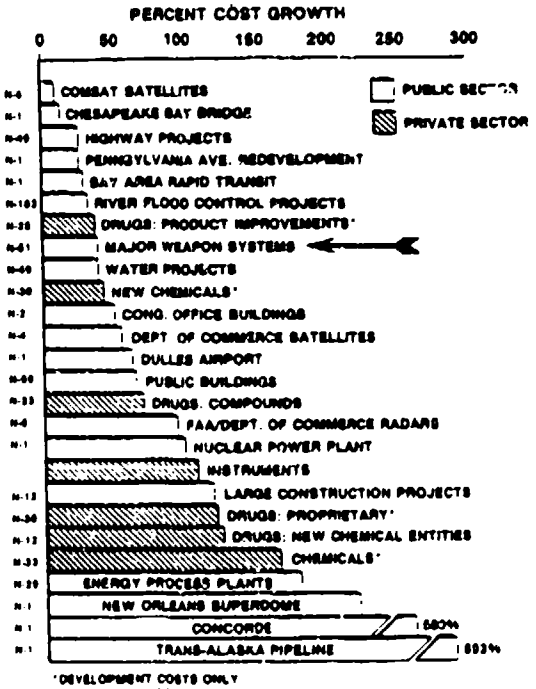
FIGURE I-3. COST GROWTH IN MAJOR PROJECTS

RAND



SOURCE: IMPROVING THE MILITARY ACQUISITION PROCESS—LESSONS FROM RAND RESEARCH (R-3373-AF/RC) THE RAND CORPORATION, 1986

TASC



*DEVELOPMENT COSTS ONLY
N = NUMBER OF CASES CONSIDERED
† ADJUSTED FOR QUANTITY AND INFLATION

SOURCE: F. SHERY, THE ANALYTIC SCIENCES CORPORATION (TASC); COST GROWTH AND THE USE OF COMPETITIVE ACQUISITION STRATEGIES, THE NATIONAL ESTIMATOR (JOURNAL OF NATIONAL ESTIMATING SOCIETY), VOL. 8, NO. 2 (FALL 1986)

Direction and Scope of Research Effort

It is with a sincere belief that selected commercial practices can be of benefit to DOD, that we embarked upon this course of research. Briefly stated, our objectives were:

1) To define commercial practices

2) To identify practices which seem to be applicable to, and offer high payoff in DOD

3) To explore fully how to implement those selected practices.

Our approach in pursuing these objectives was partly driven by the nature and duration of the Defense Systems Management College (DSMC) research fellowship in which we participated. Early in that fellowship we attended an executive education program at the Harvard Business School (The Program for Management Development). This education program provided academic exposure to the latest in theory and practice of managing commercial companies. In addition to significant classroom experience, we were sequestered during the 12-week program with 135 classmates who were up-and-coming middle managers from many of the world's most prestigious companies. The combination of the two forums proved to be a superb learning experience and opportunity to "kick off" our research; we were able to effectively immerse ourselves in the ways commercial companies do business.

Because our research objective is to import some of these smart commercial ways of doing business into DOD, we focused on commercial business functions that were comparable to functions carried out by DOD. Specifically, we focused on how commercial companies develop new products, and how they acquire major capital projects. We felt these activities most closely parallel the acquisition of major military systems because:

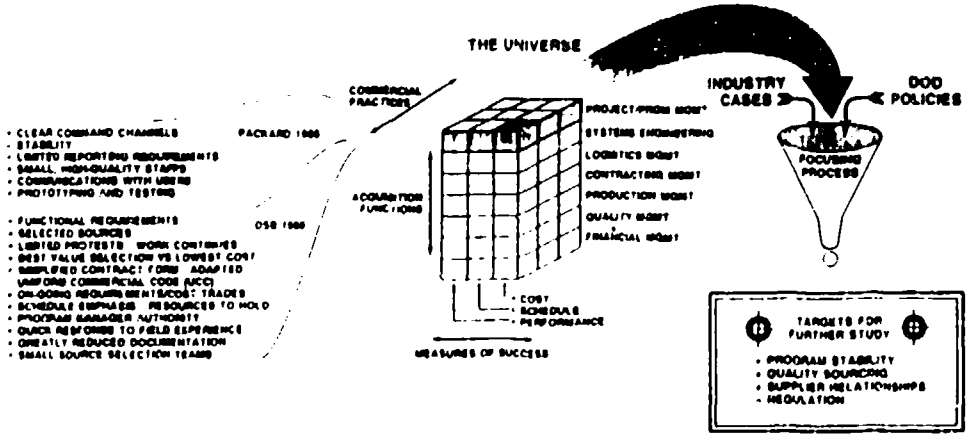
—Such products and systems require large commitment of corporate resources with extended payback periods.

—They often incorporate new technology and push the state-of-the-art.

—They require a comprehensive management system to integrate the efforts of many people, equipment and technologies.

Even with our focus constrained to new product developments and capital projects, it became clear that the universe of commercial practices was expansive. To conceptualize this universe, we developed a three-dimensional model as shown in this exhibit:

FIGURE I-4. RESEARCH MODEL



We designated the axes of the model as follows: on the X axis, the traditional measures of project success; on the Y axis, the functions or disciplines of acquisition; and on the Z axis, "commercial practices." Our objective here is to show not only the broad universe of commercial practices, but to show their interdisciplinary and interdependent nature. We will now briefly explore the variables that make up each of these axes.

The bottom line of any management practice is the degree to which that practice contributes to the success of the mission, and the success of a "project," whether commercial or defense, is judged on three variables: cost, schedule, and performance. Accordingly, we felt these success criteria should be an integral part of the analysis of any commercial practice. We include them in our model to reflect this importance. The three variables are so highly interrelated that the success of a project is dependent not only on each variable independently, but also on the effect that each exerts on the others. Mathematically, this relationship would appear:

SI = f (S, P, C)

SI = successful implementation

S = Schedule

P = Performance

C = Cost

The goal is optimization of the total equation rather than its individual variable values. The impediments to doing so lie in the complexity and amorphous nature of the interrelationships, as well as the difficulty of traditional, functional organizations to work across organizational lines. While it is possible to optimize one (or even two) component(s) of the equation, it is practically impossible to optimize all three independently.[17] The process of making effective trade-offs between variables is, therefore, critical to the overall success of any project. We found stark contrasts between how this process is treated in the defense acquisition environment versus the commercial world.

The second element of our model, depicted on the Y axis, is the array of functional disciplines implicit in acquisition. While many conventions were possible, we adopted the approach used by the Defense Systems Management College (DSMC). They include seven discrete disciplines under the umbrella of systems acquisition management; to wit: quality, systems engineering, production, contracting, logistics, program and business/financial management. Each interacts with the others, so that policy changes designed to improve one area may impact another, perhaps adversely. Each function has specific policy, doctrine, and culture, as well as multiple levels of advocacy within the acquisition hierarchy. Any analysis of commercial practices must, therefore, examine the impact across the entire range of disciplines, although this research is focused particularly on those of program management, quality, contracting and financial management.

The final axis of our model is the crux of this research effort--commercial practices. As a point of departure we used commercial practices identified by the Packard Commission and the 1986 Defense Science Board (shown on the left side of our research model). Our real target, however, was a level of specificity below those that the Packard Commission and the DSB identified. We sought to identify management techniques, strategies, and practices used in the commercial sector to develop major new products, or manage capital plant/equipment projects.

Again, our ultimate objective is "lessons learned" for DOD, so we constrained our focus to commercial practices that: 1) seem to be consistently successful, and 2) are different from those typically employed by DOD. We found many. Too many, in fact, for this research effort of limited duration and resources. Therefore, it became necessary to concentrate our in-depth research on a selected number of these practices. In choosing from among the many "good ideas" for additional study we used the following criteria:

1) Commercial practices that DOD could implement within it's existing authority

2) Practices that offered high payoff if implemented in DOD

3) Practices that complemented the diverse functional background and interests of members of the research team.

This focusing process is depicted in the model as a funnel yielding an output of targets for further

research. It is important to note that this research effort does not purport to be an all-inclusive study of the commercial practices that might be applied to DOD. Rather, it is an in-depth treatment of several of those practices. The practices we chose to develop offer real advantage if adopted institutionally by DOD, but there was clearly an element of "randomness" in their selection. There are many more commercial practices that are worthy of further research, and we hope that this report will establish a framework for such research.

It is important also to note that we did not find any heretofore undiscovered, "gee whiz" panaceas from among the range of commercial practices that we examined. The term "commercial practice" really means "smart business practice." Most are strongly rooted in common sense. Many are already in use sporadically throughout DOD (reference appendix G discussion of MSE for example). In keeping with this perspective, recognize that our findings and are not novel or "inspired" but instead seek to report for widespread implementation some good things we saw consistently in successful commercial programs. We firmly believe the commercial practices identified can and should be implemented by DOD.

Research Approach and Case Studies

We relied on a literature search and our Harvard experience during the early phase of our research to identify the range of commercial practices. We assessed the various business practices in use in the commercial sector against the background of our individual acquisition experiences as Product Manager, Contracting Officer, Financial Manager, Technical Manager, Logistics Manager and Quality Manager in prior military assignments. By doing so, we identified several potentially high pay-off opportunities for in-depth research.

Once this focusing process was complete and we had specific targets for study, interviewing became our principle method of research. At that time we embarked upon a course of face-to- face, intensive, nonstandardized interviews with personnel at various management levels in a broad range of concerns.[18] These concerns ranged from companies with purely commercial business, to companies engaged in a significant amount of defense business, and finally to DOD program offices. Thus, we were able to compare and contrast management practices being used to accomplish like functions. The organizations that were the subjects of our interviews are shown in Figure 1.

FIGURE I-5. RESEARCH CONTACTS WITH INDUSTRY

WESTINGHOUSE •	• GENERAL ELECTRIC •
• GTE •	• DOW CHEMICAL •
• TEKTRONIX •	PUBLIC SERVICE GAS •
EASTMAN KODAK •	• BECTON DICKINSON •
ROCKWELL •	• PACIFIC BELL •
VALENTEC •	BOEING •
MARTIN MARIETTA •	• UNITED TECHNOLOGIES •
DIGITAL •	GEHL •
GENERAL DYNAMICS •	AT&T •
BRITISH AIRWAYS •	• HP •

• Interviews; • Commercial Case; • DoD Case

Based on the first round of interviews, several opportunities for program specific case studies developed. These are annotated on the exhibit.

FIGURE I-6. COMMERCIAL CASE STUDIES DEVELOPED

Scope

Case#	1	2	3	4	5	6	7
Co.	UTC	HP	Dow	Tektronix	GE	PacBell	BDIS
Proj	PW4000 Engine	Several	Several	Several	Several	Adv Digtl Ntwk	FAC-Star
New	Prod.	Prod.& Plants	Plants	Plants	Plants	Prod.	Prod.
Time	4-5yrs	1-4yrs	18mos	1-2yrs	3yrs	27mos	18mos
Funds (est)	‹$1B	‹$500M	‹$500M	‹$100M	‹$100M	Not Released	‹$10M

Figure 3. 1986 DSB Commercial Case Studies

Scope

Case#	A	B	C	D	E
Co.	AT&T	Boeing	SBS	IBM	MITRE
Prog.	EES-4 Switch	767 Aircraft	Comm Sat'llte	360 Computer	FAA Nat'l Airsp Sys
All cases were new product development.					
Time	8 yrs	4 yrs	34 mos	3 yrs	Unk
Funding was not identified in cases by DSB.					

We found the case study method for further data gathering most appropriate in order to investigate not only what commercial management practices were employed, but why, how, and how well. Further, in examining specific cases we could determine the interdependencies of the practices within each program. All case studies were developed without any preconceived bias as to which practices or techniques to include for assessment. The scope of each case study program is summarized below; the full case study narratives are in appendices. The cases cover a range of program sizes and types that we feel are comparable to defense system programs (all the commercial cases (1-7) were financed privately).

1. PW4000 is a high thrust, fuel efficient, turbofan engine for large, wide-body commercial aircraft developed by United Technologies Pratt and Whitney Commercial Engine Business. Cost $1B (approximately); 54 months from concept to deployment.

2. The Hewlett Packard (HP) Computer Business Organization's new product development management process was studied and documented in lieu of a specific case study. We discussed a major program, the "Spectrum" which was the total HP 3000-series computer hardware and software architecture development program conducted from 1980-1985 and funded at approaching $500M. Spectrum was not managed via the phase review process. Also, we discussed a major new surface mount technology facility program, now in process, in the HP Microwave and Communications Instrument Group. This latter program provides a state-of-the-art development and production facility. It is scheduled to last 3 years and will cost several hundred million dollars. It too, does not use the phase review process, which appears most applicable to product-line enhancement and customer-unique application projects.

3. The Dow Chemical Company's Michigan Division's new capital plant/equipment management process was studied and documented in lieu of a specific case study. The Michigan Division has four or five major capital programs underway at any point in time to build production facilities (e.g., aspirin plant, plastics plant, etc.). The typical program is on an 18-month schedule, from approval for preliminary engineering to production start-up and costs from several tens to several hundreds of millions of dollars.

4. Six separate capital plant/equipment projects were documented in the Tektronix case study. Design and implementation of the following plants is included: Integrated Circuit (IC) development and production facility (cost $53.4M; 21 months to completion in 1981); Gallium Arsenide (GaAs) IC development and production plant, designed into the IC facility (cost $1.7M; 14 months to completion in 1985); Automated Warehouse (cost $23M; 18 months to completion in 1979); Cathode Ray Tube (CRT) production plant; Hybrid Circuit production plant; and Circuit Board production plant. The latter three plants cost between $20-50M each and were completed by the mid-1980s.

5. The "Factory of the Future" was designed and built by General Electric Aircraft Engines. It is a fully automated machining facility for processing (i.e., turning, milling and drilling) rotating components of high performance jet engines. The project required 3 years from concept to initial production start-up and cost $52M.

6. The Advanced Digital Network (ADN) is a new digital line service customer providing full duplex, point-to-point or multi-point service with customer selectable data rates from 1.2 to 64 Kbps. It was implemented in 27 months from completion of concept development to deployment in 1989. Program costs are not releasable.

7. The Fluorescence-Activated Cell Sorter (FACStar), an automated system, identifies blood and tissue cells in a flow stream, separates them, and collects them for further analysis. It is the lead new product of Becton Dickinson Immunocytometry Systems (BDIS). The development program required 18 months and more than $1M. It was completed in 1985.

8. Mobile Subscriber Equipment (MSE) is a major U.S. Army program to acquire a complete tactical telephone, mobile-phone and facsimile system for the entire field Army at Corps-and-below levels. The system is provided by GTE Government Systems Division. It is a $4.3B NDI program requiring 10 years for system integration, testing, production and deployment. The MSE was selected for case analysis as a non-commercial program to determine what commercial practices

were employed and how they fared. The Army Communications Electronics Command had been directed to employ commercial management practices in the acquisition of MSE.

The 1985 DSB Summer Study developed the following five major new commercial product case studies; we considered their findings along with the cases developed above:

A. The EES-4 telephone switch developed by AT&T; 2 years from requirement to start of development; 8 years to deployment

B. The 767 aircraft developed by Boeing; long conceptual development period; 4 years to develop and deploy

C. Communications satellite developed by SBS; 14 months from requirement to start of development, 34 months to deploy

D. System 360 computer family developed by IBM; 12 months from requirement to start of development; 3 years to deploy.

E. The FAA National Air Traffic Control System developed by MITRE; schedule not provided.[16]

The "guts" of our research effort is contained in Sections II and III of this report. There, we present the findings of our research and make suggestions vis-a-vis implementing certain commercial practices in DOD. Section II is dedicated to the treatment of issues affecting program stability; Section III covers individual topics in acquiring quality systems, establishing buyer/seller relationships, and implementing certain regulatory issues.

We recognize that our approach and methodology to this research may not be considered "rigorous" from a purely academic standpoint. We do feel, however, that we garnered sufficient evidence, albeit primarily anecdotal, to strongly support our findings and suggested improvements, particularly when considered in the context of the broad acquisition experience of the authors. We believe DOD can, in fact, learn a great deal from the commercial sector, and this report provides a blueprint for doing so.

Endnotes

1. *Report of the Commission on Government Procurement*, December 1972.

2. Note: A third concept that may also prove confusing is Commercial Activity Contracting by the government. This is when the government contracts out a service that historically has been performed by government employees. An example is the contracting out of aircraft maintenance services to a commercial company, rather than continuing in-house maintenance.

3. Deputy Secretary of Defense Memorandum, "Improving the Acquisition Process," April 30, 1981.

4. "President's Private Sector Survey on Cost Control: A Report to the President," January 15, 1984.

5. "President's Blue Ribbon Commission on Defense Management, Final Report to the President," June 1986.

6. Office of the Under Secretary of Defense for Acquisition, "Final Report of the Defense Science Board, 1986 Summer Study," January 1987.

7. Under our system of government, the public sector steps in to provide a service only when the free market cannot, or has not done so. Good examples are national defense and police protection which simply cannot be provided effectively by the free-market system. These public services, by their very nature, are abstract and difficult to quantify.

8. Kirby, Wendy T., Esquire, "Expanding the Use of Commercial Products and 'Commercial Style' Acquisition Techniques in Defense Procurement: A Proposed Legal Framework," *A Quest for Excellence: Final Report by the President's Commission on Defense Management*, June 1986, Appendix H.

9. Musgrave, Richard and Peggy, *Public Finance in Theory and Practice*, McGraw-Hill Book Company, New York, N.Y., Fourth Edition, 1984.

10. Plato, *The Republic*.

11. Georgetown University, Center for Strategic and International Studies, "U.S. Defense Acquisition: A Process in Trouble," March 1987.

12. Fox, F. Ronald, *The Defense Management Challenge: Defense Acquisition*, Harvard Business School Press, Boston, Mass., 1988.

13. Hartle, Terry W., "Sisyphus Revisited: Running the Government Like a Business," *Public Ad-*

ministration Review, March/April 1985.

14. Biery, F., The Analytic Sciences Corporation (TASC), "Cost Growth and the Use of Competitive Acquisition Strategies," *The National Estimator*, Vol. 6, No. 3, Fall 1985.

15. The Rand Corporation, "Improving the Military Acquisition Process—Lessons from Rand Research," R-3373-AF/RC, 1986.

16. *A Formula for Action*.

17. Hayes, Robert G., Steven C. Wheelwright and Kim B. Clark, "Dynamic Manufacturing," *The Free Press*, New York, Chapter 11, 1988.

18. Non-standardized interviews are designed to elicit different information from each interviewee by tailoring questions to their individual background, experience and placement.

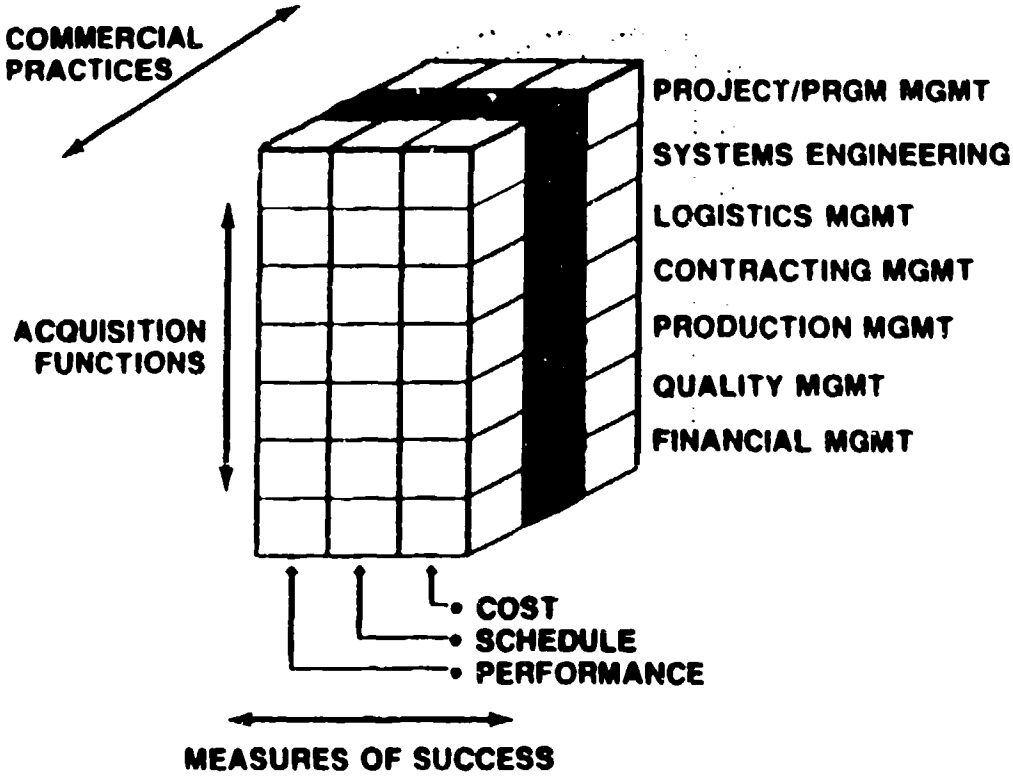
19. The DSB study did not identify development costs for the programs.

II

ENHANCING PROGRAM STABILITY

II

ENHANCING PROGRAM STABILITY



A fundamental commercial practice in successful major new product development and capital systems project implementation is program stability. The 1986 Packard Commission report highlights stability as one of:

> "six underlying features that typified the most successful commercial programs" and that "defense acquisition typically differs from the commercial model in almost every respect . . . (but that several) successful DOD programs have incorporated some or all of these management features to a greater or lesser extent."[1]

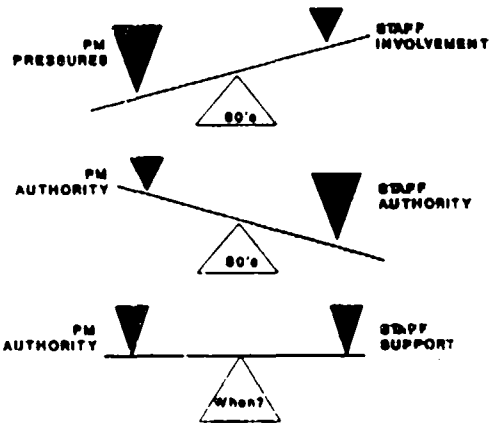
In this section, program stability is described; successful commercial business management approaches to stabilizing programs are identified; Department of Defense (DOD) policies and inhibitors impacting program stability and actual practice are discussed; and specific improvements are proposed for application via DOD acquisition policy changes. The motivation is to institutionalize the use of those good business practices which enhance program stability in the DOD acquisition system.

Program stability features ripple across all of the traditional functions associated with systems ac-

quisition. The obvious focus of this section is on program/project management functions, but our treatment of program stability must, and will, cross functional boundaries (i.e., engineering, logistics, and financial management) to deal effectively with the necessary complexity of system programs. The criteria for measuring success in systems acquisition—cost, schedule and performance—as impacted by stabilizing management techniques are the central treatment of Chapter 2.

The research model, introduced in Section I, is recast at the beginning of this section to highlight the commercial practice, program stability. We develop in Chapters 1-4 the principal management techniques impacting the stability of systems programs, major and non-major, which we observed employed in highly successful major commercial systems programs.

FIGURE II-1. ACHIEVING PROGRAM BALANCE



A Working Description

The key attributes of program stability are steadiness of purpose, a firmly established plan and a supportive system.[2] For a program to have stability it must have a goal of sufficient permanence that it outlives the time it takes to implement the plan. The program plan links the purpose to the resources (time, people, funds and technology) needed. It organizes these resources and defines the process for achieving consensus and approval to implement. It then guides the execution phase and provides for the integration of effort. The plan should be realistic and provide flexibility to adapt to unforeseen problems or modest changes in purpose and resource availability. In a bureaucracy, such as DOD, the approved plan should be a product of systematic consensus and a clear decision rather than the result of continual incremental decisions.

What's Wrong?

Figure II-1 dramatizes the issue; it represents the current imbalance of forces impacting program stability. This situation is the result of decades of piecemeal regulatory efforts to ensure against recurrence of perceived (including some very real) past transgressions. It shows DOD and Service functional organizations and staffs attempting to ensure against ineffective and excessively costly defense systems.

The misfortune here is that defense acquisition professionals are all on the same team but often act counterproductively and very inefficiently in both a micro and macro sense. Program Manager (PM) perception is that DOD and Service functional organizations and staffs are often the problem rather than team members in achieving program success. These organizations and staffs often operate as though PMs should not be trusted. In Section I, we mention that cost and schedule controls on major defense programs are no worse than on other public or private programs. We all recognize that cost, schedule and performance accomplishment in defense systems acquisition is not what it should be. Especially in times of decreasing budgets and increasing operations and maintenance needs, DOD must do better if it is to continue essential force modernization.

From the PM's perspective, the essence of the problem is instability. There are an inordinate number of often conflicting requirements and demands, coupled with a basic lack of authority (anywhere) to tailor them into a cohesive plan. And no one seems to remain in charge long enough to see the plan through. It is the singular intent of this section to identify and promote adoption of good business practices which can begin to bring our acquisition forces into constructive balance.

Commercial Practices Enhancing Program Stability--What Are They?

Our research used literature search and interviews of practitioners of commercial practice in major new product development and capital systems development projects. There is a wealth of literature in existence describing good and bad business management practices; in general, this material was useful to overview applicable philosophy, but not particularly informative in establishing how to implement the concepts. The best sources for implementation techniques were those which used the case study method based on real examples or those which documented real time issues and their resolution.

We anticipated researching only commercial capital plant equipment programs due to their functional similarity to defense weapons programs (e.g., size, funding, technology, purpose, complexity, etc.) but found that major new product-line programs were handled similarly. We decided to use evidence from both types of programs. On the surface, one might initially question the applicability of new product development techniques since commercial businesses tend to execute these programs internally versus contracting-out to a prime contractor—the typical defense system approach. We also found that all of the commercial capital programs we saw were internally managed and integrated, using contractors for component subsystems and supplies. We leave to you, the reader, the final call as to applicability under these circumstances, but expect you will recognize that the management techniques discussed here are no more than good management methods applicable to any large, complex program within a large bureaucratic organization.

Based directly on this research, we found that the good business practices contributing most to program stability are: (1) top management involvement, (2) on-time completion, and (3) the authority and accountability of acquisition line management. We also found the commercial techniques for implementing these practices; these are outlined in Figure II-2. Each is developed in Chapters 1-3 along with DOD environmental inhibitors.

FIGURE II-2. COMMERCIAL TECHNIQUES FOR ENHANCING PROGRAM STABILITY

1. Role of Top Management (Chapter 1)
   - Vision and Selectivity
   - Active Involvement
   - Supportive System
2. Cost, Schedule, Performance Prioritized (Chapter 2)
   - Meet Schedule
   - Sufficient Performance
   - Flexible Funding
3. Authority, Accountability, Resource Control and Responsibility to Line Management (Chapter 3)
   - Enable Line Managers
   - Focus Responsibility
   - Experienced People

Chapter 4 assesses several congressional and DOD policies which impact across program stability, and provides some suggested implementing steps for institutionalizing these techniques into the defense acquisition system.

Endnotes

1. President's Blue Ribbon Commission on Defense Management, *A Quest for Excellence, Final Report to the President*, June 1986, pp. 40-51.

2. These derive directly from definitions of "program" and "stability," *Webster's New Collegiate Dictionary*.

1

THE ROLE OF TOP MANAGERS

FINDINGS

a. Active involvement of top corporate managers is essential to program success.

b. The commitment to program success crosses organizational lines.

DISCUSSION OF THE FINDINGS

> **1986 Packard Commission:** "At the outset of a commercial program, a program manager enters into a fundamental agreement or 'contract' with his CEO on specifics of performance, schedule, and cost. So long as a program manager lives by this contract, his CEO provides strong management support throughout the life of the program. This gives the program manager maximum incentive to make realistic estimates, and maximum support in achieving them. In turn, a CEO does not authorize full-scale development for a program until his board of directors is solidly behind it, prepared to fund the program fully and let the CEO run it within the agreed-to funding."[1]

We found that successful major systems programs (i.e., new product line, new capital plant/equipment) within the commercial acquisition environment are the product of unequivocal top management approval and support. In the *programs which reflect the strategic emphasis of the company*, there was clear linkage to organizational business strategy and direct involvement of the Chief Executive Officer. Involvement did not mean micromanagement, but an awareness of the program's current status, active questioning, and a willingness to commit organizational resources to resolve problems.

Strategic Vision and Selectivity

Best business practice is to develop project plans for new products, and any necessary new processes, from top management's *strategic vision* of *what* customers want and *when* it must be there to beat the competition. Top management of successful businesses identify customers needs/wants and what they are willing to pay; they are also very aware of what the competition is doing and likely to do.[2] These two factors allow top management to determine when they must bring in a new product or new capability to cover costs and make acceptable profits before the competition catches up. For example, Nissan's highly successful implementation of their truck and auto plant in Smyrna, Tenn., was, in part, attributed to senior management's focus on a single, simple goal: "To build the highest quality truck sold in North America."[3]

Figure 1-1 diagrams the relationship of top management to several key elements of program management. Basically, it shows the top manager is actively involved with strategic planning and decision making as it applies to major programs; it also shows top management commits to seeing programs through. Top managers are personally involved in making early trade-offs to get to a practical program baseline; and they select the PM. Not all projects, conceived and proven feasible in the bottom-up process most organizations use to identify new opportunities, will directly support such vision; those that do are seized upon and made to work.

Active Involvement

Our assessment of top management's role in the case studies (Figure 1-2) is that the predominant role is *active involvement*: either they *lead*, actively champion the important projects; or they *enable*, ensure the system functions whereby the whole organization actively supports, approved programs.

FIGURE I-1. ROLL OF TOP MANAGEMENT

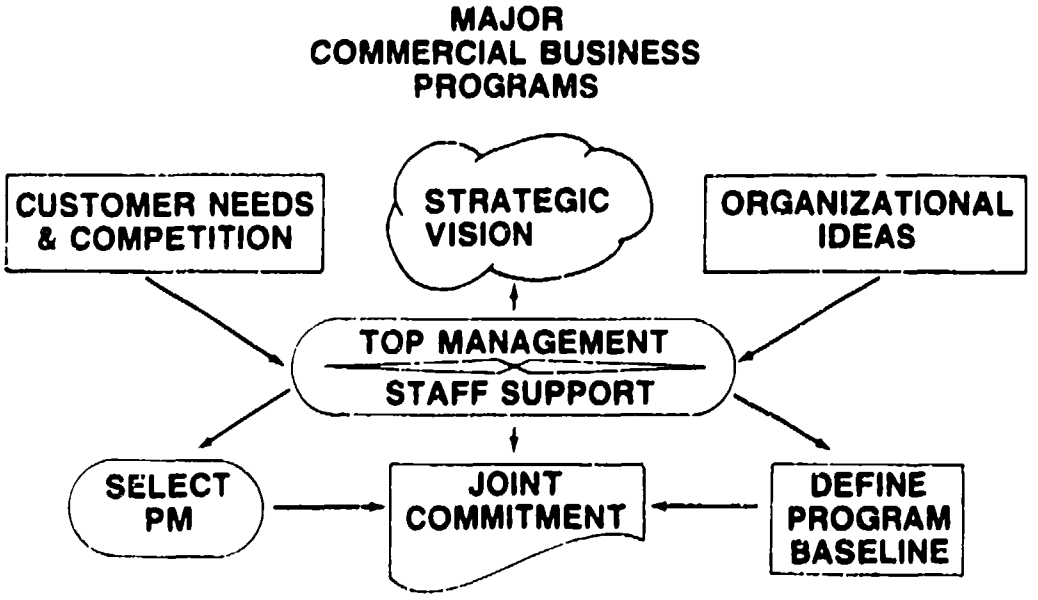


FIGURE I-2. COMMERCIAL CASE STUDIES

Case#	1	2	3	4	5	6	7
MODE	Lead	Lead	Enable	Lead	Enable	Unk	Lead
#Prog MSs	1	1,6•	2	2	2	2	1
Dcs'n Auth'y	Prog Dir	COO	PM	Gp VP	Mfr GM	Cmt'y	Div Pres

• Strategic Programs Had 1 Go/No-Go Decision

Although procedural methods of establishing program approval were not specifically investigated, we did note that such decisions were often based on intuitive judgment as opposed to detailed cost and benefit analyses. Top management actively participates in managing these selected programs to *ensure focus*, focus of program objectives and focus of organization effort.

A senior HP executive stated that the most damaging new product problem is failure to bring in a new system once development has begun.[4] Major projects in all seven commercial case studies were limited to *two or fewer "go/no-go" decisions*; typically, the first is a decision to create a design and a mini-business case; the second is approval to enter full-scale development and implementation. For example, UTC committed $1B on a new jet engine development (the PW4000) based on market research and a decision to be ready with a new proven product when the market needed it. There was no further need to reconsider the commitment as the work was being done.[5] Quinn went on to say that top management should establish a "few critical points" for intervention (i.e., it cannot be a continuous necessity) and not depend solely on elaborate planning and control systems. The number of intervention points varies, but is characterized by an acceptance of "chaos and replication in early investigations...(but at the) later stages, these managers have learned to maintain flexibility and to avoid the tyranny of paper plans."[6] We found that early conceptual planning is very decentralized to promote opportunities for good ideas to bubble up; whereas programmatic decisions following the approval for development/implementation were delegated to acquisition line management.[7] Smaller projects, such as product-life extensions or customer-unique appliques were more rigidly controlled by a formal, central decision process. Since these smaller projects were not central to the thesis of this research, we did not pursue this area in most case study efforts.

Supportive System.

Figure 1-2 also shows that in six out of seven cases a line manager had authority to make program decisions following BOD program approval. Approved programs were, therefore, no longer subject to program oversight by committee unless the approved baseline was expected to be breached. The environment was set for speedy and effective execution. In each of the companies visited there was a real *organizational commitment* to the success of approved programs. New product line development and capital acquisition programs are strategic commitments reflecting the company's future direction and emphasis. Such program go-ahead decisions are clearly communicated to all participants in the corporation. Along with vision and active involvement in creating and pursuing strategically essential projects, top management must *establish the environment for success*. This includes smaller projects which would fragment top management attention to oversee directly. Delegation of top management decision authority and resource control is the technique they use to provide smaller projects the same opportunity for success as major programs. Division presidents are the final decision authority on less-than-major programs once approved for development/implementation (e.g., BDIS case #7).

As stated earlier, the commercial marketplace severely penalizes companies which do not bring new products on line once the decision has been made to commit major resources (typically, entry into full-scale or detail engineering). The functional staffs, operational and program managers spoke of *shared goals and direction*. Functional organizations recognized that they were accountable to higher management for support of those programs. Managers of functional departments (e.g., VPs of marketing, engineering and manufacturing) were responsible for providing resources (the right people and technology) and assisting the PM in solving problems. They were not involved with program oversight and direction. Correspondingly, the program manager considered it to be in his best interest to accommodate the recommendations of departments such as engineering and manufacturing because they bring the best technical knowledge and experience to bear on individual program objectives.

For example, Sony feels top management must *manage the value system and atmosphere* not the details of all projects; nor should their staffs. Depending on the scale of projects, PMs should report as closely as possible to the management level making the critical decisions concerning the

project.[8] However, no "best management structure" evolves out of the literature. It is situational; various alternative approaches are needed depending on the projects, the market area and the people involved.

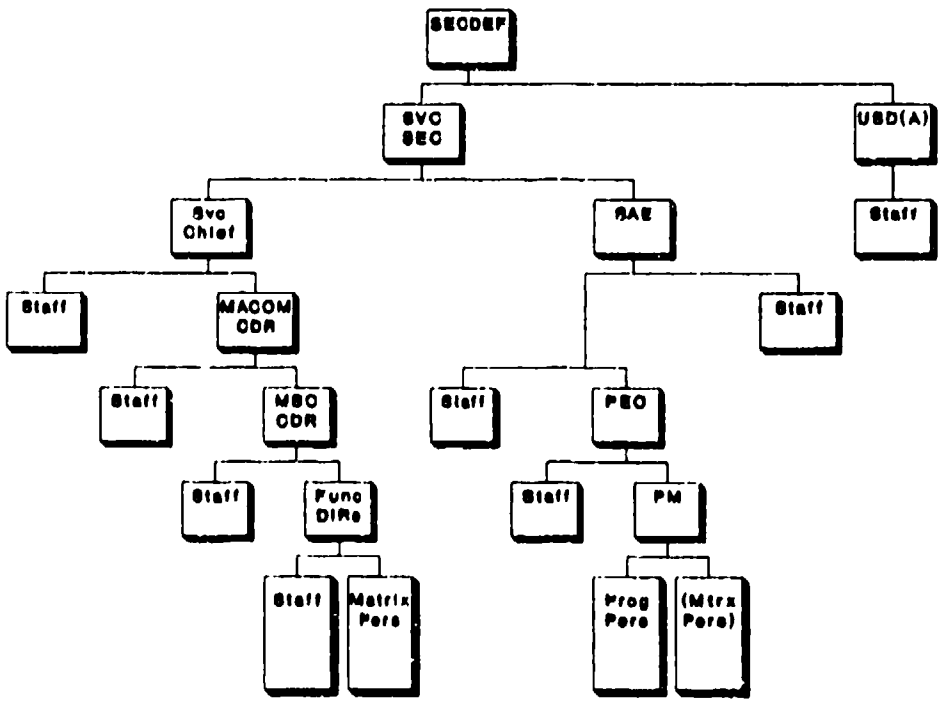
As a result of his investigation of decision-making in large conglomerates, Richard J. Marshuetz points out that these organizations must separate decisions supporting daily operations from those determining the future of the business (the same people who manage daily operations are not necessarily the right people to manage essential change). To do that the program management *process must be simple and efficient*. (Note, the process must be efficient, not necessarily the projects; we'll take that up later.) Typically, "business as usual" applies to daily operations but not management of essential change; that is the arena for line management.[9] There are sufficient layers of line management in DOD that a hierarchy of projects can be implemented, within resources, if line management takes appropriate actions.

A system that spreads program oversight and decision-making authority broadly, especially via large powerful staffs and functionally segregated organizations, but that fails to hold them accountable for program success, is counterproductive. Successful commercial companies recognize that staffs are necessary to manage ongoing business matters, but line management must assume the risks of change. In Chapter 3, the authority, accountability and oversight factors of stability will be treated in detail. They are mentioned here to establish the dependency on the environment set by top management.

DOD PRACTICE AND INHIBITORS

In DOD, it appears that our large senior staffs perform many of the roles associated with top management in the commercial world. There appear to be major distortions between the role of top management in competitive, commercial industries and DOD. In the former, the critical programs are recognized and made to work; in the

FIGURE I-3. DOD ACQUISITION MANAGEMENT ORGANIZATION



latter, it is often not clear which of the programs are critical. McDonough and Spital found three principle reasons for new project failures--appearance that success or failure *really doesn't matter* to top management; slips are *ignored*; and there is *no reaction* from top management to status reports.[10]

Historically, in the Services, systems acquisition has been an ancillary function of logistics support to the operation forces. As such, top Service management focused on other things; but, of course, had to approve major resource commitments. This beginning appears to have evolved to a *defense management system devoid of clear, CEO-like, top management*. Figure 1-3 depicts DOD's organizational structure for acquisition. The DAE is on the OSD staff; the SAE is on the Service staff, both are without control over the personnel resources who work for the military Chief.

The implementation of the PEO—the SAE relationship was very different in each Service; i.e., the Army PEO does not control personnel resources and, the Navy and Air Force PEOs have two different bosses.

The point here is that it is *not clear who should have and communicate his vision* as applies to acquisition priorities; this inhibitor contributes to those covered in Chapters 2 and 3. Senior, appointed managers in DOD and the Services are often transients who may never have the time to develop clear visionary strategy objectives which link to acquisition programs. One result is that the bureaucracy, the uniformed military and civil staffs, function in the absence of a clear relation to top management. These staffs and functional organizations have grown great institutional power which contributes to the Chapter 3 inhibitors. A second important result is that senior leaders and staffs manage via *committee consensus*, versus personally-attributable senior decision-making. This has bred a practice whereby individual decision-making is often ignored or watered down due to the continuous need to build and maintain consensus with the many heads of the bureaucracy; and committee consensus is rarely timely, especially when it must handle many diverse and complex projects on a continuing basis.

A typical, Services, commodity-oriented, buying command is responsible for support of current operations of fielded systems plus the design-through-implementation of new systems programs. (The Air Force is a major exception in this respect.) On one hand, we should expect feedback from current systems operating and support experience would be helpful in new systems. On the other hand, functional organizations (e.g., maintenance or supply-support directorates) must prioritize and standardize procedures for effectiveness and efficiency. They tend to institutionally impose many rigidly interpreted, *standard decision systems* optimized for dealing with support of fielded systems. This latter tendency flies in the face of effective innovation on systems in development.

SUGGESTED IMPLEMENTATION FOR DOD

Improvement in this fundamental area boils down to establishing who is in charge. Though layers of organization are a major complicating factor, the solution here is more one of delegation than reorganization. The practical authority of the DAE, in particular, is crucial. The DODD 5000.1 and 5134.1 must clearly provide the relationship of the DAE to the top DOD decision-making authority and DODD 4245.1 must similarly treat the SAE and the top Service decision-making authority. If these positions, DAE and SAE, are to be decision-makers, so state; if they are to be staff advisors to the Secretary, so state; but don't then confuse the direction with other names (e.g., Procurement Executive). This inhibitor is probably the toughest to fix, for many reasons, but it must be fixed if major improvement is intended. Suggested improvements in the following chapters do not depend on this one, but will be much enhanced if this problem is corrected. There are sufficient layers of line management in DOD that a hierarchy of projects by priority/resources can be implemented if a clear chain of authority for them is established from the top.

The 1986 Packard Commission concludes:

> "He (the PM) should be fully committed to abide by the program's specified baseline and, so long as he does so, the Defense and Service Acquisition Executives should sup-

port his program and permit him to manage it. This arrangement would provide much-needed program stability."[11]

Endnotes

1. *A Quest for Excellence, Final Report to the President*, p. 40.

2. Quinn, James B., "Managing Innovation: Controlled Chaos," *Harvard Business Review*, May-June 1985, p. 78.

3. Campbell, William H., CDR, USN, *Productivity Using Japanese-Style Management: Any Defense Industry Applications?* p. 31.

4. Interview with Carl Snyder, Director of Program Management, HP Computer Business Organization, Cupertino, Calif., March 21, 1989.

5. Interview with James Bruner, Director of PW4000 Engine Programs, Pratt and Whitney, East Hartford, Conn., April 14, 1989.

6. Quinn, p. 82.

7. This term means the program manager up through general managers to line vice presidents or division/business presidents; not all these levels are present in any one company.

8. Quinn, pp. 77-83.

9. Marshuetz Richard J., "How American Can Allocates Capital," *Harvard Business Review*, January-February 1985, pp. 87-88.

10. McDonough, Edward F. III and Francis C. Spital, "Quick-Response New Product Development," *Harvard Business Review*, September-October 1984, pp. 52-57.

11. *A Quest for Excellence, Final Report to the President*, p. 59.

2

ON-TIME COMPLETION

FINDING Schedule is first among cost/schedule and performance.

DISCUSSION OF THE FINDING

The 1985 DSB Summer Study on *Practical Functional Performance Requirements* found that in 5 successful, major commercial new product development programs differed from the typical defense program, of which 26 were analyzed, as follows:

* Financial and market considerations made schedule top priority

* Performance requirements are traded to hold schedule; block upgrades, P3I for new requirements

* Tendency toward proven technology as schedule is paramount

* Quick reaction to mandatory changes.

Of the primary criteria for success in major commercial capital investment or new product development projects, we found *on-time completion to be the first priority*. If the first entrant in a product field is considered to be a good value, it will sell. Product price and performance are the next most important criteria since the competition must bring in its competing products later at a better overall perceived value in order to take away market share from the leader.

Meet the Schedule

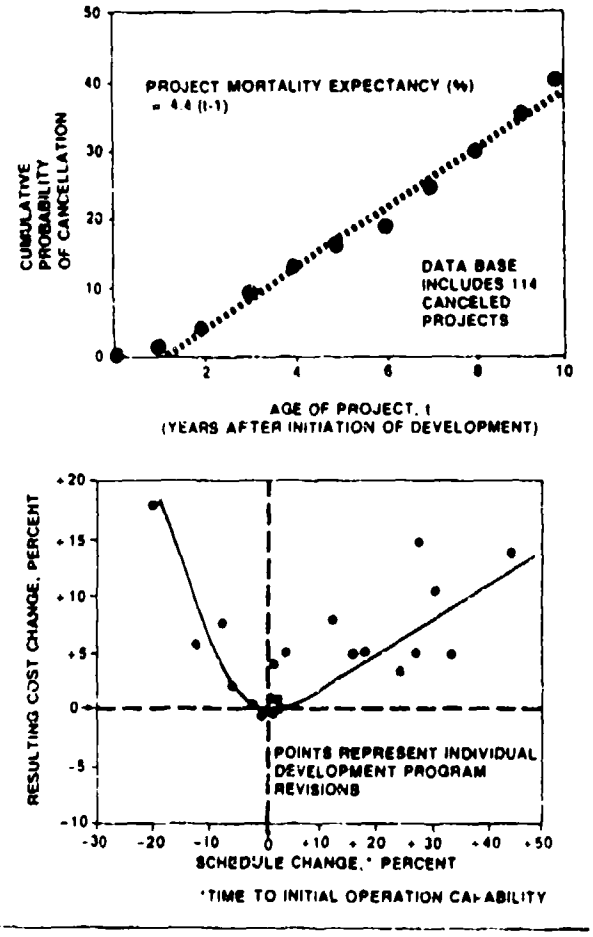
Without exception, schedule was the driving motivation, in the commercial acquisition environment, once a program was approved for development and/or implementation. This is not to imply performance or cost are ignored but, rather, they are considered principle variables which may be adjusted, following baseline approval, in order to meet the scheduled introduction. This practice is primarily market driven due to the implications of late entry on long term market share and the need to recover investment and overhead costs quickly. Seven out of seven first-hand commercial case interviews (Figure 2-1) systematically established a "must" schedule and traded cost and/or performance features to meet it.

FIGURE 2-1. COMMERCIAL CASE STUDIES COST VS. SCHEDULE VS. PERFORMANCE

Case#	1	2	3	4	5	6	7
Priority	Sked	Sked	Sked	Sked	Sked	Sked	Sked
Push Tech	Yes	Yes	No	Yes	No	No	No
Perf Trades	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Risk Buffer	10%	10%	10%	10%	10%	10%	10%

Program stability both enhances and is enhanced by a priority to on-time completion. First, a stable program can be executed more quickly than one which is continually changing or subject to change in an unforeseen way. Second, a project completed quickly is naturally subject to forces of change for the minimum time possible. Figure 2-2, borrowed from Norm Augustine's recent book *Augustine's Laws* shows that the absolute length of the program development schedule beyond its approval point is directly proportional to the likelihood of cancellation (left graph); and any attempt to change schedule (accelerate or stretch

FIGURE 2-2



out) will *always* lead to increased costs for the same capability.

The Final Report of the Defense Science Board, 1985 Summer Study, also concluded, "Schedule is paramount (in successful commercial programs), and resources—in terms of money and people—are planned to solve problems in an effort to hold schedule."[1] Two examples, previously introduced are:

—The PW4000, a $1B jet engine project, dependent first on completing development and FAA certification within 54 months of approval.[2]

—Nissan's Smyrna truck and auto plant, a $600M effort, required to be in full rate production within 42 months of groundbreaking.[3]

In industry, schedule is measured in *months, not years*. This related observation is significant in terms of tenure of program managers and senior decision makers. It is a "chicken and egg" problem. A short schedule facilitates maintaining tenure of management. Continuity in management reinforces rapid decision-making and thus, short schedules. If, as in DOD, system acquisition schedules are too long and management tenures are too short it becomes more and more difficult to acheive real program successes unless the reinforcing negatives (i.e., long schedules and short tenures) are broken.

Sufficient Performance

Performance features were next in priority. Successful non- DOD industry develops and proves-out new technologies and then introduces them into new products. *Sufficient performance* in terms of mission capability, supportability, life-cycle costs and unit costs, etc., was required. But *stretch goals* were also used, along with *contingency development* to facilitate trade-offs should the schedule be jeopardized or development costs become excessive. Typically, top commercial management recognized that not all technical goals could be achieved and *delegated to program management*, or first level general management, *authority to make required trade-offs*. The PM had authority to use the best technical support available in the company to assess relative costs and benefits of performance trades and to make timely trade-off decisions. Functional department chiefs supported program managers on performance trade decisions and in solving technical problems in a cooperative manner. Their motivation was frequently enhanced by pay incentives associated with program success.

It takes industry about 10-12 years to bring new technology into the market, so technology programs are usually separated from new product development. Preplanned product improvement and *evolutionary development* were the standard approaches to pick up desired technology or features not available at *planned schedule cutoff points*. The focus on new products is to get them into the market fast. This is done by applying available and *proven technology*. In this way, commercial industry takes low cost chances on small, new technology projects but few technical chances on new products or production capability which are too expensive to experiment on.

Planning for successful new products involves avoiding early detail since the design process is iterative and many decisions should be flexible so as to advantageously consider trade-offs as it evolves. Our first hand interviews with commercial firms established that seven of seven began development and implementation with flexible designs; seven of the seven indicated that they were prepared to, and did, trade off technical performance requirements for overriding schedule or cost reasons.

Flexible Funding

The commercial companies we researched had business planning systems not unlike our PPBS in most functional aspects. They were, barring major revenue problems, less constrained than DOD in committing funds over the full program investment phase. The keys to successful integration of business planning and stable funding in commercial business enterprises are: 1) realistic financial planning—using the business planning process in a disciplined manner to accurately forecast revenues and expenses, thus capital funding available; 2) selective advancement of program opportunities to BOD approved status—ensuring that all approved programs were affordable based on business planning; and 3) completing approved programs on schedule, thus supporting the program assumptions used in the business planning process.

Cost tends to be the buffer variable in the cost-schedule- performance criteria for measurement of project success in commercial industries. That does not mean cost is unmanaged; rather, budgeting is done to *expected cost* and *flexibility* is typically provided to acquisition line management to proceed as long as costs are within 10 percent of the approved budget. Robert N. Anthony and David W. Young, when describing management controls in non-profit organizations, identified two subactivities—accounting and performance. They attribute best accounting practice to include establishment of "guidelines" and not to focus on detailed resource breakdown (e.g., travel versus salaries versus materials versus contracts, etc.). *Best practice involves management authority and accountability* to meet project goals and *flexibility* to change plans, if needed. They also stated line management must have control over funds allocation and expenditure (versus funds control by functional management).[4] In six of seven out of our first hand cases, acquisition line management had direct funds control (if the PM didn't have funds control, his line manager did). This evidence reinforces the concept that fast, timely projects are predictable in terms of funding needs, and do more for effective cost containment than a priority focus on cost.

Of the twelve individual programs documented in the seven commercial case studies we documented, only two had overruns beyond 10 percent of the original estimated cost. The evidence strongly supports the conclusion that meeting schedule reduces risks of cost overruns by limiting expenditures for direct and overhead development costs.

DOD PRACTICE AND INHIBITORS

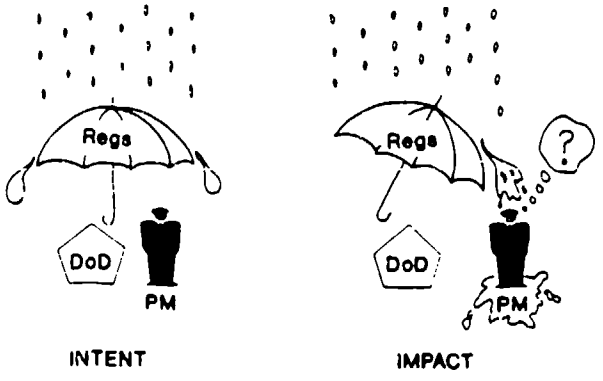
Of the fundamental criteria of project success, DOD, on the other hand, effectively prioritizes performance (overstated mission and administrative requirements and overly detailed specifications) and acquisition cost (or price) over quality. We have an institutional willingness to trade time for added funding or performance. Getting the "most bang for the buck" is not necessarily bad; but, it can be and is counterproductive if performance is optimized independent of cost and schedule objectives. Our historic failure to meet schedule objectives also promotes excessive requirements. Users must wait extremely long periods before their needs are satisfied; the further out requirements must be projected, the more technologically impractical they will be. If, in practice, system performance requirements are excessive they drive costs unnecessarily high and stretch out schedules.[5]

Typical DOD programs take 10-15 years to complete development, production and initial deployment. This is about twice as long as it takes to see fundamental changes in defense strategy goals with unique types and quantities of forces required to support it; and more than three times longer than line managers have to commit to executing approved programs. We must do something to turn this around or forego necessary force modernization in a constrained resource environment.

It is generally understood that DOD's systems are more complex than commercial. Thus, they tend

to suffer lower mean time between failure (MTBF) and availability, larger O&M costs and are produced in smaller quantities. The higher complexity and smaller quantities are sometimes unavoidable; but unnecessary complexity together with less mature production techniques (due to smaller quantities) may impact availability and O&M costs too much. Despite the obvious intent of functional departments and staffs at all levels of DOD to protect and "help" program managers deal with the complexity of new systems, they actually complicate the process and confuse PMs (Figure 2-3).

FIGURE 2-3. MANAGEMENT VIA DETAIL POLICY, PROCEDURE AND REGULATION



The impact of innumerable functional directives and regulations (many of which are countermanding of each other) is to dump more requirements on the programs in the form of excessive single interest "-ilities" which drive the total performance envelop, thus the time and cost to implement.

The job of trading-off counterproductive elements of performance is extremely difficult for most DOD PMs. The typical DOD PM is a colonel or Navy captain; whereas the "-ilities" functional specialists have, and use, their senior executives (who are usually generals, admirals and SESs) to support them. Thus, performance trades are forced up into "Flag Officer" channels or are not accomplished. We should not become slaves to unrealistic schedules; but we will perform better if we have an achievable schedule objective which is not compromised by inflexible, bureaucratic procedures.

We have an institutional aversion to budgeting for risk and contingency. Though the Congress has acted to permit a 15 percent cost growth in development on Defense Enterprise Programs (5 percent in production), as part of its milestone authorization process, the PPBS decision process doesn't provide such flexibility. Typically, any risk buffer is pulled out and committed elsewhere. Thus, when needed, it requires contributions from other "bill- payers," which ripple down through programs. Perhaps more important is our aversion to committing funds more than 1 year into the future, thus, limiting flexibility to change priorities annually. This latter destablizing effect is well documented and is above DOD's authority to direct change.

SUGGESTED IMPLEMENTATION FOR DOD

The DOD can simplify procedures and facilitate success in executing essential programs. We can simplify all programs, major and non-major, via disciplined, program specific decision-making (i.e., establishing priorities among programs and internal program objectives) from the top-down. The milestone decision process must establish the essential cost, schedule and performance criteria for the program. Best commercial practice suggests that: 1) performance should be treated with minimum detail, not reems of standard "-ilities" references; 2) a realistic schedule should be established; 3) with funding guaranteed for the duration of at least the development phase; and 4) the funding commitment should provide a buffer to the program manager to give him some flexibility to perform trade-offs and optimize the total equation.

Figure 2-4 portrays several interrelated features of *what could be* our PPBS and acquisition management systems. The diagram is adapted from one seen at HP's Computer Business Organization. We need to link decisions made in the acquisition management process to constrain future decisions in the PPBS process. To be fully consistent with successful commercial businesses, approval occurs at what effectively is our MS II for developmental programs (MS III for NDI programs). The diagram shows PPBS driving funding availability up to MS II, then being driven by acquisition program decisions at MS II and beyond. Implementation of this improvement would en-

tail phasing in Defense Enterprise-like Programs at all levels (major and non-major) with milestone-authorized stable funding for clearly essential programs. Key to this implementation is disciplined decision-making based on realistic planning and programming, and institutional follow-through based on commitment to and communication of strategic priorities.

Practical baselining of new systems requires a professional, disciplined organization and process. The suggested improvements of this chapter and Chapters 1 and 3 are so interdependent, a fuller treatment is provided in Chapter 4.

Endnotes

1. Defense Science Board 1986 Summer Study, *Use of Commercial Components in Military Equipment*, January 1987, p. 10.

2. Bruner interview.

3. Campbell, p. 30.

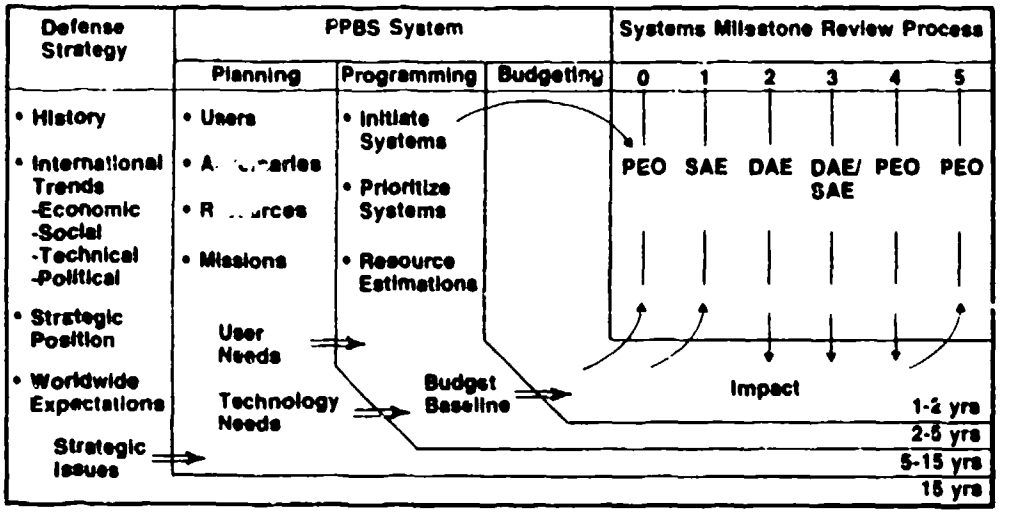
4. Anthony, Robert N., and David W. Young, *Management Control in Nonprofit Organizations*, pp. 537-541.

5. Cohen, Barry L., CMDR, USN, and Stewart L. Manley, CMDR, USN, *An Evaluation of the Packard Commission Recommendations Encouraging Commercial-Style Competition and Expanding the Use of Commercial Products*, p. 2.

6. A general conclusion drawn from the book by Robert P. Haffa, Jr., *Rational Methods, Prudent Choices: Planning U.S. Forces*, December 1988.

FIGURE 2-4. LINKING DEFENSE STRATEGY, PPBS, AND MAJOR SYSTEMS ACQUISITION MANAGEMENT

Objective: Provide capable systems to our users, efficiently and on time.



The MS II (MS III for NDI programs) is the critical point in the life of a program where the baseline is defined and committed. The PM/PEO should be given flexibility and authority to make trade-offs to achieve an optimal mix of cost, schedule and performance within flexibly defined limits (the MS II baseline agreement). This improvement depends on how the program authority, accountability and resource control aspects of Chapter 3 are handled.

The key policy directives applicable are DODD 5000.1 and 5000.45 which should be revised to emphasize stability and flexibility. Many lower tier directives and procedures detail how to do many of the "-ilities;" these need to be consistently treated in order to emphasize objectives and facilitate effective, tailoring to individual program, acquisition strategies.

3

PROGRAM AUTHORITY, ACCOUNTABILITY AND RESOURCE CONTROL

FINDING Program managers are afforded significant authority and resource control, and are held personally accountable.

DISCUSSION OF THE FINDING

1986 Packard Commission: "We must give acquisition personnel more authority to do their jobs. We must make it possible for people to do the right thing the first time and allow them to use their common sense."[1]

1986 DSB Summer Study: "The commercial program manager has very great authority and responsibility. His review levels are very few—2 or 3 at most."[2]

We found that program stability in successful commercial projects is fundamentally dependent on *clear delegation of program responsibility, authority, accountability and resource control.* Accountability, as used here, includes line management's accountability and the accountability of all program participants (e.g., functional specialists, functional management and senior staffs) for program success. Resource control is further narrowed to mean control of participants; funding stability is not a central focus of this study due to the reality in DOD that funding is not going to be independently stabilized without statutory changes; materials are not a central focus for DOD acquisition programs because most of that is provided by the prime contractor involved. The other primary resources, time and technology, we've addressed in preceding paragraphs.

Enable Line Managers

Program management authority in commercial systems programs is assigned to a clearly visible acquisition line manager whose title may be program/project manager (PM), vice president (VP), or general manager (GM). Program authority was not shared with functional managers. Acquisition line managers generally are "captains of their ships" held responsible and accountable for the success of the project but given the authority to: 1) make timely decisions and, 2) control critical resources (especially participating personnel). This finding is intrinsically tied into the findings in Chapter 1. Our first-hand interviews (see Figure 3-1) established no consensus on (1) absolute authority to the project manager (PM), (2) who has absolute control of program resources nor, (3) showing clearly the "best" project management organizational approach. The best commercial practices in this area of authority and accountability go deeper.

FIGURE 3-1. COMMERCIAL CASE STUDIES AUTHORITY AND RESOURCE CONTROL

Case#	1	2	3	4	5	6	7
PMO	Ded.	Matrix& Ded.	Mix	Matrix& Mix	Mix	Mix	Matrix
Type PM*	PM	PC or PM	PM	PC or PM	PM	PC•	PC•
Res. Auth'y	PM	GM or PM	PM	VP or PM	PM	Matrix	PM

*PC no control; PC• some control, PM full control

Best commercial practice is to place authority and resource control in the hands of acquisition line managers; then, they are fully accountable for

program success. Career success of the PM in the company is linked to his project, but bad news is not punished. Problems discovered as the project progresses, if reported quickly and accurately, do not reflect poorly on the manager. Hiding problems, even if the project is deemed a success, would result in separation from the company. At Tektronix, for example, there was a 50 percent overrun in a critical, major capital project which was not reported by program management to corporate management; responsible line managers were replaced, but the company philosophy and system of total project authority and resource control to acquisition line management was not changed. The real issue was not the overrun; it was the matter of line management failing to report a cost problem, thus surprising top management when it was too late to consider alternatives.[3] This example applies as well to the environment (Chapter 1) for program success; the rules were not changed just because someone disobeyed the old rule.

Jerry L. Chapin, in comparing major program management at John Deere, HP and Boeing with DOD, attributes small central staffs and line management authority and accountability as best business practices.[4] In a recent example, McDonnell Douglas Aircraft Company was reorganized to remedy a burgeoning $26B backlog in orders to "end the fingerpointing and frustration caused by lack of authority and accountability." The solution included elimination of all five senior vice presidents and provided each aircraft program with departments for engineering, finance and procurement. The latter change was made to avoid delays in ordering parts, hiring people and getting other necessary support.[5] The lesson here is *to enable line acquisition managers.*

Focus Responsibility

Successful commercial programs are also dependent on focused decision-making up the line; PMs of major systems have and use direct access to top management to keep the CEO, or surrogate (for example COO, a VP or GM), up-to-date and to resolve problems beyond the capability of the PM. Staff review of the program prior to PM access to the CEO is unusual since it would fragment line management's responsibility and slow down decision making. Senior functional officers (e.g., VPs of marketing, engineering, manufacturing, etc.) are charged with providing support to line management but not direction of lower-line program management. The primary support they provide is experienced, professional personnel to give the PM every opportunity to get it done right the first time.

Quinn observed that bureaucrats require many approvals in the "name of efficiency." Successful, competitive, commercial businesses know that such "efficiencies" are not affordable in a competitive marketplace. Some inefficiencies are directly attributable to the way a specific program is run but the concern here is the inefficiency systematically imposed on all programs by a large bureaucracy if it is not held accountable for project success; nor is it accountable for the overhead costs it embodies.[6]

In another recent example, Goodrich announced the elimination of many vice presidential positions and staff; the new CEO observed that "The company had VPs of every function imaginable" when he joined the company. He systematically went about eliminating most of the people in "approving" types of jobs. He recalled that when he had been a division general manager he had to obtain corporate approval for $25,000-plus purchases.[7]

As seen in Figure 3-1, matrix management or a mix of some dedicated project staff with matrix support is normal. The way industry provides the professional work force to the PM is to *focus the responsibility of matrix functional managers* and make them accountable for program success. The result is they provide responsive support or must answer to top management directly. Companies visited seemed not to require frequent top management intervention to solve people problems because everyone understood the vision and top management's commitment to successful projects. As well, these *functional departments are given no project oversight role;* they are a resource provider. Their only means of contributing to project success is to be responsive to acquisition line management, not by finding fault.

During our interview with the PW4000 Program Director, he was asked about the role of senior functional management; specifically, what reports were required of him to assure them of proper execution in their functional area? His answer was

in line with that of other companies visited but still surprisingly concise; it was: "I don't; they assure me!"[8] Successful commercial companies typically minimize project reporting requirements to those essential to keeping upper *line* management informed. The companies we visited did not formally involve functional management in the post-approval program review and decision process.

Experienced People

> **1986 Packard Commission**: "Generally, commercial program management staffs are much smaller than in typical defense programs, but personnel are hand-selected by the program manager and are of very high quality. Program staff spend their time managing the program, not selling it or defending it."
>
> "They involve, above all, trust in people. They involve the belief that people in an organization want to do a good job, and they will, if given the opportunity..."[9]

A key prerequisite for decentralized management control is an *experienced professional acquisition work force*. Successful businesses appear to employ such a work force on projects which are determined necessary to the future of the business. Project manager selection criteria varied across the companies visited. But there was a strong tendency to appoint a technically oriented PM for the early "sell" phase leading to project go-ahead decision and then replace him with a strong "organization" (business or production) oriented PM to implement and initiate operations.

Commercial businesses (e.g., GE, P&W, Tektronix, HP and Nissan) also focus much attention to prequalifying and selecting the right people into support positions on project dedicated staffs or from matrix departments. They also intentionally kept the skill categories few, preferring generalists who can appreciate the project goals over the narrow disciplines traditionally available from functional departments. Mr. Quinn also observed (during several years via many industry case studies, including Sony, IBM, AT&T, Intel, HP, 3M and Honda) that a clear long term vision by top management will attract quality people, focus creativity and channel action to the high payoff opportunities.[10]

The best available people are recruited for the program support positions and they are accountable to only the PM. Their best efforts are orchestrated by the PM and compromise among competing interests is handled at that level, not by the corporate functional staff. Senior level (corporate staff) expertise is invited by the PM, not the supporting functional specialists, if help is needed.

Though virtually all companies were matrix organized, with many functional specialists assigned to programs in a task organized fashion, all functional personnel assigned to support a program look only to the program manager for program direction and decision-making. Program managers, in turn, depended on the expertise and recommendations of their assigned functional specialists.

DOD PRACTICE AND INHIBITORS

A key difference between best commercial practice and typical DOD practice is that commercial projects encourage compromise and consensus building up to the point that the program is approved, then all participants support the solution. In DOD, typically, the functional specialists continue attempting to optimize according to their special interest and are supported in doing so by policy (e.g., each OSD functional staff office publishes detailed procedures for all components to follow; these are translated and "enhanced" by Service and command level regulations) and reporting structure (OSD, the Services and all levels of command have staff functional chiefs, some of which are entitled "advocates"). Resolution of conflicts over functional issues often depend on the Secretary's personal involvement and decision, one case at a time. This is very impractical due to time constraints on the Secretary, so many counterproductive compromises are agreed to if only to get on with something; lost is the optimal, tailored solution. The DOD acquisition culture has become one of extremely strong central control of the details of execution via committee consensus. The overwhelming strength of our senior functional staffs has robbed: 1) PMs of any significant discretion in making program execution decisions and, 2) functional participants of opportunities to compromise in the best interest of the program.

Functional and special interest advocates exert

significant influence over the systems acquisition process. They often can stop or delay actions to ensure their particular interest is accommodated; and the defense bureaucracy is constructed so the senior advocates outrank many PEOs and most PMs. This latter feature causes PM/PEOs, who may disagree with senior advocates from time-to-time, to have to consider career-risking, "fall-on-your-sword" encounters with top acquisition line and staff management every time (it could be often) there are disagreements.

Economic utility theory provides a useful means of analysis of our advocacy situation.[11] It stipulates that each program participant has a unique set of indifference curves which , for example, represent his willingness to trade off program performance and schedule (cost is held constant for this example). The participant is equally satisfied anywhere along a curve, but feels better off on a higher curve. The point of tangency between the program budget line and the highest utility curve provides the optimal point for the participant whose indifference curves are employed.

The dilemma is to identify the participant who is best able to evaluate this trade-off. Whose utility function should be maximized?

Figure 3-2, for example, represents the impact of compromise between a program manager and a special interest advocate or narrowly defined functional participant. The graphs are simplified to show performance versus schedule indifference at a constant cost. Here, performance is a composite of mission performance and all "-ilities" which impact the work effort on the project. The left graph shows at point O(PM) the optimal intersection of the program budget line with the PM's utility function at U = 4. The right graph shows that the same budget line applied to a functional specialist's utility function yields an optimal utility at O(F) where, coincidentally, his U = 4; his indifference curves are significantly biased toward some added performance feature(s) and a willingness to trade schedule as necessary for it. Attributing such bias may seem unfair but it is typical in DOD given the direction of accountability of many functional specialists. The O(C) is a hypothetical compromise along the budget line between the PM and the functional specialist. Of course, compromise yields less utility for each participant, U(PM) = 3 and U(F) = 3, in this case. This compromise process is healthy if concluded prior to program approval; but is unhealthy if it continues following that point.

FIGURE 3-2.

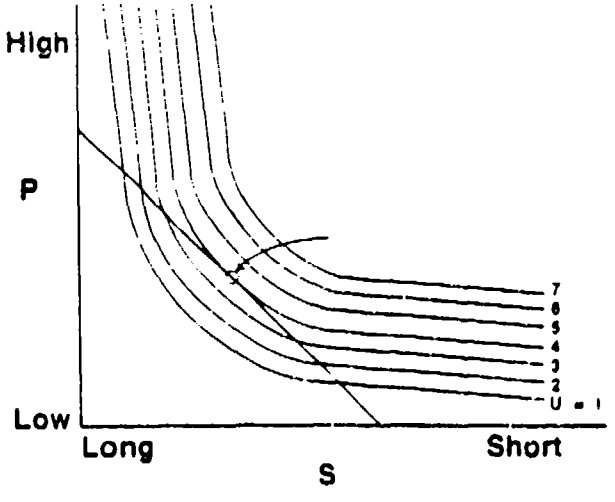
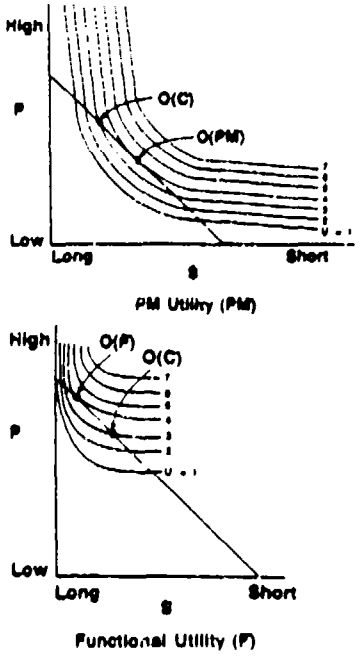


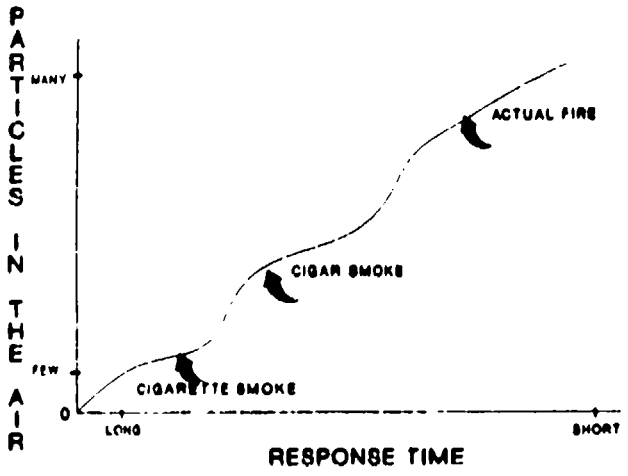
FIGURE 3-3.



Considering the impact these advocacy offices have on the program decision process, it is important to understand their genesis. They largely evolved in response to some real or perceived problem.

Conceptually they can be considered like a fire alarm system:[12]

FIGURE 3-4. FIRE ALARM



This graph shows the trade-off between the alarm sensitivity setting (which represents a special interest being advocated) and response time (representing the impact that failure to accommodate the special interest may trigger). A low alarm setting (greater sensitivity) provides more response time in the event of a real fire but also may result in false alarms; false alarms tend to reduce attention given to the alarm system.

As problems are identified in the defense acquisition system, alarm settings have been made more sensitive to prevent possible reoccurrence. However, in doing so, the effectiveness of the system to identify real problems or make practical trade-offs between conflicting special interest demands, has been reduced.

Rosabeth Kanter, in her 1983 book, *The Change Masters*, defines two different organizational cultures: 1) the "integrative" organizations which minimize conflict between subunits; whereas, 2) the "segmentist" organizations which are anti-change and compartmentalize issues and people. The "segmentists" approach, where the subunits are kept separate from each other, causes hostility and difficulty in achieving consensus.[13] The segmentist attitude pervades defense acquisition. we have evolved to the point that most DOD participants in systems acquisition are checking to see what the other guy is doing wrong. Compromise is required continuously in order to overcome the short memories of transient participation at all levels. The incentive for many seems to be, "How can I keep anything from going wrong on my shift?" Instead, it should be, "How can I help this program succeed?"

Another important inhibitor to professional functional expertise to PMs in DOD is the civil service system which requires people to be promoted to earn more money. Promotions are tied to organizational positions; the higher grade positions are on headquarters staffs, not in program or functional operations offices.

The myth that fewer functional people can accomplish more in a part-time, indirect, consulting role has further reduced the effectiveness of defense acquisition. All programs are not alike; to effectively tailor standard solutions to program unique situations requires functional knowledge, program experience and an ability to trade-off. Typical, offsite matrix management approaches preclude functional participants from gaining program experience and from feeling a part of the program they must support. It boils down to there being no positive motivators for such matrixed personnel to do their best and to accept some risks.

SUGGESTED IMPROVEMENTS

Following approval for a program to enter full-scale development, the PM and PEO should be empowered to use the best expertise available to them to solve problems and perform trade-offs as necessary to complete the program within baseline constraints and without independent program oversight and direction from functional staff managers. The SAE or DAE should be kept informed of progress and problems, directly by the PM, on a quarterly basis. The SAE or DAE should then be the link to the DRB and the Congress should there need to be a significantly altered program baseline.

Implementation of this improvement would entail the decision-maker, at MS II, committing to the program baseline with all subordinate acquisition line managers and ensuring the baseline objectives were sufficiently prioritized that acquisition managers had flexibility to solve problems encountered during execution.

Professional functional support to program managers should be strengthened and the need for staff functional oversight of program execution greatly reduced. Professional functional expertise should be assigned in *direct support* of program management. The thrust of this improvement is to implement, within DOD, a system whereby top functional executive staffs are primarily focused on creating and managing a system to educate, train and govern the careers of acquisition professionals. Such a system would provide PMs and PEOs the functional expertise they need to plan, organize and direct programs right the first time and be much less dependent on program review by functional managers at all levels. A collateral benefit is that programs would be less exposed to the diffusion of responsibility associated with committee decision-making.

Matrixed, functional, program support personnel should be dedicated to programs through organizational alignment and incentives. To the maximum degree possible, matrixed personnel should work full-time for, and be rated by, the PM. In some of the Services and many subordinate commands, functional acquisition specialists and PMs/PEOs have different chains of command. The thrust of this suggestion is to provide PMs and PEOs the functional expertise they require, and deserve (dependent on program priority) to plan and execute the program. The policy should be in the form of principles and goals, not directives, due to the need to provide flexibility to local commanders to optimize the use of scarce personnel expertise. Adoption of this approach should reverse the growing trend in some commands to place functional participants (even those full-time on specific programs) under the control and evaluation of the functional matrix manager.

Endnotes

1. *A Quest for Excellence, Final Report to the President*, p. 42.

2. DSB 1986 Summer Study, p. 10.

3. Interview with Alan Patz, former Director of Finance and Operations at Tektronix, Beaverton, Ore., March 30, 1989.

4. Chapin, Jerry L., *Government and Industry System Development Models: A Review and Comparison*, p. 33.

5. Valente, Judith, and Roy J. Harris, Jr., "McDonnell Douglas, Flush With Orders, Overhauls Management of Aircraft Unit," *Wall Street Journal*, Feb. 15, 1989, p. A6.

6. Quinn, p. 77.

7. Deutsch, Claudia H., "Goodrich Finally Gets It Right," *The New York Times*, March 12, 1989, pp. 1, 8 (business section).

8. Bruner interview.

9. *A Quest for Excellence*, pp. 42, 50.

10. Quinn, p. 78.

11. Browning, Edgar K., and Jacquelene M. Browning, *Microeconomic Theory and Applications*, Boston: Little, Brown and Co., 1983, Chapter 2.

12. The convention was suggested by Dr. Elizabeth Pate Cornell of Stanford University in several articles dealing with building codes for earthquakes and the dangers of nuclear waste.

13. Dean, James W., Jr., *Deciding to Innovate - How Firms Justify Advanced Technology*, pp. 25-27.

4

DOD ACQUISITION POLICY

WHAT IS IT?
HOW SHOULD IT BE IMPROVED?

1986 Packard Commission: "The program manager finds that, far from being the manager of the program, he is merely one of the participants who can influence it. An Army of advocates for special interests descends on the program to ensure that it complies with various standards for military specifications, reliability, maintainability, operability, small and disadvantaged business utilization, and competition, to name a few. Each of these advocates can demand that the program manager take or refrain from taking some action, but none of them has any responsibility for ultimate cost, schedule, or performance of the program. None of the purposes they advocate is undesirable in itself. In the aggregate, however, they leave the program manager no room to balance their many demands, some of which are in conflict with each other, and most of which are in conflict with the program's cost and schedule objectives. Even more importantly, they produce a diffusion of management responsility in which everyone is responsible, and no one is responsible."[1]

In this chapter we look at recent congressional guidance and statute as applies to program stability then assess DOD's major applicable directives and instructions.

Congressional Guidance. Though there are several statutes and implementing regulations controlling relatively detailed aspects of procurement practice, recent congressional guidance and statute are noticably in line with our previous descriptions of best commercial practices as applies to program stability: (1) baselining; (2) multiyear authorization commitments, (3) Elimination of the need to follow policy and regulations and reduced reporting channels for PMs of designated major programs; (4) the need for a plan for improving professionalism in acquisition managers; (5) buffers in cost threshholds and milestone dates; (6) limits in SECDEF authority to stretch out programs solely for budgetary reasons; and (7) direction to SECDEF to review all programs transitioning from development to production by 1993 to minimize the demands for very limited funds. These are all statutory attempts to get DOD to stabilize major programs. Limiting aspects of these laws include the emphasis on independent Cost Estimating and Operational Testers. Though these latter constraints do run counter to best business practice as they impact DOD leadership, the general thrust is for DOD to implement stabilizing features in major programs. Some of the committee language accompanying the acts indicates congressional intent to ultimately mandate more stability yet, to wit: (1) HASC and SASC desire for all major programs to be milestone funded; (2) joint authorization conferees desire for SECDEF to make recommendations to reduce test time and eliminate philosophical problems in current test approaches. (3) The SASC encouraged SECDEF to develop a system whereby PMs and contracting officers have appropriate decision-making authority and greater impact on the PPBS process; (4) the Congress chided DOD for not linking programs to strategy, policy and operational concepts.[2] If the latter is not considered fair criticism, then DOD should clear up the appearance of lack of continuity between strategy, policy, operational concepts and system acquisition programs.

The DOD Policy

Next, we evaluate the key DOD acquisition policy

which tends to promote instability despite its stated goal of facilitating stability. The top two DOD policy documents dealing with acquisition are DODD 5000.1, "Major and Non-major Defense Acquisition Programs," and DODI 5000.2, "Defense Acquisition Procedures." The former captures, fairly concisely, the essence of congressional guidance, but with many counter-stabilizing measures. The latter is, as entitled, a procedures document. We will not repeat the contents of these documents but critically identify aspects which appear directly contrary to the effective adoption of best commercial practice in defense acquisition.

(1) The DODD 5000.1 directs the policies, principles and objectives in managing major DAPs be applied to non-major DAPs. However, *the principles and objectives are not stated*; they should be, as lower-level staffs tend to overapply detailed policy and procedures when in doubt. (2) The DAE is described as an advisor; the SECDEF is the decision-maker. This appears contrary to the Packard Commission recommendations. With the SECDEF, USD(A), Service Secretary and SAE in the chain of command and authority for defense acquisition, there are six *levels of acquisition line management* in DOD from the PM to the SECDEF; each layer has a staff checking on the efforts of lower managers and staffs. What's wrong with SECDEF and Service Secretary permanently delegating acquisition systems decision authority to the DAE and SAE respectively? (3) Five phases, with six DAB milestone reviews are directed. This conflicts directly with best business practice of two or fewer go/no-go program decisions; these should be our MS II and MS III at maximum. We cannot afford, any better than industry, to second/third/fourth/etc.-guess our approved programs. The MS 0, MS I and MS IV reviews are appropriate but should not be DABs. These reviews should be left to the PEO and user communities. The MS V is a duplication of MS 0 and should be eliminated. (4) Affordability should not be reconsidered at each milestone, only once; MS II is optimal with adjustment at MS III if necessary. (5) The ten DAB acquisition committees diffuse responsibility from line management and set an example for lower executive staffs. The requirement that they use senior staff consensus to identify program issues and make recommendations to the USD(A) thence to the SECDEF ensures time is wasted while line management is put through a wringer. These committees should be reduced and redirected to review and advise the DAE but not have any directive power over programs. For example, they should not meet with the PM/PEO/SAE prior to and separate from the full DAB. Senior functional staff, freed from these committees, could then be assigned to proactive work in managing the career system for acquisition specialists, or to PM and PEO staffs. (6) The Directive subordinates Acquisition Decision Memoranda (ADM) to the PPBS without qualification; PPBS should be subordinated to ADM baselines from MS II-on.

The DODI 5000.2, the second acquisition policy in precedence, is a procedure. If a staff procedure is necessary, and it probably is, it should be an internal OUSD(A) SOP; it should not be applicable directly to the DOD components. The bulk of the document directs procedures for milestones and the preDAB process for which the latter should be discontinued. Those enclosures which would still be revelant to the DAB main decision reviews (MS II and III only) could be appended to DODD 5000.1.

The DODD 5000.45 and 5000.52 are key policy directives directly impacting the culture of defense acquisition. The former establishes baselining, whereas the latter establishes certain objectives for acquisition career management. They both need strengthening to establish the intent to provide authority, accountability, resource control, and reasonable flexibility in the management of defense acquisition programs.

This criticism has been brief and direct; there are at least 50 second- and third-tier DOD directives and instructions (and hundreds at lower tiers) that add excruciating detail to OSD acquisition policy and cascade down to Service staffs who must implement via service directives, regulations and procedures. All these should be reviewed keeping in mind to eliminate or redirect are procedures for internal OSD staff.

For DOD to emulate best commercial practices will be difficult because the true solutions will cut deep into our bureaucratic organizational overhead. Successful commercial companies are lean; DOD is fat. To begin providing effective

authority and accountability to acquisition management, functional staffs must be removed from program oversight and direction roles.

> "The fundamental intent of the (Packard) Commission's recommendations is to simplify the acquisition system by consolidating policy and oversight, reducing reporting chains, eliminating duplicative functions and excessive regulations, and establishing an environment in which program managers and their staffs can operate as centers of excellence. This should allow for a substantial reduction in the total number of personnel in the defense acquisition system, to levels that more nearly compare with commercial acquisition counterparts. Eliminating a layer of management by moving the functions and people of that layer to some other layer clearly will not suffice."[3]

Thus, stability in defense acquisition programs boils down to the presence of strategic goals which top management has committed to—a full organizational commitment to on-time completion, and the clear delegation of top management's authority to acquisition line management to get it done. Congressional impact upon DOD system acquisition is probably exaggerated. Yes, the Congress does overly micromanage projects; but it is less likely to step in if it, too, can identify the strategy goals of the project and, most importantly, it is confident that the project will deliver a satisfactory product, on time and within cost allowance.

An Example, Mobile Subscriber Equipment

It can be inferred from our comparisons of successful program management in commercial companies and in the DOD environment, that there is room for improvement in DOD acquisition policy. Without enumerating all problems (that would take more room than appropriate here), an example of a major Army program ultimately designated as a Defense Enterprise Program may be illustrative. As part of our research, we investigated the Mobile Subscriber Equipment (MSE) program and a case was developed which is included as Appendix G. The MSE acquisition strategy was an experiment by then Under Secretary of the Army (USA), the Honorable James Ambrose, prior to the aforementioned congressional acts, but which incorporated many of their features. A look at the features of the MSE case is instructive to see what good business practices were employed and several that were not (see Figure 4-1). Many techniques like those attributed to best commercial practice were used in MSE with the result that it has been much more stable than most major DOD programs. However, we will focus on commercial practices that were not employed as they illustrate the essence of some remaining problems. Do not miss the point that MSE is exceptional in the degree that innovative, good business practices were used. A reading of the MSE case will underscore the institutional difficulties MSE encountered in employing many good business practices even with top-level commitment and support. Unfortunately, just because practices (see Figure 4-1) were used to advantage in MSE, it would be wrong to assume DOD has institutionalized them. Rather, the good techniques used in MSE were due to extraordinary top-management efforts and an unusually long, stable tenure of key program management personnel.

FIGURE 4-1. COMMERCIAL STABILIZING FEATURES OF MSE ACQUISITION

1. **Those employed:**
   - **Schedule prioritized over performance**
   - **Top management (SAE) involvement**
   - **Freedom from policy, regulation**
   - **Fewer Go/no-go decisions (effectively 3)**
   - **Flexibility to use program savings**
   - **Test schedule flexibility**
   - **Competed once for life of program**
   - **Used available production technology**
2. **Contrary practices employed:**
   - **Special interest and functional staff oversight**
   - **No buffer to bottom line cost (Congressional cap)**
   - **PM/PEO continual fight for people and travel funds**

The Under Secretary of the Army made the unique acquisition strategy work for MSE. The PM and later the PEO, once appointed, are more like project coordinators than directors. Due to the Army's implementation of the PEO concept and,

within AMC, the simultaneous restructuring of the functional matrix, there was a need for the PM, with PEO support, to continue to fight for people resources and travel funds and with senior functional and special interest executives to stay with the program baseline and acquisition strategy decisions made by the Secretary of the Army when he approved entering full-rate production in 1985. The DEP designation helped force practical trade-off decisions, but they had to be made at the major general level and above (the PM is a colonel; the PEO is a brigadier general) to override the institutional biases of the lower-level acquisition bureaucracy. These lower-level functional staffs continue to try to standardize the "-illities" aspects of the program rather than proactively applying their innovative, functional expertise to optimize program success. The PM, Colonel John Power, has committed to seeing MSE through deployment. In doing so, he provides the continuity essential to a management system which quickly forgets earlier program decisions. His tenure as PM, MSE is expected to be 5 years—about twice the norm for PMs and key program participants in the Army.[4]

Conclusion

If we in DOD can clearly link each major acquisition to the strategy supported; if we can show the product being acquired is a practical, sufficient product; and we remain on a practically achievable schedule; we should expect the Congress to recognize the need to continue necessary funding. If DOD top management can prioritize systems needed and plan around reasonable funding levels for all programs, then the project managers of those truly essential systems can focus on system capabilities and on-time delivery. The authority requirements for acquisition line-management success are really just good people-management techniques. It is through our people that we conceive, plan and implement projects.

We have recommended that acquisition line managers be given clear authority to implement approved projects without the intercession of independent review authorities and senior staff bureaucrats, and be given the functional personnel resources to get the job done right the first time. Inherent in this recommendation is the understanding that not all programs are needed "now" and that top DOD management must decide which ones must be accomplished and when, and communicate these decisions to the field.

Our recommended authority and resourcing approach demand that all program participants be directly accountable to an acquisition line manager. These acquisition line managers are few by law; they are: the Project Manager, the Program Executive Officer, the Service Acquisition Executive, the Service Secretary, the Defense Acquisition Executive, the Secretary of Defense, and the President (the SECDEF and Service Secretaries could be eliminated via proper delegation of authority). Staff executives and staff officers, by definition, are not in the line-management chain; therefore, they must not have power to influence programs executed at lower organizational levels, except through line management and then only via policy, not program specific, direction. This recommendation would remove staff elements from any review or approval role as pertains to individual programs. Staff responsibility must be to create and maintain concise policy so the acquisition system works for line management, thus facilitating the accomplishment of the programs and the strategic goals which are the domain of line management.

Each Service has implemented the PEO concept differently, but each approach can work, and work well, if the following inhibitors are removed:

—Staff executives who have direct program impact such as resource control (i.e., personnel, funds, schedule and other equipment) or program approval

—Functional personnel resources assigned and accountable to other than acquisition line management (e.g., directorates of the Services' materiel commands or subordinate commodity commands).

To effect such changes in DOD, which has grown a large number of executive staff directorates, the executive staffs must be reduced and functions limited. Also, the Services' commodity or product divisions and headquarters, which provide the functional participants to programs (e.g., engineers, contracting officers, logisticians, testers, controllers, etc.) must allocate their personnel to

acquisition line managers for the duration of needed services without imposing additional layers of program oversight. The key to an effective transition for such functional staff elements from program oversight roles to program support is to ensure professional development and experience of such personnel and program managers. This can be done without major reorganization by the senior functional staff at each organizational level, once properly led and directed.

A good beginning would include a total rewrite of DODD 5000.1, elimination of DODI 5000.2, and review of all DODDs and DODIs with the intent to eliminate most. Our recommendations to senior defense acquistion leaders for enhancing program stability are provided in the executive summary.

In conclusion, the 1986 Packard Commission report points out:

> "Instead of concentrating on the things that are being done wrong and trying to fix them with more laws, more regulations, more inspectors, DOD should concentrate on those things that are done right and use them as models."[5]

Endnotes

1. *A Quest for Excellence, Final Report to the President*, pp. 46-47.

2. Office of the Under Secretary of Defense (Acquisition), "Legislative Guidelines Data Base," January 1989. An analysis and summary of 1986-88 Senate and House legislation and public law.

3. *A Quest for Excellence*, p. 55.

4. Interview with Colonel John R. Power, USA, Project Manager, Mobile Subscriber Equipment, January 18, 1989.

5. *A quest for Excellence*, p. 42.

III

INNOVATIONS IN THE SOURCING PROCESS

III

INNOVATIONS IN THE SOURCING PROCESS

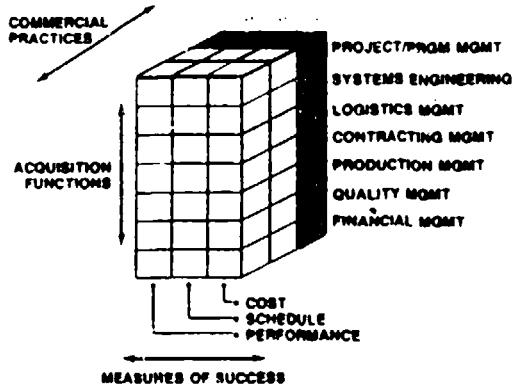
The previous section dealt with program stability as fundamental property of many successful commercial practices. The focus was on how companies internally manage a project in order to enhance the project's stability, and correspondingly, the project's chance of success. The management practices described were applicable to projects performed in-house as well as those performed by an external concern (i.e., contracted-out). Differentiation between in-house and external projects was not relevant in Section II, because the focus there was on project management practices internal to the company; practices found to be surprisingly consistent regardless of the source of the project's execution.

In this section we direct our focus external to the company, to the processes by which companies go about procuring or sourcing from outside vendors, suppliers, or subcontractors (terms which will be used interchangeably throughout). Like program stability, this area is a fundamental component of successful business management. In the context of our research model, this change can be characterized as a shift from focus on the stability "slice" of the model, to other "slices" representing various other commercial practices.

Several factors are at work in today's business environment, making this focus on external sourcing particularly relevant. First, companies are increasingly giving suppliers a greater "share of the action." In the manufacturing sector the amount of "action" placed with suppliers is currently 60 percent and rising.[1]

Second, the entire area of sourcing has been extremely dynamic over the last decade, with some fundamental changes, particularly in relationships existing between buyers and sellers in the commercial marketplace.

FIGURE III-1.



This change, perhaps best described as an evolution toward a more cooperative buyer/seller relationship, will be explored fully in this section. Specifically, the nature of the commercial buyer/seller relationship will be examined, then some lessons will be drawn for import into DOD's way of doing business. Chapter 5 examines the relationship as it pertains directly to the government purchase decision, with particular focus on how quality is made a viable factor of that sourcing decision. Chapter 6 will drop a level, and examine the relationship as it pertains to purely commercial companies and DOD contractors alike, as they make sourcing decisions.

Finally, Chapter 7 provides a brief discussion of the pervasive influence of government regulation on sourcing, and all other decisions, of defense contractors.

Endnote

1. Leenders, Michael R., and David L. Blenkhorn, "Reverse Marketing - The New Buyer-Supplier Relationship," *The Free Press*, New York, N.Y., 1988, p. 8.

5

QUALITY SOURCING

FINDING Price is but one element in the purchase decision.

DISCUSSION OF THE FINDING

The Packard Commission, identified the difference in approach toward price between the commercial and defense decision processes and suggested that industry practice could be adapted as follows:

> Commercial procurement competition simultaneously pursues several related objectives: attracting the best qualified suppliers, validating product performance and quality, and securing the best price...Defense procurement tends to concentrate heavily on selecting the lowest price offer, but all too often poorly serves or even ignores other important objectives.[1]

Throughout the United States there is renewed emphasis on the importance of quality in all aspects of the manufacturing and production process. Within the Department of Defense, this emphasis has been shaped within the framework of Total Quality Management as developed from the works of W. Edwards Deming, Dr. J. M. Juran and Mr. P. B. Crosby. Because this concept was successfully applied first in production and manufacturing organizations, it is not as clearly defined to defense purchasing. In defense purchasing there are countervailing forces based on law and regulation which restrict its full implementation.

We found that ownership costs and dependable quality are the dominant variables in commercial buying decisions. Purchase price was not ignored, but it was a variable which would be traded off for desirable features, uniformity and dependability.

Purchase decision-making in support of systems programs was decentralized and geared to the requirements process. In systems programs, the ultimate source selecting authority was the program manager. Firms tended to employ strong technical (engineering) background in the purchase department so that they not only knew the marketplace but also could understand the requirement.

Quality in many firms is becoming a total company commitment with access and input to supplier quality data base information being made available to more organizations in the company. Firms are developing systems to factor quality performance into their source selection decisions and are communicating their use of these systems to their suppliers.

Purchasing involves a complex ranking and evaluation of objective and subjective factors. These factors may be addressed explicitly in the form of objective criteria or implicitly based upon judgment or taste. Personal, commercial/industrial, and governmental purchases all adhere to the "classical" definition of the purchasing objective:

> Buy materials and services of the right quality, in the right quantity, at the right price, from the right source, and at the right time.[2]

The extent to which selection of the "right source" may be based on subjective factors accounts for the differences in personal, commercial/industrial and government purchases.

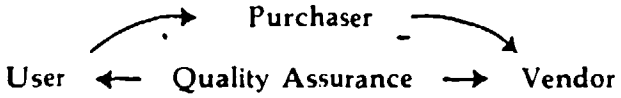
In personal purchases, in contrast to those in the commercial/industrial and governmental environments, selection may be completely subjective based upon a mental evaluation of how a given product meets the personal requirements of the individual. The selection process is likely to be

unstructured, may change over time, and only needs to satisfy the individual.

By comparison, in most government and industrial offices, purchasing is structured in method, centralized to some extent to provide consistency, and open to audit and review. In government and industry, the purchasing office takes written requirements from the requesting office, matches them with available suppliers, and negotiates the most favorable terms for the purchase. Their success in selecting the right supplier is important to the efficiency and effectiveness of any firm or government agency. However, despite certain common procedures, there are fundamental differences between government and commercial organizations in terms of their status, accountability, process complexity, and objectives.[3] These differences result in a significantly different approach to value of quality and the role it plays in the purchase decision.

It is useful in looking at the sourcing decision to develop a simple, conceptual framework of an organizational purchase decision. Such a simple model includes only a user, purchaser, vendor and quality assurance inspector. The loop begins and ends with the user. The purchaser and the quality assurance inspector act as the user's agents. This model is diagrammed below:

FIGURE 5-1. THE FORWARD PURCHASE FLOW



Each individual in the purchase flow has multiple objectives and incentives. For simplicity, we consider only the most significant. The user has a requirement, a budget and is responsible for the costs of owning the item. The purchaser must conform to established organization practice, convert the requirement into contract terms and evaluate bids received from vendors. The vendor must understand the requirement, produce the item and be paid. Quality assurance inspects the item to ensure that it meets the terms of the contract.

Recalling the concept of competing utility functions from Chapter 3, we can see the potential of competing functional goals and objectives which may lead to compromise solutions.

The flow of information becomes complex; it is difficult to design a feedback loop which allows the user, purchaser and quality assurance individuals each to accommodate each other's function and incentives. As organizations become larger, with centralized purchasing, the distances and barriers grow. In the study of government contracting officers and industry purchasing agents previously cited, there was a definite correlation between the size and centralization of purchasing and the quality information which the purchaser had at the time of making the source selection.

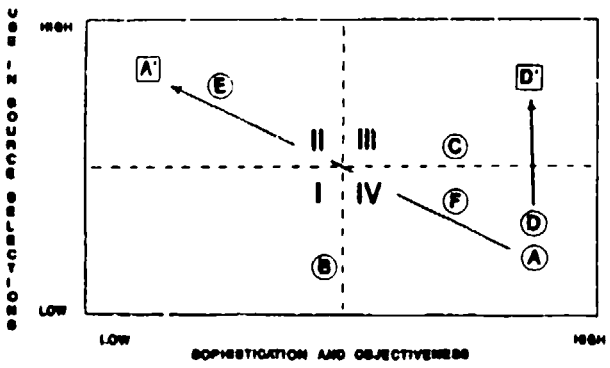
Within this model, purchases are based upon the purchaser's evaluation of price, quality and ownership costs. Price is a concrete decision measure, which represents an outflow of today's budget. Quality and life cycle considerations account for later year expenditures which may not be visible at the time of the particular purchase decision. Incentives placed on the purchaser in the form of business practice are extremely important. If such incentives emphasize price reduction, this reduction may come at the expense of quality or ownership costs. Trade-offs made by the purchaser among price, quality and ownership costs, may conflict with user preference. This problem is compounded because often no accepted measure of quality exists.[4] By comparison, price can be easily and accurately measured.

Recognizing problems associated with obtaining a workable definition of quality, competing utility functions for the players in the model, and the need for a systematic approach to improving quality, the following convention is developed.

Along the X axis is the sophistication in the quality information available. The Y axis represents the use of the information in making source selections.

In Quadrant I, the organization has a limited quality collection system and no objective way of evaluating quality when it makes source selections. It must rely on subjective emphasis on quality and hope that its suppliers will provide adequate quality.

FIGURE 5-2. APPLICATION OF QUALITY DATA



In Quadrant II, while there is an ... ence of comprehensive qual ty information, there is a commitment to use that which is available to make future selections. Such systems are generally tied to a single measure such as schedule or are based on inspections of supplier facilities and procedures. Because they are based on limited or incomplete information they may measure and emphasize measures not accurately reflecting the quality of the material being received. Type II cases, however, provide a strong indication to suppliers that quality is important and the firm will use the data available to discriminate between its suppliers.

Quadrant IV reflects an objective quality data collection system, but little use of the information in making selections. There are two primary reasons for its lack of use in making selections. First, this information is often collected in different parts of the organization and not integrated in a fashion which permits easy application in purchase decisions. Second is the question of professional competency and relationship to suppliers. An experienced purchasing agent knows the market, coordinates with the manufacturing elements of the firm, monitors the performance of suppliers, and enjoys the confidence of management in making the subjective evaluation of which supplier will be selected. Such experienced purchasers may not need a systematic quality-based selection system because they subjectively make quality-based selections.

Quadrant III shows a high level of sophistication in data collection and a willingness to use it. Unlike Quadrant II, the bid factors are based on a wide range of integrated data, closely monitored and updated. It seeks to systematize the professional evaluation discussed above into a method which is objective and perceived as fair.

For most large firms, it would be preferable to operate in Quadrant III, however for the reasons already discussed most firms find themselves in Quadrant IV. The following are some examples of systems in use.[5]

—Company A

This large firm has a significant quality-control organization and a large centrally-managed purchasing department. For most purchases, historical quality information is available in addition to price information for review by the purchasing department official. Selection of a higher-priced item can be made only with the approval of the purchasing supervisor.

In one division of the business, a comprehensive supplier qualification and rating program has been established. It looks at the quality control documentation and system which is installed at suppliers' plants. Based on an annual review the vendor is given a rating factor which is then applied to all purchases from that vendor. The price basis is adjusted by this quality factor.

—Company B

This large organization has an elaborate quality collection system which records the results of facility certifications, on-site inspections and problems reported on receipt or users. Purchasing is a separate organizational entity. Source selections are made based upon competition with only limited prequalification of the suppliers, and without consideration of past history.

—Company C

The company implemented their quality system in the early 1980s and following several refinements, 40 percent of its production purchases are made through the system. It is based on an on-line computer system which contains information provided by vendors as well as past company purchase data. It concentrates on items with a significant dollar volume or for commodities which when taken together are significant. A value

analysis approach employs commodity-teams early in the requirements process. These teams include people from engineering, purchasing, manufacturing, and marketing as well as vendors, end users and customers. The result is a total systems approach for those items which meet the criteria for inclusion in the system. The company believes that it is achieving cost savings and obtaining better quality items.

—Company D

This large firm has long collected quality information from various sources. Recently, its efforts have focused on the integration of this information into a computer data base which is jointly maintained by purchasing and quality and which can be used by the purchaser when making a source selection. The system produces a supplier evaluation rating ranging from outstanding to unsatisfactory. Elements factored into purchase decisions include past delivered performance and a graduated assessment of any problems with the supplier. Theassessment becomes progressively more severe as problem discovery moves from the supplier's self-identification to a problem reported in an installed piece of equipment.

Presently, the rating system requires substantial justification if a source selection is recommended for a marginal or unsatisfactory vendor. Likewise, substantial justification is required to select other than a low bidder. It is planned that weighting factors which will adjust the price basis to account for past quality performance.

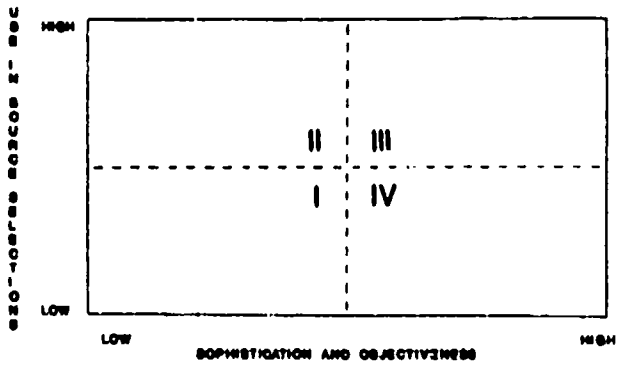
—Company E

A vendor rating system was established to systematically evaluate price, delivery and quality. Its goal is to allow the purchasing agent to select the best vendor based on past performance. It is purposefully simple to ensure that suppliers understand the requirements. Each bid price is adjusted by applying evaluation factors to established prices. Evaluation of delivery at 100 percent is based upon receipt plus or minus 7 days of the established date, 75 percent if received 8-14 days early and 50 percent if received 8-14 days late. Quality adjustments to this rating are based on sampling of incoming parts, and input from the company's quality control department.

—Company F

This large firm is developing a vendor performance improvement system which stresses improved communications between buyer and seller. Early involvement in new product development projects by potential suppliers, supplier process controls including statistical qualification of processes, and delivered performance measurement are included. It is an integrated system which will provide the firm with the ability to rate a supplier's performance accurately. However, it does not employ a bid factor to adjust the relative prices between suppliers. Placing the six companies on the conventional diagram, most fall in quadrant IV. The ability to use quality information to adjust prices is not common. The efforts made by Company D to move in this direction seem to provide the most promising example for government procurement since the method of selection will be open and objective.

FIGURE 5-3. APPLICATION OF QUALITY DATA



INHIBITORS

The policies, pressures and practices of government purchasing places the DOD source selection process in a unique environment. Individual source selections must be made fairly and openly with each being defensibly based upon legal and technical criteria which can be demonstrated to auditors, unsuccessful bidders and other interested parties.

A definition of quality in the purchase decision is murky.

Defining quality is complicated because in many organizations, including the Department of Defense, quality organizations have been separate from line management. Major advocates of quality have focused on the importance to overall corporate goals of a strong quality organization and economic/profit benefits from a directed approach led by these quality organizations. Such an approach concentrates primarily on improved manufacturing methods and the need for top-management support and has a twofold objective:

(1) The scope and authority of the quality control organization should be expanded.

(2) Top management must become personally involved in promoting quality.

Since this emphasis is primarily outside the purchase function and organization, it is not surprising that the principle advocates provide only a minimal treatment of the purchase function.

Mr. Crosby, in his book *Quality Is Free*,[6] defined quality as "conformance to requirements." His major thesis was that the cost of scrap, rework, service, warranty, inspections and tests which result from "non-conformance" cost much more than efforts to produce products which "do not fail in the field." However on the subject of purchasing quality goods, Mr. Crosby devotes only two pages of his work. He describes the futile effort as follows:

> "Traditionally purchasing's job has been to take an order constructed by some other department and place it. The operation has not usually been involved in whether the item specified offers the best purchasing opportunity. The shortest time lag in the operation is usually spent searching for the best supplier in terms of quality, cost and delivery. Most of the time is spent in product development or conceptual design. Purchasing has little opportunity to do a selection job, and quality doesn't really know how to help them."[7]

Mr. Crosby's assessment of the utility of the traditional audit and inspection approach was equally pessimistic:

> "A tour of potential suppliers, conducting "quality audits," is next to useless. Unless the vendor is a complete and obvious disaster area, it is impossible to know whether their quality system will provide the proper control or not. You can only know by being inside of the vendor's company."[8]

The solution he posed to his problem was that quality control personnel should get involved earlier in evaluating key items that will be bought. Such actions are evident in many commercial firms.

Dr. Juran's definition of quality is "fitness for use."[9] This determination is made by the user, based upon features the user recognizes as beneficial. His development of the concept of "fitness for use" is quite comprehensive. He describes the interrelation of quality parameters in a "tree" leading from fitness for use through quality of design, quality of conformance, availability, and field service to a further breakdown of twelve components.[10]

The comprehensive nature of Dr. Juran's work makes specific application complex. Representative of this dilemma is the following:

> For important purchases it is well to use multiple sources of supply. A single source can more easily neglect to sharpen its competitive edge in quality, cost and service. Despite the evident advantages of multiple sources, there is an enormous extent of use of single sources....These operations are quite successful in using monopolistic sources of supply because they solve their quality problems through a combination of managerial tools.[11]

Dr. Juran's all-inclusive approach typifies the difficulty in quantifying and measuring quality in purchased goods and materials. In a later book, *Quality Planning and Analysis*,[12] he includes a chapter on how to foster cooperation with the vendor without offering suggestions other than two inspection sampling techniques. Dr. Juran is perhaps the best advocate of the importance of a strong quality control organization, but like Mr. Crosby, he provides no objective measures to be used in purchasing quality supplies.

Dr. Deming is perhaps the most widely-known and respected person in the field of quality. He

is credited by many for the successful implementation of a total quality approach in Japanese manufacturing.[13] He does not try to provide an operational definition of quality. Instead, he views the concept in terms of who should judge quality. The closest he comes to defining the term is in describing the difficulty of the task.

> The difficulty in defining quality is to translate future needs of the user into measurable characteristics, so that a product can be designed and turned out to give satisfaction at a price that the user will pay....The quality of any product or service has many scales. A product may get a high mark in the judgement of the consumer, on one scale and a low mark on another.[14]

Dr. Deming's thesis is that only a total approach to quality will be successful. In his "14 Points for Management," a comprehensive cultural change in operations is advocated; however, the method of accomplishing the change is left to the manager. Dr. Deming's focus has been on the benefits to top management of adopting a total quality management program. While he fails to provide a specific process, the success attained by firms which have adopted his methods make it believable.

Of Dr. Deming's fourteen points, two deal with the purchase of items from suppliers. They state:

> # 3. Require statistical evidence of process control along with incoming critical parts.
>
> # 4. The requirement of statistical evidence of process control in the purchase of critical parts will mean in most companies a drastic reduction in the number of vendors with whom they deal.

David A. Garvin in a 1984 *Sloan Management Review* article[15] reviewed five approaches to defining quality. His definition framework is summarized below:

> The **Transcendent Approach** is the philosophic concept of "innate excellence" which is both absolute and universally recognized. It cannot be analyzed but is recognized through experience.
>
> The **Product-Based Approach** focuses on the quantity of some ingredient or attribute possessed by a product. As in the amount of cream in ice cream it can be assessed objectively and is based on more than preferences alone.
>
> The **User-Based Approach** begins with the premise that quality "lies in the eyes of the beholder." Through maximization of the composite individual preferences a "proper" quality is determined. It is subjective and rooted in consumer preferences.
>
> The **Manufacturing-Based Approach** focuses on engineering and manufacturing practice. It identifies quality as "conformance to requirements" and it is equated with meeting specifications or making a product right the first time.
>
> The **Value-Based Approach** defines quality in terms of costs and prices. Quality provides performance at an acceptable price. The phrase "affordable excellence" summarizes the dilemma. There are no defined limits and no means of application.

The five approaches often conflict and, depending on the perspective taken, lead to disparate conclusions. Under the product-based definition of quality, we expect to pay more for quality because we expect better materials, workmanship and inspection were applied to achieve this quality. Theoretically, from the product-based paradigm, there should be a positive correlation between the price of a high quality item over one of lower quality. This is a marketable attribute which, regardless of whether it is based upon fact, reputation, or simply impression, can be applied when marketing under the user-based perspective. The lack of precise information on the true attributes of the product encourages managers to set higher prices to "imply higher product quality."[16]

Within the user-based paradigm, quality is an attribute by which consumer goods are marketed. Many products are labelled using adjectives such as "choice," "select," "prime," "superior," or "distinctive" to demonstrate the perception that quality is important and valuable. Perhaps nowhere else is quality more extolled than in the automobile industry. For reasons beyond the

scope of this research the American automobile manufacturers lost considerable market share to the Japanese and German auto makers on this issue.[17] However, slogans such as "the quality goes in before the name goes on," and "quality is job 1" indicate a focus on the manufacturing-based definition of quality. Ford Motor Company adopted a "defect prevention" approach to quality which while manufacturing based, has yielded dramatic improvements and boosted Ford's standings in consumer quality ratings.[18]

Numerous studies have shown that in many consumer products people will pay a premium for real or perceived quality.[19] In such simple items as a pen or a pencil, suitable value-based products can be found for under a dollar, while there are also many value-based products marketed at a much higher price. Production management and quality sampling techniques which operate under the manufacturing-based definition can ensure that the established quality standards for both the Number 2 wooden lead pencil and the precision drafting pencil are maintained. However, the premium that will be paid for quality is determined by the market mechanism within the user-based definition.[20]

No concise view of defense acquisition quality emerges, rather one can infer, based on organizational structure and implementing policies. Dr. Robert E. Costello, former Under Secretary of Defense for Acquisition, in establishing a Total Quality Management Program for the Department argues that efforts toward a continuous improvement process are necessary. The following excerpt from Costello's speech to the Defense Logistics Agency Commanders' Conference in November 1987 establishes his desire to push for a change in focus:

> For much too long we have been following the concept of "minimum acceptable" quality. America's manufacturers and our maintenance depots have pursued this concept with the placid resignation that a persistent level of errors, perceived as irreducible is a way of life....The process should continuously strive for improvement rather than accept a predetermined level of imperfection.[21]

The concept of continuous efforts toward improvement, abandoning "minimum acceptable" quality, are philosophical shifts which have major implications for defense acquisition practice.

The operational definition of quality which was used to develop a plan to implement Dr. Costello's approach in DOD, was:

> Conformance to correctly defined requirements satisfying customer needs.[22]

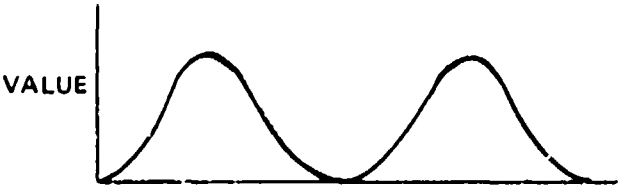
This definition closely resembles a combination of those of Mr. Crosby and Dr. Juran. It was also the most commonly cited definition by industry and government contracting officials in a survey conducted during the Summer of 1989.

Cooperation and Competition Are Mutually Exclusive

Companies are dealing with fewer suppliers. This is not an abandonment of competition but a recognition of its limits. Practices such as Just-in-Time (JIT) and Material Requirements Planning (MRP) depend on reliable deliveries of uniform quality from suppliers. Performance information is being collected on suppliers and is beginning to be used in the purchase process.

In an interview with Dr. Broedling,[23] she expressed the conflict in terms of the bi-polar model illustrated here:

FIGURE 5-4. VIEWS TOWARD ACHEIVING BEST VALUE



One pole is centered on competition and the positive effects it has on price and the other centered on cooperation as the most important in quality decisions. The benefits of each can be illustrated by analogy to team sports. Individuals on the team must cooperate rather than compete with each other to be successful while they are simultaneously competing rather than cooperating with their opponent.

Dr. Deming views competition on a much larger scale than an individual purchase decision. Competitiveness in the international arena requires cooperation in the many small purchase decisions which impact a firm's product. What emerges is not wide-open competition for each item but a limited competition in which repeat business, stability and product improvement are emphasized.[24]

There is a definite conflict between free and open competition (required by law in government purchasing) and the cooperative concept. Dr. Deming explained the justification for limiting suppliers as follows:

> We can no longer leave quality and price to the forces of competition -- not in today's requirements for uniformity and reliability. Price has no meaning without a measure of quality being purchased. American industry and the U. S. Government are being rooked by rules that award business to the lowest bidder.[25]

The recent awakening of the importance of quality in American products has greatly expanded writings in the field. Most authors, in discussing quality, focus on application of one or more of the principles discussed by Mr. Crosby, Dr. Juran and Dr. Deming and adopt a "conformance to requirements" type of definition. Those attempting to deal with the role of purchasing focus on reducing the number of suppliers and increasing the level of cooperation between the requiring and supplying companies.[26]

The dominant role that price plays in government purchases stifles creativity and innovation. Objective evaluation, as practiced in government purchasing, requires that there be little innovation in the suppliers' approach because the competitive decision process becomes one that is based on price. Dr. Harry Page described this process as follows:

> It has become traditional practice in government to write purchase specifications in such a way that any potential supplier can produce the item, and award can be based upon lowest price.[27]

Since passage of the Competition-In-Contracting Act (CICA) in 1984, the view that defense procurement overemphasizes the importance of price intensified. While not criticizing the intent of CICA, the Packard Commission identified three problems with its implementation by the Department of Defense:

> (1) Interpretation that the government must buy from the lowest price bidder
>
> (2) The notion that CICA precludes qualification criteria, consideration of technical expertise, or life cycle costs
>
> (3) The resulting focus on the number of competitions rather than the success the competition achieves in terms of reduced prices for current items or better products.

The Commission concluded that the full potential of CICA could not be realized until these problems were overcome.[28]

Recommendation F of the Packard Commission's final report was to "Increase the Use of Competition" which was explained as follows:

> Federal law and DOD regulations should provide for substantially increased use of commercial-style competition, emphasizing quality and established performance as well as price.

In the government, procurement awards are made within an environment influenced by history, social legislation, budget pressures, a distinction between price and cost, specification complexity, a definition of what distinguishes suitability from gold-plating, a preference for fixed-price contracts and a preference for competition. Individually and collectively, these environmental influences may skew any procurement decision.

It is apparent that the theoretical foundation for objective quality measurement is not established well enough to facilitate objective evaluation of quality factors in either the government or commercial/industrial environments. The principle authors in the field of quality: Mr. Crosby, Dr. Juran and Dr. Deming fail to provide objective methods of obtaining quality purchases. Current conventional wisdom in obtaining quality is to work toward development of long-term symbionic relationships with suppliers. Such relationships are impossible to attain under the current environment of government rules and practice.

SUGGESTED AREAS FOR IMPROVEMENT

On-Line Contractor Performance History File

The first step in using quality information in making source selections is to make it available to the contracting officer. The elements of the file need to be established and should include indices for price, delivery, and reported quality problems.

Second, the ability to input and access the files throughout DOD must be established. A partial net will not be sufficient, since it will fail to provide the objective information needed eventually to make source selections.

Third, once the network is functioning, quality factors can be established to adjust bid prices to reflect the value associated with variations in schedule, quality or other performance features.

There are several innovative techniques being tried to implement such a system. We are aware of efforts being sponsored by the Defense Logistics Agency,[29] and the Services: but, they are limited in scope, not exploiting the potential for more accurate measurement, which is essential to their widespread acceptance and application and their ability to withstand administrative protest.

Quantification of Non-Price Factors

There is a need for a method to quantify evaluation of factors in addition to price. Adapting the dimensions of the quality framework established by David Garvin, it is possible to segment quality into dimensions which could be weighted, ranked and evaluated. A quantifiable, auditable and defensible means could be developed for the DOD contracting officer to use when evaluating source selections.[30] The challenge is to develop an objective quality system which can operate effectively in the defense acquisition environment.

A review of the regulatory and policy directives established no specific prohibition to the use of quantitied non-price factors. The FAR specifically states that source selections are to be made based on price and other factors. The reason for their lack of application is the lack of a generally acceptable, theoretical criteria for quality. Measurement of quality is identified consistently as a major stumbling block. As discussed earlier, this is because any system requiring information can only be as good as the information input. The problems associated with quality feedback in DOD also contribute to the need not only for an on-line contractor performance file but improvements in quality data feedback. However, several examples of attempts within DOD to apply quantitative past performance to source selections should be noted. For example, the "Blue Ribbon Supplier" systems being established in the Services and DLA recognize a supplier's past performance and apply a percentage cost bonus in subsequent source selections.[31]

A Variable-Incentive Specification

The current method of establishing a minimum specification which, if satisfied, permits the selection to be made based on price, should be selectively replaced by a method through which performance specifications define the value of variable features. Performance feature variations would be evaluated using a preestablished and published cost/performance criteria.

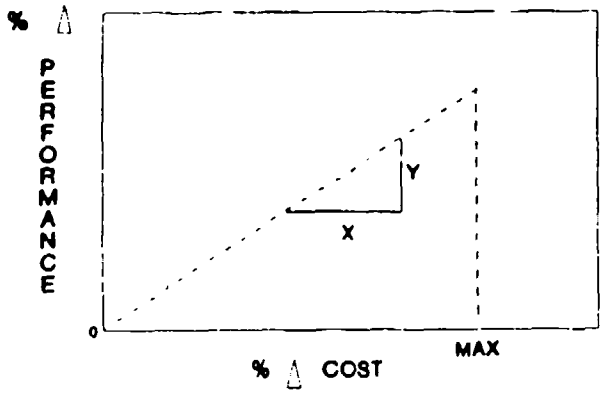
Such a method would preclude the need to "gold plate" specifications. It would provide incentives for contractor who have better ways of meeting the requirement to be selected over contractors who barely meets minimum requirements at the lowest cost. Presently there is little incentive for a contractor to innovate or exceed the minimum.[32] Such a focus on low price makes the rules of competition easy to apply, focusing principally on price, with results such as those reported in *The Washington Post*:

> The Defense Department inspector general's office, testing random samples of parts bought by the Air Force the past two years, estimated that as much as 98 percent of the money spent for the spare parts surveyed went for items with major or minor defects.[33]

To shift the emphasis from price competition, it is important the vendor recognizes that something more than price will go into the source selection; that there will be an incentive provided for delivering a better product even at a higher price.

What makes a product better must be established clearly in the solicitation, as must the value of the incentive. This can be viewed in terms of percent improvement in the designated performance element for a percentage difference in price with an

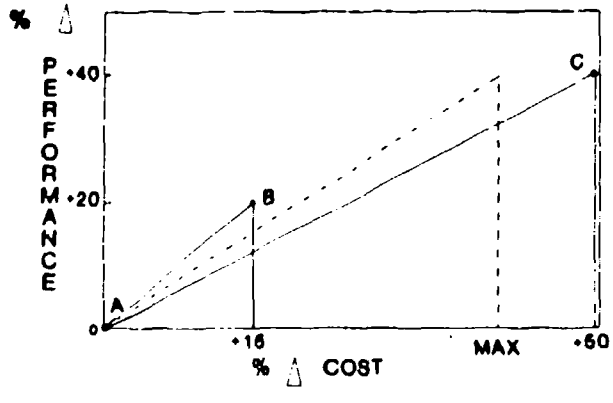
FIGURE 5-5. VARIABLE SPECIFICATION



upward bound as illustrated in the following figure.

This can raise the specter of "gold plating" and too much subjective judgment. However, discussions with senior DOD contracting officials confirmed that, provided the relationship was clearly stated in the solicitation and applicable to all vendors, there is no impediment to its adoption.[34] The following examples illustrate the concept.

FIGURE 5-6. VARIABLE SPECIFICATION



PERFORMANCE QUALITY FACTOR

An aircraft program has a need to reduce weight of installed equipment. Assume the current standard communications radio weighs 10 pounds and costs $100, and there is some value for a reduction in its weight. The current contract method would specify 10 pounds or some lighter weight. Contractors would then seek to minimize costs to meet that specification, perhaps ignoring weight savings which might cost "a little more." Simplistically, the proposed quality factors contract would be structured as follows:

QUALITY FACTORS CONTRACT SPECIFICATION

All other performance specifications are unchanged. An incentive of 10 percent of total price for each pound less than 10. Maximum price incentive is 40 percent.

Assuming that three bids are received which satisfy all the specifications as follows:

	Company A	Company B	Company C
Weight	10	8	6
Price	$100	$115	$150

Selection would be for Company B, because its price is within the range specified for the incentive and beats the cost/performance trade-off ratio. The product proposed by Company C would not be selected because the preestablished weight/price relationship is exceeded and it provides less relative benefit per extra unit of cost.

RELIABILITY QUALITY FACTOR

Reliability improvement may also be desired for the same ratio. If the current ratio has a Mean Time Between Failures (MTBF) of 100 hours, a similar relationship could be set where a 10 percent improvement in MTBF would be valued at 5 percent of the acquisition price. The contract solicitation would be structured as follows:

QUALITY FACTORS CONTRACT SPECIFICATION

All other performance specifications are unchanged. An incentive of 5 percent of total price for each 10 percent improvement in the MTBF up to a maximum of 60 percent price incentive.

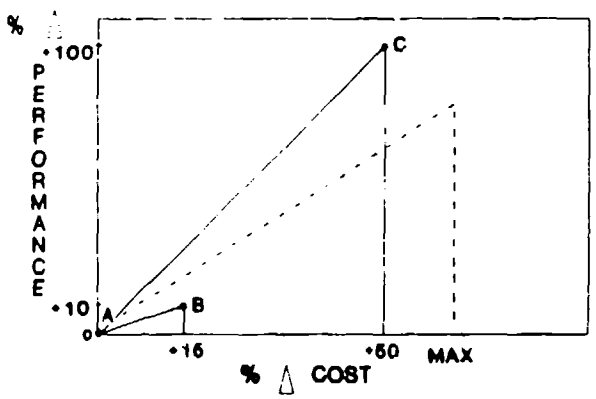
Assuming that three bids are received which

satisfy all required specifications, they would be evaluated as follows:

	Company A	Company B	Company C
MTBF	100	110	200
Price	$100	$115	$150

Using this specification, the selection would be Company C's product.

FIGURE 5-7. VARIABLE SPECIFICATION



GENERALIZED APPROACH

From examples discussed, the contract proposal process has become more complicated for the supplier. No longer will attainment of the minimum specification be sufficient. A product which exceeds the specification in a quality factor considered valuable to the requestor may be selected over one which meets the specification. The examples cited are simplistic but not impractical for application. Of course there is the potential of adding so many incentive systems that the process would become one of linear programming; but, even in this case, the evaluation of the criteria would be based objectively. It provides a means to change the focus from lowest price to one of best value.

One of the major distinctions between the government and commercial purchasing practice is that this relationship must be clearly stated in the request for bids. Because of the absolute requirement for fairness, all interested parties will need to understand the relationships proposed and the evaluation criteria.

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6

SOURCING BY DOD CONTRACTORS

FINDING Companies are adopting more cooperative relationships with their suppliers.

DISCUSSION OF THE FINDING

We have examined, in some detail, the nature of the buyer/seller relationship in the commercial marketplace, with particular emphasis on how that relationship is evolving to improve quality. This chapter continues that examination, looking specifically at the buyer/seller relationship in the context of commercial companies and their suppliers and subcontractors (a.k.a. sourcing). We established the prevailing commercial practices in this area, and examined how they may differ for companies operating under the umbrella of a DOD prime contract. Our premise at the outset was that defense contractors are uniquely constrained or inhibited from using certain innovative commercial practices in sourcing.

One need not look far to discover evidence that commercial companies are definitely changing their relationships with suppliers. They are moving down the continuum toward more cooperative supplier relationships and away from the traditional, competitive way of doing business.

This new relationship goes by many names (partnering, strategic alliances, comakers, value-added partnerships, etc.), but the central elements are common. All are long-term arrangements with a small number of high quality suppliers; relationships characterized by mutual dependence and open communications.

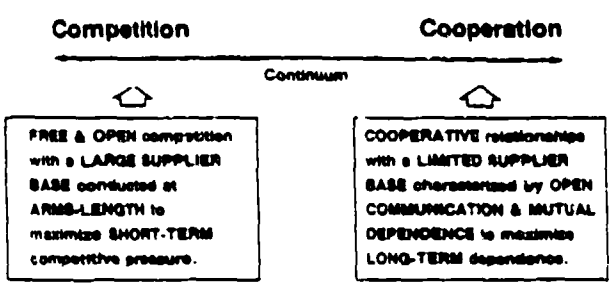
Note that our focus in this chapter is exclusively on relationships between companies and their suppliers. What we do not discuss is the "teaming" of major companies to spread the risk and return of a major development effort. Also not discussed is a company's internal "make-or-buy" decision. While "make-or-buy" is a critical element of any sourcing decision, we examine here relationships external to the company.

To fully understand the forces driving companies toward cooperative relationships with their suppliers, it is important to understand first the forces that drive the traditional way of doing business.

Traditional, Competitive Buyer/Seller Relationship

The dependence theory of bargaining (Bacharach and Lawler, 1981) provides an excellent conceptual framework for understanding the traditional, competitive approach to the buyer/seller relationship, a relationship often referred to as "competition". The dependence theory asserts that the power of buyer or seller is based on the degree of dependence the other party in the relationship has on the first. This degree of dependence is driven principally by two factors—commitment of each party to an outcome, and the degree to which each party has alternative means of satisfying that outcome.[1] In the normal course of the buying/selling process, each party seeks to maximize their power by making the other party more dependent on them (in reality or perception), and/or making themselves less dependent.

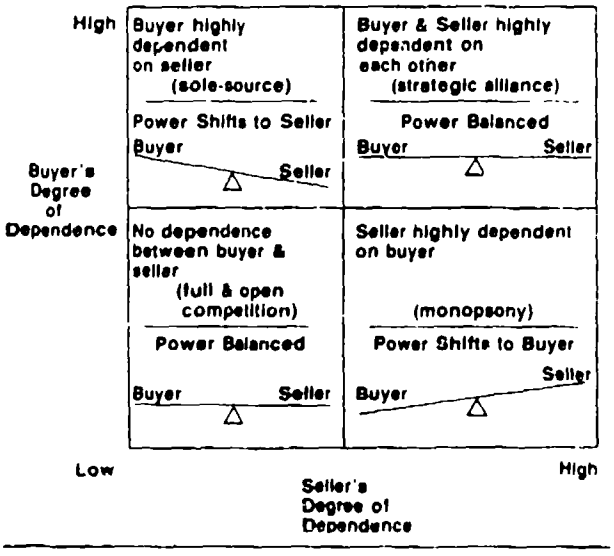
FIGURE 6-1.



Traditionally, most relationships with suppliers have followed this competitive model. Companies go to great lengths to avoid being trapped in a sole-source position with its associated loss of bargaining power. They feel the pressure of competition is the best tool to avoid becoming overcommitted to a supplier, thereby maintaining parity in the bargaining process. If this competitive pressure is lost, companies fear their suppliers will exploit the power of sole-source status, and take advantage of them. Chester Karrass, a noted expert on practical negotiation techniques, says of this sole-source situation, "Buyers fold like a tent in front of a seller who has no competition."[2]

Conversely, suppliers go to great lengths to maneuver themselves into a sole-source position so they can take advantage of the power differential. They employ what the *Wall Street Journal* calls a "get-it-while-you-can strategy"; recognizing that when the tables turn, as they inevitably do, their profits will be "cut to the bone."[3] Each side inherently distrusts the other, and an arms-length, often adversarial, relationship develops.

FIGURE 6-2. DEPENDENCE THEORY OF POWER IN BUYER/SELLER RELATIONSHIP



Classic economic theory is useful also in understanding this competitive approach to the buyer/seller relationship. Competition is a fundamental element of our free enterprise system. With multiple buyers and sellers in the marketplace, the laws of supply and demand make price essentially self regulating. This is the situation most buyers desire. Conversely, if there is only one seller (a monopoly), or one buyer (a monopsony), or if the marketplace is not "free" (regulated or collusive), then the laws of supply and demand cannot be relied on to determine price effectively.

This traditional approach to the buyer/seller relationship is by no means passe, but is still the favored approach by many in industry, and by most in the government. However, there are an increasing number who are employing, and benefiting from, more cooperative approaches in dealing with their suppliers.

Innovative Trends in Commercial Supplier Relationships

The current literature of manufacturing science is replete with examples of the "new" supplier relationship. Hayes, Wheelwright, and Clark of Harvard Business School found that one important characteristic of what they termed a "world class manufacturer" (i.e., a manufacturer able to compete on equal footing with the Japanese) was a redefined relationship with a small cadre of top quality suppliers. Specifically, they assert:

> "it is essential that suppliers change from arm's-length adversaries to co-makers. Under the co-maker view, the buyer organization seeks close working relationships with a few key vendors over the long-term."[4]

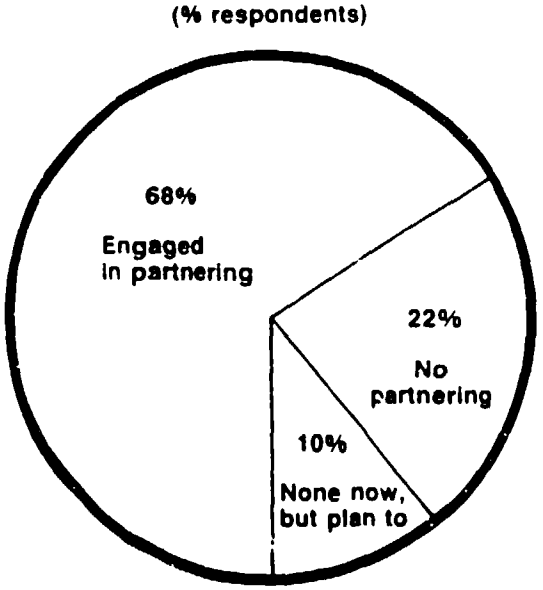
Elwood Buffa of U.C.L.A. made a similar finding in *Meeting the Competitive Challenge*:

> "there are economies that result from intelligent, cooperative bu[illegible]r-seller relationships,...which may even result in single sourcing with the supplier located close to the buyer."[5]

Finally, Richard Schonberger, a noted manufacturing consultant, said that a world-class manufacturer found one good source of supply for each part, and then treated that supplier as a comaker.[6] These expert opinions are representative of what can be found in the current literature.

They are also consistent with our findings after visiting an array of commercial firms for this research project; *every* firm visited was attempting in some systematic way to reduce their supplier base, and many were trying to fundamentally redefine their relationship with suppliers. *Purchasing*, a journal of the commercial purchasing profession, found in a 1988 survey that 68 percent of respondents use some form of partnering with suppliers, and another 10 percent said they planned to do so in the next year.[7]

FIGURE 6-3. SEEKING PARTNERS



There are a number of innovative commercial practices that are, at least in part, responsible for this trend toward a closer, more cooperative relationship with suppliers. One practice, as discussed earlier, is total quality management or TQM. One aspect of TQM that is particularly relevant to this discussion—TQM philosophy with regard to the supplier relationships. The Godfather of TQM, Dr. W. Edwards Deming, rejects the idea that "competition in the marketplace gives everyone the best deal." He argues that the leverage of competition may get the best price *in the short term*, but at the cost of reduced quality, which in the long-term reduces value. Dr. Deming argues that long-term, sole-source relationships with suppliers are the answer.

Another commercial practice contributing to redefined supplier relationships is the increasing use of Just-in-time (JIT) manufacturing. The JIT is a material management philosophy borrowed from the Japanese designed to reduce inventory and its associated costs. This is done by placing greater reliance on suppliers to deliver the item to the production site literally just-in-time for that item to be incorporated into production. Since safety stocks are minimized (or non-existent), the reliability of supplier's deliveries are critical. As such, just-in-time systems require closer, "open kimono" relationships with sources and tend to rely on a small number of highly-reliable sources.

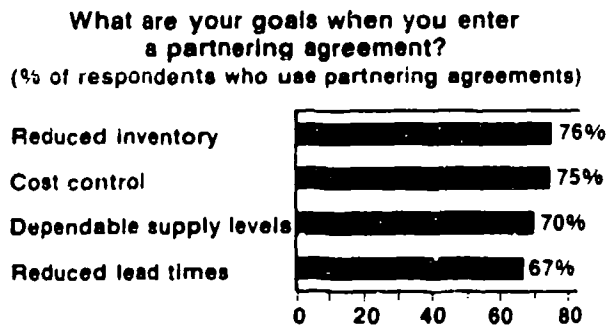
The evidence is clear, more commercial firms are recognizing the long-term benefit of concentrating purchases with one or a limited number of sources, and substantially altering their relationship with those suppliers. They find a supplier that can meet their quality and schedule requirements and enter into long-term buying relationships with that supplier. Without competitive pressures on each purchase, the instant unit price may be higher, but that price is typically offset by improved quality, schedule performance, and/or lower life-cycle cost. With one vendor supplying a firm's total requirement for an item, quality should become more consistent, causing fewer rejects and less rework. Similarly, a single vendor should be more consistent and reliable in deliveries allowing the firm to maintain smaller inventories of the item, hence saving money. If a firm concentrates their purchases with one supplier they should enjoy greater influence over that supplier since they represent a significant portion of the supplier's total business. The level of communication and cooperation between the firm and the supplier should increase, as each has a greater stake in the success of the other.

In these cooperative arrangements, the buyer and seller are agreeing to become more dependent on each other for the overall success of both companies. Some would argue that this refutes the dependence theory of the buyer/seller relationship, the cornerstone of which is minimizing your dependence on the other party. On the other hand, proponents of the cooperative approach

would argue that in the long-term, power is maximized on both sides of the ledger when each becomes dependent on the other. Graphically, this would be seen as a shift to the upper right quadrant in the graphic shown earlier in this chapter.

It appears that commercial firms are realizing major benefits from adopting more cooperative relationships with a limited base of suppliers. *Harvard Business Review* attributes partnering with suppliers as a major factor in the recent turnarounds of both Ford and Chrysler.[8] The *Purchasing* survey cited earlier found that 80 percent of the respondents who use some form of partnering, found it met their goals of reduced inventory, cost control, dependable supply levels, and reduced lead times.[9]

FIGURE 6-4. PARTNERING GOALS



Government Attitude Toward the Buyer/Seller Relationship

Like many other organizations with large procurement budgets, the government is interested in the economic merits of bargaining parity and a self-regulated price offered by competition. It is a widely-held perception in government circles that competition does, in fact, lead to a superior product at a lower price. Beyond these economic considerations though, the government embraces competition because of another important dimension—the connotation of equity it conveys. Full, open competition conducted at arm's length gives the public a perception of fairness and integrity in the use of their tax dollars, since everyone is able to compete equally for a portion. (Chapter 1 contains a more through treatment of the concept of equity in public spending).

Consequently, at least since 1809, the government has favored using competition in its purchasing. The Armed Service Procurement Act and the Federal Property and Administrative Services Act require that government procurement be competitive to the maximum extent practical. The July 1984 Competition in Contracting Act (CICA) broadened the requirement for competition in federal purchasing, and reaffirmed this need for equity in defense spending.

Benefits of competition from an economic and an equity standpoint can be compelling. The equity consideration alone is so compelling it is unlikely the U.S. Government will ever abandon competition as the preferred method of government procurement. It should be recognized, though, that in the commercial environment the need for equity becomes much less compelling, and competition must stand on economic merits alone.

INHIBITORS

Clearly, commercial firms are increasingly using new, cooperative supplier relationships to advantage. When the commercial firm is a DOD contractor, however, are they able to take full advantage of these innovative commercial ways of doing business? The answer appears to be "no." Research did not indentify even limited cases where a defense contractor sought sole-source alliances with suppliers, regardless of arguments for doing so. It is clear these contractors feel, to some degree, inhibited from entering into this type of arrangement, so they avoid them. All had supplier reduction programs, but never with the intent of reducing to a single supplier for a given item. A typical arrangement was for the defense contractor to partner with several sources for each item, thereby preserving competition, but potentially at the cost of watering-down the benefits of partnering. Alternately, defense contractors might have a sole-source of supply, but with periodic (annual) competition. Again, the full benefits of partnering are not being realized.

On the other hand, purely commercial companies (i.e., those with little-or-no DOD business), were not reluctant to enter into long-term, sole-source arrangements when the business situation warranted it. Interestingly though, Dr. Deming and

the current literature to the contrary, these firms (some of whom have industry-leading quality records) typically do not use sole-source arrangements on a wholesale, across-the-board basis. Rather, they tend to use them very judiciously—only for the procurement of selected items of strategic importance. In a majority of the cases these companies *compete* their supplier requirements because it is in their best business judgment to do so. Unlike DOD contractors, however, they seem uninhibited in using whatever supplier arrangement the business situation dictates.

We will now examine what seem to be the major inhibiting factors to DOD contractors.

The DOD Intervention in Contractor's Internal Management

One could argue that a DOD prime contractor, as a commercial firm, should have complete flexibility dealing internally, and externally with other commercial firms. However, this is not the case. The DOD imposes a plethora of requirements dictating how it's contractors conduct their business. Many of these requirements flow through the prime contractor directly to the subcontractors and suppliers. The Defense Science Board observed in 1986, "A typical military contract contains 214 general and special provisions, 144 of which flow down to subcontractors."[10] Ostensibly, each of these provisions has some impact on how that company (or subcontractor) conducts business. In contrast, the Defense Science Board found that in a purely commercial environment, even a complex contract would more typically have about 45 of these types of provisions. Of course, DOD's requirements on its contractors are not imposed arbitrarily; each requirement is designed to elicit desired behavior on the part of the contractor (hiring from areas of high unemployment, for example). The weight of many requirements when taken in aggregate, however, can have the opposite effect and elicit undesirable behavior, such as bureaucratic lethargy or resistance to innovation.

The DOD Intervention into Contractor's Sourcing Decisions

The DOD is particularly interested in how its prime contractors carry out their sourcing function. Ideally, DOD seems to want its contractors to emulate the methods and procedures it uses in awarding prime contracts, including the use of free and open competition. To maintain this oversight and control, the government uses the Contractor Purchasing System Review (CPSR), the subcontract consent and notification requirements, and the subcontract plan requirement.

A CPSR is designed, "to evaluate the efficiency and effectiveness with which the contractor spends Government funds and complies with Government policy when subcontracting."[11] In conducting a CPSR, a team of government specialists critically examines a prime contractor's purchasing system, with the objective of approving that system if it meets government requirements . The degree to which the system "provides for full and open competition, or obtains competition to the maximum extent practical" are central to the government's decision to approve or disapprove.[12] Where competition is not obtained, the system must ensure that its absence is fully justified.[13]

If a contractor does not have an approved purchasing system, each individual subcontract action falls subject to the subcontract consent or notification requirements. The consent requirement means the prime contractor must obtain prior written consent from the government before they subcontract for work that is particularly complex or of high dollar value. Subcontracts for less complex purchases are subject to the less stringent notification requirement. Notification means the prime contractor must notify the government of certain subcontract awards; no prior written consent is necessary.

The subcontract plan requirement is levied on a contract-by-contract basis, usually only on major contracts. It is often tailored to the specifics of the situation, but typically requires contractors to submit subcontracting plans up front for evaluation during the source-selection process. The degree of competition expected is often a critical element in the evaluation of such plans.

The purchasing system review, consent and notification processes, and subcontract plan requirement provide a systematic framework under which DOD can have a direct influence on how prime contractors do business with subcontractors and suppliers. The degree to which DOD

exerts that influence to advocate competition in awarding those subcontracts will inevitably affect the degree to which DOD contractors pursue more cooperative relationships with their suppliers. Accordingly, a closer examination of the nature and degree of DOD's advocacy for subcontract competition is called for.

Government Attitude toward Subcontract Competition

As we established, the government has compelling reasons to be interested in competition at the prime contractor level. They have established competition advocates through various levels of the government to maximize prime-contract-level competition, and annually establish specific competition goals for each department. Beyond this, there are reasons why government leaders have also become interested in the once neglected area of competition at the subcontract level. On one hand they are faced with tremendous pressure from the Congress to increase the use of competition as a panacea for the ills of the procurement system. On the other hand, less and less of DOD's procurement budget is staying with prime contractors, but rather, is flowing through the primes to subcontractors. Recent estimates place the percentage of subcontracted content as high as 75 percent and rising; this is up from about 50 percent in the early 1960s.[14] With an increasingly smaller percentage of DOD's procurement budget actually subject to prime-level competition, it could be argued that the government should, therefore, subject all subcontracts to competition, as well. Therein lies a major impetus behind DOD's burgeoning advocacy for competition below the prime contract level.

. . 1984 the Deputy Secretary of Defense in a memorandum entitled, "Increasing Subcontract Competition," identified circumstances where subcontract competition should be of particular interest, including instances where large quantities of high priced components were being subcontracted. The Congress began showing an interest in subcontract competition in 1983 in the law reauthorizing the Office of Federal Procurement Policy (OFPP). In that legislation, they specifically required the administrator of the OFPP to, "conduct studies...on the extent of competition in the award of subcontracts by federal prime contractors including an evaluation of the data available on subcontracts awarded...." This interest in data is significant since any effort to expand subcontract competition must start with a quantifiable baseline from which to measure success. While the government collected data on competitive expenditures at the prime-level for many years, there has not been a reliable way to collect data on competition at the subcontract level. In response to congressional interest, DOD began capturing some data on subcontract competition, an action some predicted would be a precursor to actual advocacy for subcontract competition. This prediction proved to be true.

The U.S. Navy is on the forefront in actively advocating competition at the subcontract level. It charges buyers to analyze carefully a prime contractor's make-or-buy decision to ensure they are maintaining "competitive pressure on cost or quality." The Navy's *Competition Handbook* says, "Subcontractor competitions...can have dramatic cost savings," and cites examples where they have done so. The Air Force, Army, and DLA are less aggressive in advocating subcontract competition, but all seem to do so subtlely through the CPSR process which evaluates and approves purchasing systems based on that system's ability to ensure "adequate price competition," among others. High-level DOD officials resisted attempts to mandate subcontract competition goals or have advocacy institutionalized through legislation, but they do advocate competition at the subcontract level on any prime contract awarded without competition. In some instances, this advocacy manifests itself through language on a specific contract that provides monetary incentives to the prime contractor based on the extent to which he attains subtier competition. This approach is, by definition, very narrow in application since it must be applied on a contract-by-contract basis.[15]

The primary inhibitor to effective supplier partnering by defense contractors is DOD's advocacy for free and open arms-length competition for subcontracts under defense contracts. While the strength and form of this advocacy are somewhat amorphous, they seem to be sufficiently clear to signal defense contractors on the desires of DOD. Since, for most, DOD is their dominant customer, they react to those desires, and use partnering only

on a limited basis, stopping short of entering into sole-source arrangements.

SUGGESTED AREAS FOR IMPROVEMENT

Adopt a Policy of Neutrality Regarding Subcontract Competition

Because competition connotes fairness and equity in expenditure of government funds, it will likely be the preferred method of government procurement for years to come. The need for equity is much less compelling at the subcontractor level, however, and the degree of competition or cooperation with suppliers is a business decision. In many or perhaps most cases, prudent business judgment will warrant using some form of competition; but, in others, the benefits of improved quality or reduced total costs will call for a sole-source, cooperative arrangement. The DOD should not restrict its contractors from using the best business practice; then, as always, hold them strictly accountable for ultimate results.

Two opposing arguments typically arise. One is, "DOD doesn't advocate subcontract competition, they just track it"; the other, "DOD only wants subcontract competition in cases where they don't have prime competition." Both are tantamount to advocating subcontract competition across-the-board. Tracking conveys the perception that DOD wants it; the contractors react accordingly. Requiring it on a single contract results in the contractor adopting a single system to ensure competition on all purchases (reference Finding 7). Further, the move toward partnering, TQM, etc., requires a fundamental philosophical shift that cannot readily be turned on and off on a contract-by-contract basis.

Notwithstanding these arguments, it is clear that DOD contractors when making business judgments vis-a-vis relationships with suppliers, are factoring in DOD's real or perceived desire for subcontract competition. Accordingly, if DOD wants the benefit of business judgments without this bias, it should adopt and communicate a policy of *complete neutrality* with regard to competition at the subcontract level. The degree of competition or cooperation with suppliers would then, like other business judgments, be left to the discretion of the prime contractor. Only by granting this flexibility can the defense industry be expected to fully implement new ways of doing business like TQM.

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7

SOME REGULATORY IMPLICATIONS

FINDING Companies Adopt Uniform Administrative Systems.

DISCUSSION OF THE FINDING

Discussion of business management approaches with several firms which conduct both military and commercial business (i.e., General Electric, United Technologies, GTE and Westinghouse Electric) showed that generally, these companies segregated their business units so commercial and military business was not collocated or comanaged. In an advertisement, a Washington-based law firm highlighted the reasons for such barriers as follows:

—Minimizing the cost of necessary controls

—Managing certification requirements

—Localizing cost accounting standards compliance

—Using exemptions from cost and pricing data disclosure

—Limiting access to company records

—Protecting rights in technical data

—Narrowing exposure to suspension and debarment.

In addition, there is a strong preference to employ one set of administrative procedures. If the firm was producing a military item and a commercial item on the same floor, they would adopt the *military* approach to sourcing, inspection and quality control for *all* items on the floor. For examples of this, look at the MSE/GTE, and GE cases in the appendices. The cost of managing two systems was deemed too expensive and confusing to the work force. We also found that relaxing a standard for a specific DOD contract was counterproductive because a firm would not want to be penalized for using a commercial practice on a subsequent military buy. Generally, if a company had other defense contracts, it would impose the defense requirement on itself so it would not lose certification of its process. This has a significant policy implication because we may consider that relaxing the requirements for a good contractor will allow cost savings to be applied to the contract. This may not be the case where a contractor has other government business which will not be affected, or may wish to compete for other business for which the waiver of the requirement may not be granted.

INHIBITORS

The discussion of the finding has, in itself, been a discussion of the inhibitors. The regulatory aspect of governmental purchasing is recognized in industry as a fact of life in doing business with the government. The problem highlighted in this section is the difficulty in selectively applying good ideas. In our research, we spoke with several individuals from programs designated as Defense Enterprise Programs (DEP) which, theoretically, could be excluded from governing policy directives. Unfortunately, viewed from government and industry, DEP designation made little difference in the management and operation of these programs. Simply stated, trying to gain acceptance of the exempt status from the functional staffs and organizations in DOD became more difficult than simply adhering to the policies and regulations.

The need for uniformity in industry/government dealings is based on sound principles. It was largely responsible for the consolidation of procurement regulations into the Federal Acquisition Regulation. Uniformity on the other hand, does make selective relaxation of requirements theoretically feasible, but extremely difficult to implement in practice.

SUGGESTED AREAS FOR IMPROVEMENT

Use the Contractor's Cost Accounting System

The original intent of the Cost Schedule and Control System (CSCS) was to use contractor-provided data to monitor the performance under the contract. In intent and design it is not significantly different from the systems described as in place to monitor commercial capital improvement or new product development programs. Unfortunately, the CSCS system has become a source of contention between the government and the contractor in its application. Despite observations about the extra costs of multiple control systems, it can be advantageous to the contractor to maintain two cost accounting systems—one for internal management and one as a CDRL requirement under the contract.

Commercial program managers find that the CSCS system provides too much information. They use a system providing summaries of cost and schedule progress, timely (i.e., actual, vice massaged data) and accessible on a daily basis. Detailed backup information, available on an query-response basis, is used to investigate problems highlighted in the summaries. The CSCS reports, a data-deliverable rather than a real-time management system, delay status reporting and focus too much time on extreme details and formatting. Consider again the fire alarm convention introduced in Chapter 3. The CSCS system, as currently employed, provides too much detail about what happened weeks or months before but has become useless in real-time management.

There are unique instances in which the government and prime defense contractors are working from the same status data base. They are exceptions to CSCS requirements and we believe they provide a more effective system for joint government-industry program management. A successful example is highlighted in the MSE/GTE case; a Defense Enterprise Program (Appendix G).

Policy or Reporting Requirement Deviation and Waivers Should Be Granted Only for an Entire Commercial Activity and Only for an Extended Period

We investigated commercial and defense businesses and it became obvious that commercial entities and the military departments could use similar standards to advantage. Policies encouraging perception of uniqueness in defense systems management are counterproductive, especially if the different administrative systems serve only the burgeoning DOD bureaucracy. As discussed in the inhibitors section, each Defense Enterprise Program (DEP) prime contractor contacted (i.e., General Dynamics and GTE) indicated there is little difference in the requirements under which they and other non-DEP defense programs operate. Commercial business leaders felt it was "too expensive" to operate parallel systems that must meet different policy or reporting requirements.

We believe policy or reporting changes need to be implemented company-wide and for an extended period if positive results can be expected. The target company must be convinced the rules will not be changed often so it can have confidence to employ best business practices across-the-board.

IV

CONCLUSIONS AND SUGGESTED IMPROVEMENTS

IV

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CONCLUSIONS

Our opportunity to research systems acquisition and purchasing management has been unique; for 7 months, we assessed private industry's management of systems programs and purchasing. The field of study we chose is great. The allegorical analogy is that of a 7-year old child given $10 to spend at a toy store. In our case, there was so much to investigate. Though time, our main resource, seemed substantial at the start, it ran out long before we could satisfy all our research desires.

We approached this research to find good ideas and techniques; not more problems; the Press, GAO, and the Congress have done enough of that. Instead, we sought to build on our experience in program offices, buying commands and at Harvard Business School to improve the defense acquisition process. Focusing on commercial practices permitted detailed investigation of various topics and scoped the potential for further research in the field.

The scenario of major commercial new product development and major capital plant/equipment programs closely parallels the acquisition of major defense systems. Such programs involve many years; major expenses upon which the future of the company depends; often new technology, and comprehensive employment of people, equipment and services into an integrated whole.

Building on our defense acquisition experience and the Harvard "case study" method, we investigated literature for best business practices as applicable to systems program management. Then we developed cases based on program examples offered by industry contacts. We found several commercial management practices definitely applicable to how we do business. These are:

Finding 1. Active involvement of top corporate managers is essential to program success.

Finding 2. Commitment to program success crosses organizational lines.

Finding 3. Schedule is first among cost, schedule and performance.

Finding 4. Program managers are afforded significant authority and resource control, and are held personally accountable.

Finding 5. Price is but one element in the purchase decision.

Finding 6. Companies are adopting more cooperative relationships with their suppliers.

Finding 7. Companies adopt uniform administrative systems.

Each chapter of the report supports these individual findings from published sources, our industry interviews and the case studies.

The findings are not unique; with some differences in approach or emphasis, they parallel those of the Packard Commission and other studies of government acquisition. To underscore this commonality, reference was made to specific sections of the Packard Commission report as the findings developed.

Our contribution is not that we discovered something new but, rather, we have assessed inhibitors to easy implementation within the defense acquisition environment and generated some practical, implementable, policy-level suggested improvements The suggested improvements that follow have been provided to senior Department of Defense and military departments' acquisition leadership.

We do not believe defense acquisition is beset with rampant fraud, waste and abuse. Rather, it is a huge, bureaucratic system operating in an environment of conflicting objectives and expectations and, thus, unacceptably inefficient. Also, we reject the naive perspective that all answers can be found in private industry because problems can also be found in many failed products. Looking at how industry acquires capital and develops new products, we focused on successful programs, identified contributing management practices and recommended adoption of these practices for use in defense acquisition.

SUGGESTED IMPROVEMENTS

Improvement 1. Establish at MS II (MS III for NDI programs) the *relative priorities* of program cost, schedule and performance in the baselines.

—Give the PM/PEO flexibility and authority to make trade-offs within baseline constraints.

—Ensure there is maneuver room between stretch goals and practical, minimum requirements.

At MS II, the baselined schedule should be as short as practically achievable via prudent cost/performance trade-offs made during the program planning process. Performance features should be designated between minimum requirements and stretch goals. "Performance" means all features directly influencing design, engineering, production, operation and support of the product or system; thus, it includes such things as unit cost, life-cycle cost, reliability and maintainability, as well as mission features (i.e., speed, range, accuracy, etc.). Stretch objectives should be incorporated if technology permits, or reserved for evolutionary upgrade if technological availability threatens the schedule. The PM should have authority to use and the best functional support available, and his judgment, to assess relative costs and benefits of performance trades and to make timely trade-off decisions. A cost buffer of 10 percent should be made available to PMs/PEOs, without need to revisit the PPBS or program baselining process, to maintain schedule and solve technical problems.

Unless our program schedules can be shortened and met consistently, we will continue to be unable to generate real teamwork so essential to program success. Top defense leaders, program managers and functional specialists must operate as teams, with confidence in each other attained through demonstrated, on-the-job performance. With long and still unrealistic program schedules, few reach this level of shared confidence; thus, teamwork suffers. Obviously, this aspect of improving systems acquisition is heavily dependent on the professionalism and experience needed on the part of all team members; Improvements 5 and 6 are key to implementation of this one.

Improvement 2. Subordinate PPBS funding decisions to DAB or SSARC approved program baselines at MS II and beyond.

—Recognize approval at MS II as a commitment for the life cycle.

Commercial companies we researched had business planning systems not unlike our planning, programming and budgeting system (PPBS) in most functional aspects. They were, barring major revenue problems, less constrained than DOD in committing funds resources over the investment phases to new programs. The keys to successful integration of business planning and stable funding in commercial business enterprises are: 1) realistic financial planning—using the business planning process in a disciplined manner to forecast revenues and expenses, thus capital funding available; 2) selective approval of program opportunities—ensuring all approved programs were affordable based on business planning; and 3) completing approved programs on schedule, thus supporting the program assumptions used in the business planning process.

Implementation of this improvement would entail:

1) Phasing in Defense Enterprise Program-like (DEP) programs (major and non-major) with milestone-authorized stable funding

2) Subordination of future PPBS decision-

making to program baseline decisions at MS II and MS III (too often budgetary cuts are applied "across the board" as though no priorities exist).

Key to this implementation is disciplined decision-making, based on realistic planning and programming; and institutional follow-through, based on commitment to, and communication of, strategic priorities.

This Figure portrays the point that PPBS drives funding available to programs prior to MS II, then it is driven by MS II and beyond program decisions. Thus, Milestones 0,1 and 5 would be subordinate to PPBS, while PPBS would be subordinate to Milestone 2-4 decisions. The Figure also supports aspects of the next improvement to reduce the number and level of program milestone decisions.

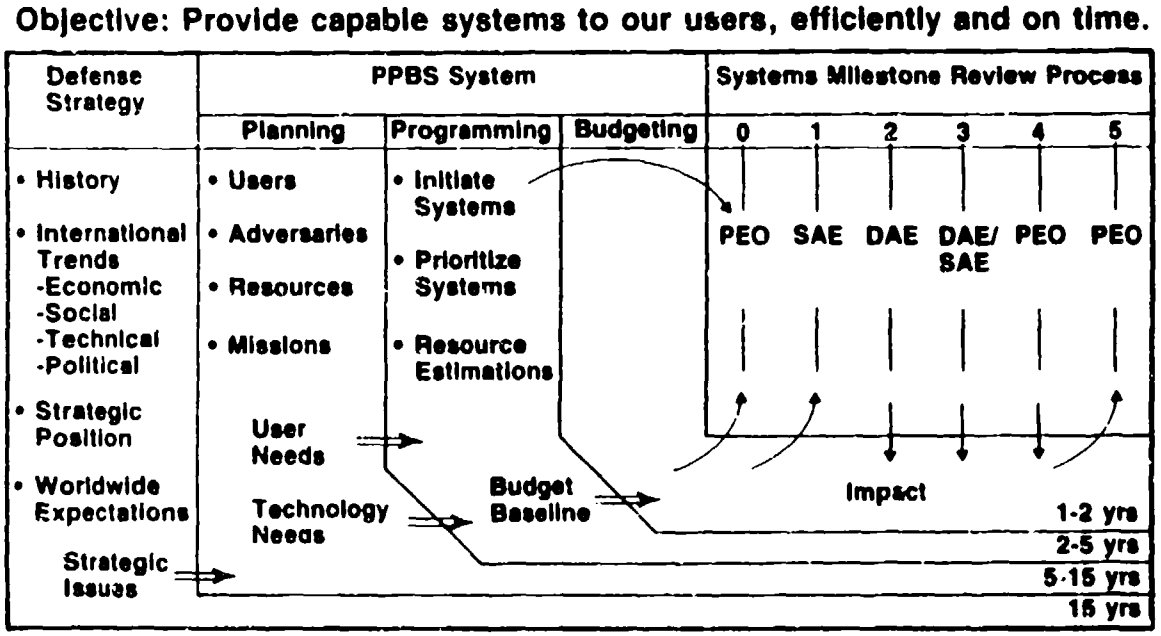
Improvement 3. Reduce the number and level of program decision milestones

—Only MS II need be a DAB-level decision.

Large commercial programs had only one or two go/no-go program decision milestones. Typically, the organization conceived of many technological or market-driven opportunities which were winnowed down by committee action, advance business planning and feasibility studies to a relative few. Based on strategic vision and resources available, top management and the Board of Directors (BOD) approved selected programs for development and implementation. If substantial technological uncertainty existed, a second milestone was required to ensure there was sufficient likelihood of success before major resources were committed. The initial committee screening of program possibilities was done at low levels within the organization as part of periodic business planning; line acquisition management, without staff or committee oversight, was then fully empowered to execute the program. The CEO, or CEO-surrogate, stayed informed and assisted line management as necessary throughout the life cycle of approved programs.

Implementation of this improvement within DOD

FIGURE IV-1. LINKING DEFENSE STRATEGY, PPBS, AND MAJOR SYSTEMS ACQUISITION MANAGEMENT



would entail limiting DAB oversight and decision to MS II only, for DOD major programs (SSARC II only for component programs); accordingly reduce the preceding and succeeding milestones one level; and delegating all other milestone decisions to the PEO in coordination with the "user" (surrogate user).

Improvement 4. Empower acquisition line managers (i.e., PM, PEO, SAE and DAE) to make program decisions, within approved program baseline constraints, without interference from functional staff advocates at higher organization levels.

This improvement augments Improvement 1. Industry PMs and their first-line general management are empowered to execute their programs without external interference as long as baseline requirements are met.

Following program approval as discussed in Improvement 3, to enter full-scale development, the PM and PEO would be empowered to use the best expertise available to solve problems and perform trade-offs as necessary to complete the program within baseline constraints and without independent oversight or direction from functional staff managers. The Service Acquisition Executive (SAE) or Defense Acquisition Executive (DAE) should be kept informed of progress and problems, directly by the PM/PEO, on a quarterly basis. The SAE or DAE would then be the link to the Defense Resources Board (DRB) and the Congress, should the program baseline need altering. Should "fact-of-life" strategic events occur, such as a major force reduction, the DAE and DAB should act to implement applicable changes to the baselines of impacted programs.

Implementation of this improvement would entail the decision-maker (SECDEF, Service Secretary, or manager with delegated program approval authority depending on program scope), at MS II, committing to the program baseline with all subordinate acquisition line managers, and ensuring the baseline objectives were sufficiently prioritized so that acquisition line managers (PM, PEO, SAE and DAE) have flexibility to solve technical problems during execution. A real budget buffer is essential to success of this improvement.

In DOD, our large senior staffs perform many of the roles associated with top management; systems acquisition is an ancillary function for senior defense leadership, providing logistics support to operational forces. We have evolved to an *acquisition system devoid of clear, CEO-like, top managers*. The DAE and SAE are staff elements, both are without control over personnel resources (who work for the military chiefs), and without full decision authority over all acquisition functional directors within the Department or Service, respectively. The result is transient leadership, temporary policy, and a huge functional bureaucracy *which manages by continuous committee consensus*.

Improvement requires clarification and simplification of who is in charge. We must establish who (singular) has program decision authority over the whole acquisition process, once a program is approved at MS II. The DODD 5000.1 needs revision to define, clearly and simply, *who (singular) can make program specific decisions involving trade-offs, personnel assignments and priorities*.

Improvement 5. Strengthen the professional functional support to program managers and reduce the dependence on staff functional oversight of program execution.

—Change the focus of functional staff managers from involvement in programs to the professional development of acquisition specialists.

Successful commercial programs were remarkable in the degree of organization commitment to program success noted. Our discussions with program and functional managers showed strong, mutual, shared goals and commitment to success. This is due partly to recognition of the importance of specific programs to achievement of the corporate business strategy, and partly to the availability of professional functional expertise in direct support of program management. Though virtually all companies were matrix organized, with many functional specialists assigned to pro-

grams in a task organized fashion, all functional personnel assigned to support a program look only to the program manager for program direction and decision-making. Program managers, in turn, depended on the expertise and recommendations of their assigned functional specialists.

The thrust of this improvement is to implement, within DOD, a system whereby top functional staffs are focused primarily on creating and managing a system to educate, train and govern careers of acquisition professionals. Such a system would provide PMs and PEOs the power to make essential personnel and program decisions and the functional expertise to plan, organize and execute programs right the first time. A collateral benefit would be less exposure to the diffusion of responsibility associated with committee decision-making.

This approach to matrix management is used effectively in military combat units where the "headquarters commandant" (consider like a functional organization manager) provides staff assets to unit commanders. The commanders make mission decisions and the staff members are not authorized to disagree. In the acquisition arena, the PM/PEO must act with the user as "advocate" for the system up to MS II. Following MS II, the "selling" aspect of advocacy can end while the PM/PEO and user shift full attention to leadership of problem prevention and solution. This can work only if real program execution authority rests solely with the PM, PEO, SAE, DAE chain of command.

Improvement 6. Ensure matrixed, functional, program support personnel are dedicated to programs through organizational alignment and incentives.

—To the maximum degree possible, matrixed personnel should work full time for, and be rated by, the PM.

Program managers in successful commercial programs have the full, dedicated support of functional specialists. The PM has hire-and-fire authority and evaluates the performance of the specialists assigned (dedicated and functional matrix). This improvement is intended to augment Improvement 5 by extending implementation to the acquisition and materiel commands of the Services where, in many cases, the functional acquisition specialists and PMs/PEOs have different chains of command. The thrust of this improvement is to provide PMs and PEOs the functional expertise they require, and deserve (dependent on program priority) to plan and execute the program right the first time. We must get away from the climate in which senior military and civilian leadership tolerates, even encourages, PMs to compete with each other for adequate resources, and accepts the divided loyalty engendered in our special advocacy system. These senior leaders should stop acting as "judges" of programs and actively manage the acquisition system.

Our policy should be in the form of principles and goals, not directives, due to the need to provide flexibility to local commanders to optimize the use of scarce personnel expertise. Adoption of this approach should reverse the growing trend in some commands to place functional participants (even those full- time on specific programs) under the control and evaluation of the functional matrix manager, thereby taking authority from the PM/PEO and diffusing responsibility for program success.

Improvement 7. Develop an on-line contractor performance history file which is available to the contracting officer (source selection official in systems programs).

This improvement is directed at procurement of non-system equipment and services which usually do not rate a source-selection-evaluation process. Some elements could, as well, be applied to major system acquisition, for example, the excellent initiative of the Air Force Systems Command's Contractor Performance Assessment Report (CPAR).

The first step in using quality information in making source selections is to make it available to the contracting officer. Implementation of this improvement should be phased. First, elements of the file should be established and should include indices for price, delivery and reported quality problems.

Second, the ability to input and access the files throughout DOD must be established. A partial net will not be sufficient, since it will fail to provide the objective information needed to eventually make source selections.

Third, once the network is functioning, quality factors can be established to adjust bid prices to reflect the cost of schedule or other problems. (In systems programs, past performance, including quality, would be evaluation factors independently considered along with price/cost.)

There are several evolving approaches to implementing aspects of such a system. We are aware of efforts sponsored by the Defense Logistics Agency and the military services to move in this direction. These are limited in scope and do not exploit the potential for more accurate measurement. This is essential in the acceptance of such systems and their ability to withstand administrative protest.

Improvement 8. Establish a variable specification method of contract source selection for non-system procurement.

The current method of establishing a minimum specification which, if satisfied, permits the selection to be made based on price, should be selectively replaced by a method through which target performance specifications are set. Variations around this target will be evaluated using a preestablished and published cost/performance trade-off formula. For example, life-cycle cost elements of performance/quality (i.e., reliability, maintainability, etc.) could be quantifiably related to adjustments to the price basis for award. The U.S. Army Communications Command has been doing this successfully for several years in their non-developmental item (NDI) program to acquire commercial electronic test equipment.

Such a method would preclude the need to "gold plate" specifications, and would alter the incentive systems for contractors. It would provide incentives for contractors who have better ways of meeting requirements to be selected over contractors who barely meet the specification, as written, at the lowest cost.

Improvement 9. Adopt, communicate, and enforce a policy of complete neutrality with regard to subcontract competition, including a cessation of data gathering.

Because competition connotes fairness and equity in the expenditure of government funds, it will likely be the preferred method of government procurement for future years. The need for equity is much less compelling at the subcontractor level, however, and the degree of competition or cooperation with suppliers is a purely business decision. In many or perhaps most cases, prudent business judgment will warrant the use of some form of competition; but, in others, the benefits of improved quality, or reduced total costs will will call for a sole-source cooperative arrangement. The DOD should not restrict its contractors from using the best business practice; then, as always, hold them strictly accountable for ultimate results. Only with this flexibility can the defense industry be expected to fully implement new ways of doing business like TQM.

Typically, two opposing arguments arise. One is, "DOD doesn't advocate subcontract competition, they just track it"; the other, "DOD only wants subcontract competition in cases where they don't have prime competition." Both are tantamount to advocating subcontract competition across-the-board. Tracking conveys the perception that DOD wants it; the contractors react accordingly. Requiring it on a single contract results in the contractor adopting a single system to ensure competition on all purchases (reference Finding 7).

Improvement 10. Use the contractor's cost accounting system and eliminate duplicate reporting methods.

The intent of the Cost Schedule and Control System (CSCS) was to use contractor-provided data to monitor the performance under the contract. In intent and concept, it is not significantly different from the systems described as in place to monitor commercial capital improvement projects or new product introductions. Unfortunately, the CSCS system has become a source of contention between the government and the contractor in its application. It can be advantageous

to the contractor to maintain two cost-accounting systems—one for its internal management and a separate one as a CDRL requirement under the contract so as to limit exposure to external review.

Taken from the perspective of the commercial program manager, the CSCS system provides too much information. What is truly needed is a system which provides top-level overview of cost and schedule progress and which is timely (i.e., actual, vice massaged data) and accessible on a daily basis. The detailed backup should be available on an "as needed" (query response) basis to investigate any problems highlighted in the top-level document. Presently, the time delay in reporting is too long, and too much time is spent investigating particulars of the reporting system.

Improvement 11. Waivers of policy and reporting requirements should be granted for an entire commercial activity for an extended period of time, not on a contract-by-contract basis.

Commercial entities need and employ consistent standards for administering activities. Policies that encourage a perception of uniqueness in defense procurement are often counterproductive because commercial business administrative systems have difficulty adapting to them. Each of the prime Defense Enterprise Program contractors contacted indicated they saw little difference in the requirements under which they operate and that of other programs. Similarly, in the commercial environment, it is felt to be just "too expensive" to operate parallel systems which must meet different policy or reporting requirements.

Policy or reporting changes need to be company-wide and for an extended period if any positive results can be expected.

APPENDIX A
UNITED TECHNOLOGIES CORPORATION CASE

PROJECT NAME: PW4000 Engine

COMPANY: United Technologies Corporation, Pratt and Whitney

DATE OF VISIT/INTERVIEWS: 14 April 89

PERSONS INTERVIEWED:

Mr. James Bruner, Director, PW4000 Engine Programs, Pratt and Whitney
Mr. Roger Chericoni, Vice President, Group Product Integrity, Pratt and Whitney
Mr. James Ward, Manager Internal Audit United Technologies Corporation

DESCRIPTION OF SYSTEM

The PW4000 is a high thrust (50,000-65,000 pound), fuel efficient, turbofan engine for use on large wide-body commercial aircraft. The PW4000 was initially designed, developed, and FAA certified to cover a broad spectrum of aircraft applications. It was then adapted to, and recertified with, each aircraft type it powers. It is u' ' to power the Airbus A300 and A310, Boeing 767 and 747 and MD 11 airliners. The engine development goals, compared with its predecessor engine JT9D-7R4, were low fuel consumption (7 percent less), low maintenance costs (25 percent less) and low manufacturing cost (50 percent less). The thrust goal of 60,000+ pounds was established as a result of forecasting efforts in 1981 'o predict commercial aircraft needs of the 1990s (the JT9D thrust was 56,000 #). The June 1986 FAA certification deadline was established to ensure availability of a mature engine system in time to meet airline company needs and airframe company offerings projected for 1987. Pratt and Whitney (P&W) personnel explained that it takes airframe companies about 3 years to develop a new airliner but 4-5 years to develop a new engine, so they had to start before the airliners were designed.

SCOPE OF PROJECT

1. **Timeframe.** Study Phase - 1981
   BOD Approval: Fall 1982
   FAA Certification (PW4000): June 1986

2. **Funding.** Up to $1B were invested by Pratt and Whitney to design, develop and certify the PW4000 and its principle aircraft applications. Of this, approximately 60 percent was for ' sign, development and certification of t' sic PW4000, with the remaining 40 percent ... applications and improvements.

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

1. **Program/Project Management**

a. The PM (termed Program Director at P&W) was given "carte blanche to do things differently" if necessary to meet the program goals. This was interpreted to include coordination with, and solicitation of, suppliers; such as inducing them to "buy in" to the future business opportunities of a long-term strategic alliance; another "sacred cow" attacked in the PW4000 program was "In-series design and development"—that is, maximizing concurrent engineering. Responsibility and

authority to circumvent "business as usual" attitude and procedures was driven down to the lowest level in the organization.

b. Dedicated project team of 1,200 persons, including matrixed specialty support, as required. The PM's office was staffed by 250 personnel who performed business management, design (120 mechanical designers), management of development, management of manufacturing and analysis and marketing. Logistics management was done in the support matrix. Excluding the design effort, the immediate PM office was moderate in size for the project scope.

c. Mr. Bruner indicated that he and each subordinate manager had direct input to the selection of all directly reporting personnel. The PM had significant personnel management power and could rapidly direct increases and decreases in manpower applied to functional efforts; the matrix was there to respond to the immediate needs of the project using an "equal hurt" philosophy. To ensure high-quality participants, some start-up manpower allocation efforts lagged.

d. The total programmed funds were committed by top management at the beginning and total control of the funding was provided to the PM annually. The PM had flexibility to transfer funding between elements of the program as required, providing he stayed within annual budget increments. He could move effort between years as long as total annual expenditures were according to plan.

e. Pratt and Whitney Commercial Engine Business manages about 8-9 engine projects at any time; these are managed under Program Directors. The PW4000 is currently the largest, but extensive management is applied to other current engines and some developmental pro A larger thrust [than the PW4000] engine ap, ars to be in the conception stages. It was noted that all projects were funded according to expected needs; they used the term "smooth funding" to distinguish from other techniques which may involve large annual budget jumps or drops. The PW4000 was approved and funded by the United Technologies Corporation (UTC) Board of Directors. Smaller projects are approved at the same level but funded and managed by Pratt and Whitney.

f. The Director, Mr. Bruner (referred to as the PM throughout) reports through the VP, Engineering, to the President of the Commercial Engine Business Division, thence to the President of Pratt and Whitney and finally to the Chairman of UTC.

g. Mr. Bruner indicated that his career has been principally in project management which includes aircraft integration and customer support. Program participants were free to pursue their own career paths into and out of project management.

2. **System Engineering Management.**

a. Key to accomplishing most program goals was the first 6 months in which detail planning and design was done by a team of design and manufacturing engineers. This team created a contract between designers and manufacturing on features and technology to be used in the product. This contract essentially was a functional specification to guide and constrain . . sign engineers. Using the production so.. e for development hardware enhances learning and lowers initial product cost, but does require significant compromises in a volume driven facility.

b. The PW4000 pushed the state-of-the-art in several areas (e.g., compressor airfoil aerodynamics). Most efforts involved backup designs using more conventional technological approaches should difficulties be encountered. Technical problem-solving was done by the PM in concert with his peer leaders from the applicable technology are .

c. The PW4000 PM had total responsibility and authority for configuration control.

d. The te: plan was developed by the PM in coordination with Directors (peers) of various engineering elements of Pratt and Whitney. The test program was directed by the PW4000 project team, not an independent tester. The FAA certification testing was planned and conducted by the project team; the FAA monitored tests of choice; the project team wrote and submitted test reports. The PM had authority to schedule, reschedule and resequence tests as he felt necessary to meet project goals.

RESULTS ACHIEVED

The PW4000 has already been a major success for Pratt and Whitney. Certification was completed on time, June 1986, within budget. Of the program performance goals, thrust and maintenance cost goals were met; fuel consumption is not quite as desired primarily due to competitive pressures requiring further improvements. Post certification improvements have been identified and are being incorporated. The competition still lags in all aircraft installations. Manufacturing costs are still slightly higher than the goal termed a "stretch goal." Improvement efforts are underway to meet or beat original goals. Sales of the PW4000 thru 1988 were in excess of $4B despite the primary U.S. competition introduction of an enhancement of a current engine design 21 months ahead of P&W. It appears that P&W's strategic forecast correctly targeted the timing of the market need and necessary features for success.

USING COMMERCIAL PRACTICES IN DOD ACQUISITION: A PAGE FROM INDUSTRY'S PLAYBOOK

Report of the Defense Systems Management College
1988-89 Military Research Fellows

Lieutenant Colonel Bruce D. Sweeny, USA
Commander Charles A. Perkins, USN, SC
Lieutenant Colonel Alan C. Spencer, USAF

December 1989

Views, findings and opinions in this Report are the authors and should not be construed as official Department of Defense positions, policies or decisions unless so identified.

PREFACE

"Instead of concentrating on the things that are being done wrong and trying to fix them with more laws, more regulations, more inspectors, DOD should concentrate on those things that are done right and use them as models."

(Packard Commission Report, p. 42.)

This report represents the efforts of the first group of military Research Fellows at the Defense Systems Management College. The 11-month senior Service, college-level fellowship included 3 months at Harvard Business School's Program for Management Development. Commercial practice was selected as the research topic area to capitalize on: 1) the apparent interest in having the Department of Defense (DOD) "do business like business"; 2) contacts and knowledge gained at Harvard; and 3) the strong, functionally diverse DOD acquisition backgrounds of the authors.

This volume is the full research report which includes the commercial case studies documented during industry site visits and the Mobile Subscriber Equipment (MSE) U.S. Army acquisition case study. A Summary Findings and Recommendations volume has been completed and provided to senior DOD acquisition leaders.

EXECUTIVE SUMMARY

INTRODUCTION

Using commercial business practices, or "doing business like business," is a recurring theme of the defense reform debate. The 1972 Commission on Government Procurement called for the "businesslike" operation of federal procurement. The 1984 Grace Commission sought to apply "private sector management tenets" across the entire federal government. More recently, the Packard Commission and the 1986 Defense Science Board (DSB) noted the potential advantages of adopting commercial practices in the Department of Defense and, in broad terms, identified some of those practices.

Despite the potential advantages that commercial practices offer, however, DOD has yet to implement them on a widespread basis. The exhibit below shows basic reasons for delay.

EXHIBIT 1.
INSTITUTIONAL IMPEDIMENTS TO THE GOVERNMENT USING COMMERCIAL PRACTICES

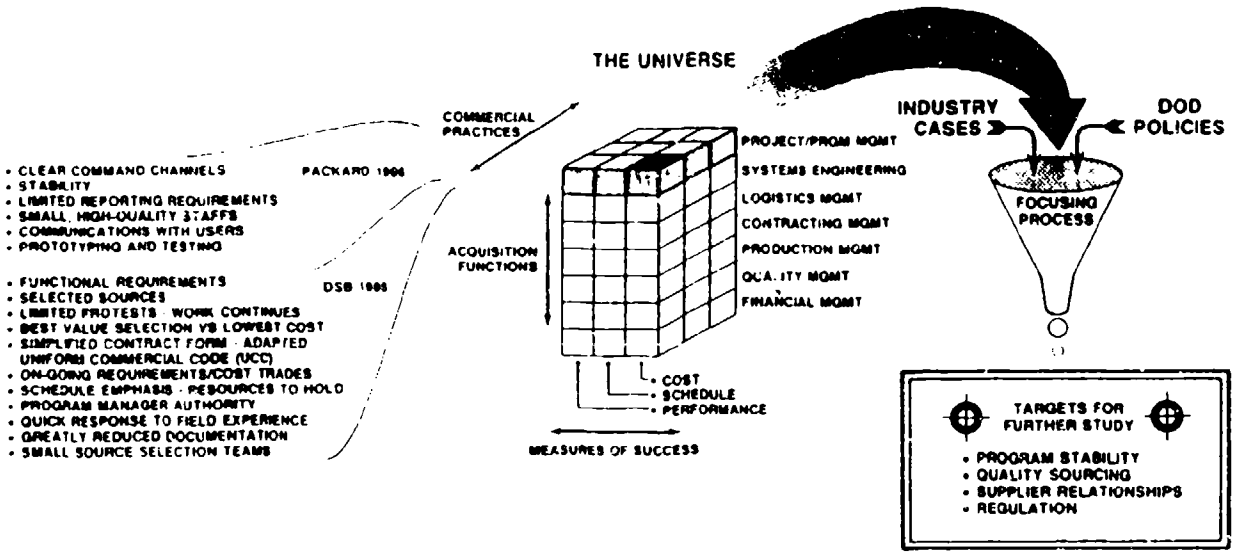
- —Confusion over specifically what they are
- —Sheer size of public sector
- —Inherent differences between the public and private sector

PRIVATE SECTOR	PUBLIC SECTOR
Single Constituency: "Shareholders"	Multiple Constituencies: "Stakeholders"
Singular Focus: "Efficiency"	Mixed Focus: "Efficiency" & "Equity"
Clear Measure of Success: "Bottom Line"	No Clear Measure of Success.

Some say these differences between the public and private sectors are so profound that government can never "do business like business." Others, notably the Packard Commission and the DSB, recognize these differences but feel DOD can still benefit from lessons of the commercial sector. Believing this, we investigated commercial practices for opportunities to improve the acquisition process in DOD.

Principal methods of investigation were literature review and personal interviews. Using facilities afforded by the Defense Systems Management College (DSMC) and Harvard University, extensive readings were conducted of topics under the general heading of good business practice. The research model we developed as the framework for our investigations is shown below.

EXHIBIT 2.
RESEARCH MODEL



Target commercial practices were investigated for clearly successful applications and techniques which can be implemented within the authority of the Secretary of Defense, and would have high payoff if established in policy, communicated, implemented, and carried into general practice by DOD and the Services. Our selected target practices are: 1) program stability (aspects other than funding which remains largely in the domain of the Congress), 2) quality sourcing, 3) supplier relationships, and 4) regulation. Our investigation drew heavily on our interviews with industry representatives of the firms identified in Figure 1.

FIGURE 1. RESEARCH CONTACTS WITH INDUSTRY

WESTINGHOUSE •	• GENERAL ELECTRIC •
• GTE •	• DOW CHEMICAL •
• TEKTRONIX •	PUBLIC SERVICE GAS •
EASTMAN KODAK •	• BECTON DICKINSON •
ROCKWELL •	• PACIFIC BELL •
VALENTEC •	BOEING •
MARTIN MARIETTA •	• UNITED TECHNOLOGIES •
DIGITAL •	GEHL •
GENERAL DYNAMICS •	AT&T •
BRITISH AIRWAYS •	• HP •

• Interviews; • Commercial Case; • DoD Case

We developed seven commercial case studies comprising twelve successful, major, new product and capital plant/equipment programs by commercial business entities; the scope of these is shown in Figure 2; the full case studies are provided in the appendices. In addition, we developed a case study to document the experience of one of the Defense Enterprise Programs, the Army's Mobile Subscriber Equipment, because it utilized substantial commercial-like acquisition practices.

Case studies were also extracted from the 1985 DSB Summer Study on *Practical Functional Performance Requirements*. These provided additional opportunities to investigate commercial programs of similar scope and are identified in Figure 3.

FIGURE 2. COMMERCIAL CASE STUDIES DEVELOPED

Scope

Case#	1	2	3	4	5	6	7
Co	UTC	HP	Dow	Tektronix	GE	PacBell	BDIS
Proj	PW4000 Engine	Several	Several	Several	Several	Adv Digtl Ntwk	FAC-Star
New	Prod	Prod & Plants	Plants	Plants	Plants	Prod.	Prod
Time	4.5yrs	1-4yrs	18mos	1-2yrs	3yrs	27mos	18mos
Funds (est)	~$1B	~$500M	~$600M	~$100M	~$100M	Not Released	~$10M

FIGURE 3. 1985 DSB COMMERCIAL CASE STUDIES

Scope

Case#	A	B	C	D	E
Co.	AT&T	Boeing	SBS	IBM	MITRE
Prog.	EES-4 Switch	767 Aircraft	Comm Sat'llite	360 Computer	FAA Nat'l Airsp Sys
All cases were new product development.					
Time	8 yrs	4 yrs	34 mos	3 yrs	Unk
Funding was not identified in cases by DSB.					

In our findings, specific techniques for managing successful major commercial programs are identified and attributed to these cases. These findings and suggested improvements are related to the target practices we investigated via Figure 4.

FIGURE 4. RELATIONSHIP OF STUDY FOCUS TO FINDINGS AND RECOMMENDATIONS

STUDY FOCUS	FINDINGS	RECOMMENDATIONS
Program stability	• Top management involvement • Organization commitment • Line acquisition mgmt authority • Schedule Primacy	- Prioritize among C,S,P objs at MS II - Subordinate PPBS to baseline at MS II - Reduce # and level of decision MSs - Empower PM/PEO/SAE - Improve sys'n profl career mgmt system - Give personnel control to PM/PEO
Quality sourcing	• Selection basis quality & price	- Provide on-line f/r performance file - Use variable specs
Supplier relationship	• Cooperation vs competition	- Stop subcontract competition advocacy
Regulation	• Uniform admin systems	- Use Fr. CAS - Apply reporting rqmts to company, not to contract

FINDINGS

There are no "gee-whiz" answers!

We observed little in the commercial acquisition environment new or different from what has always been known as good management practice. Correspondingly, little has not been associated with DOD policy, identified as a problem by the Department in the past, or is not being tried someplace in DOD. Many good ideas proposed by the Packard Commission and the Defense Science Board must overcome tremendous organizational inertia. As a direct result, many good business practices, though employed somewhere in DOD, are not used widely. The Department is like a supertanker—superb at accomplishing its primary mission but sluggish in changing course.

Finding 1. Active involvement of top corporate managers is essential to program success.

Successful major systems programs in the commercial acquisition environment are the product of unequivocal top-management approval and support. In projects reflecting the strategic emphasis of the company, there is clear linkage to organization business strategy and direct involvement of the Chief Executive Officer (CEO). Involvement does not mean micromanagement, but does mean awareness of the project's current status, active questioning, and willingness to commit organization resources to resolve problems.

Top management leads (e.g., promotes within) selected programs by: 1) communicating the vision, 2) reviewing programs often, and 3) solving problems beyond the control of lower-line managers. Once a decision is made to enter engineering development, the CEO commits to seeing it through.

Finding 2. Commitment to program success crosses organization lines.

In each company visited, there was a real organization commitment to the success of major programs. The commercial marketplace severely penalizes companies which do not bring new products on line once major resources have been committed (typically, entry into full-scale or detail engineering). The functional staffs, operational and program managers, exhibited shared goals and direction. Managers of functional departments (e.g., vice presidents of marketing, engineering, manufacturing) and staff directorates were responsible for providing resources (the right people and technology) and assisting the program/project manager (PM) to solve problems; they were not involved with program oversight and direction.

Finding 3. Program managers are afforded significant authority and resource control, and are held personally accountable.

Program management authority was assigned to a clearly-visible acquisition line manager whose title may be program manager (PM), vice president (VP) or general manager (GM), but this authority was not shared with functional managers. Acquisition line managers generally are "captains of their ships," held responsible and accountable for the success of the project but given the authority to make timely decisions and control critical resources (especially participating personnel).

Successful commercial programs also depend on focused decision-making up the line; PMs of major systems have and use direct access to top management to keep the CEO, or surrogate, informed and to resolve problems beyond the capability of the PM. Senior functional officers (e.g., VPs of marketing, engineering, manufacturing, etc.) are charged with providing support to line management but not direction of lower-line program management. They provide experienced, professional personnel to give the PM every opportunity to get it done right the first time.

Finding 4. Schedule is first among cost, schedule and performance.

Without exception, we found that schedule was the driving motivation, thus, the first priority in the commercial acquisition environment, once a program is approved for development and/or implementation. This practice is primarily market driven due to implications of late entry on long-term market share and need to recover investment and overhead costs quickly.

Performance features are the next priority. Sufficient performance (mission capability, supportability, life-cycle costs and unit costs, etc.) is ensured. But, stretch goals were used, with contingency developments to facilitate trade-offs

should the schedule be jeopardized or development costs become excessive. Preplanned product improvement, or evolutionary development, was the standard approach to pick up desired technology or features not available at planned schedule cutoff points.

Funding is the business tool to achieve on-time program completion. In all cases a 10 percent buffer was provided to the PM or his first-line general manager to use to stay on schedule and solve unexpected technical problems.

Finding 5. Price is but one element in the purchase decision.

Ownership cost and dependable quality were dominant variables in commercial buying decisions. Purchase price would be traded off for desirable features, uniformity and dependability in required products. Firms tended to have a strong technical (engineering) background in the purchase department so they knew the marketplace and could understand requirements.

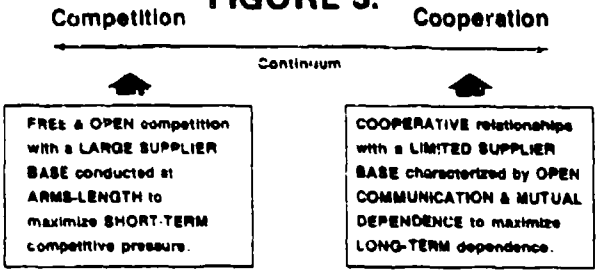
Companies prefer dealing with a few suppliers. They do not abandon competition, but recognize its limits. Practices like Just-in-Time (JIT) and Material Requirements Planning (MRP) depend on reliable deliveries of uniform quality from suppliers. Quality is becoming a total company commitment with access and input to data base information being made available to more organizations in the company. Firms are developing systems to factor past performance into their source-selection decisions and are communicating these systems to their suppliers.

Finding 6. Companies are adopting cooperative relationships with their suppliers.

There is a trend for companies to adopt cooperative relationships with suppliers, away from the traditional, competitive way of doing business. This new relationship goes by many names (partnering, strategic alliances, co-makers, value-added partnerships, etc.), but the central elements are common: long-term arrangements with a small number of high-quality suppliers; relationships characterized by mutual dependence and open communications.

Every company we visited was using partnering to some degree. Programs like Total Quality Management (TQM) and Just-in-Time (JIT) fuel

FIGURE 5.



the trend. Dr. W. Edwards Deming, of TQM fame, says that best value can be realized only through long-term, sole-source supplier relationships. Similarly, JIT often drives companies toward sole-source arrangements with suppliers.

Commercial companies do not use sole-source on a wholesale basis. Rather, they apply business judgment to each situation, forming partnerships with a few suppliers for most items, but reserving sole-source arrangements for items of particular importance. Department of Defense contractors stop short of effective partnering with suppliers, seemingly because they perceive DOD desires full and open competition in subcontracting.

Finding 7. Companies adopt uniform administrative systems.

We visited firms doing defense and commercial business. Generally, these companies segregated their business units so commercial and defense business was not colocated or comanaged. In cases where the firm was producing a defense item and a commercial item on the same floor, they adopted the defense approach to sourcing, inspection and quality control for all items on the floor. The cost of managing two systems was deemed too expensive and confusing to the work force.

We found also that relaxing a standard for a given contract was, in many ways, ineffective. Generally, if the company had other defense contracts, it imposed the defense standard requirement on itself so it would not lose certification of its process. This has a significant policy implication because we may consider waiving certain requirements for a good contractor expecting cost savings to be applied to the contract. But, this may not be the case if the contractor has other govern-

ment business which will not be affected or may wish to compete for other business for which the waiver or the requirement may not be granted.

IMPROVEMENTS, INHIBITORS AND IMPLEMENTATION

Our recommendations are similar to those of previous studies; therefore, it is reasonable to ask why they have not already been implemented. We realize that overcoming institutional inertia is a major impediment to successful application of good ideas across a huge bureaucracy. In this section, we acknowledge certain environmental constraints inhibiting ready adoption of our recommendations and suggest some implementing steps we feel can begin overcoming the inertia.

The Department recently underwent a major acquisition reorganization in response to the Packard Commission recommendations. Therefore, we do not attempt to deal with organization issues but, instead, concentrate on people and process management issues. Nor, do we propose any manpower adjustments. We do sense strongly that most acquisitions professionals can be more effective and the acquisition process more efficient if these commercial management techniques are institutionalized in DOD.

Table 1 identifies specific improvements in acquisition practice, principle environmental inhibitors and suggested implementing approaches.

TABLE 1

SUGGESTED IMPROVEMENTS	INHIBITORS	IMPLEMENTATION
1. Establish at MS II (MS III for NDI programs) the relative priorities of program cost, schedule and performance in the baselines.	Institutional willingness to trade time for added funding or performance.	Revise DODD 5000.45 policy principles.
	Historical failure to meet schedule objectives promotes excessive requirements.	Educate decision-makers and staff advisors on costs of requiring perfection and benefits of practical trade-offs.
—Give the PM/PEO flexibility and authority to make trade-offs within baseline constraints.	Institutional aversion to budgeting for risk and contingency.	Relates to Recommendations 2-6 below.
—Ensure there is maneuver room between stretch goals and practical minimum requirements.	Program development and production phases far exceed tenure of decision-makers; thus, decisions are reconsidered by later decision-makers.	
2. Subordinate PPBS funding decisions to approved program baselines at MS II and beyond.	Institutional aversion to reducing flexibility in future budgets.	Revise DODD 5000.1, para E.3. and flow-down to other directives/instructions.
—Recognize approval at MS II as commitment for life-cycle.	Lack of clear linkage between essential programs and military strategy objectives.	Build up the number of DEP programs with milestone authorizations.
	Tendency of senior military and civilian leadership to act as "judges" of programs instead of managers of the system.	

TABLE 1 (CONTINUED)

SUGGESTED IMPROVEMENTS	INHIBITORS	IMPLEMENTATION
3. Reduce the number and level of program decision milestones. —Only MS II need be a DAB-level decision	Institutional tendency to overcontrol actions of subordinate layers. Institutional tendency for continuous management by committee.	Revise DODD 5000.1, para D.3. and flow-down to other directives/instructions.
4. Empower designated system acquisition managers (i.e., PM, PEO and SAE) to make program decisions within approved baseline constraints without interference from functional staff advocates at higher organizational levels	Institutional tendency for functional specialists to appeal to staff advocates rather than compromise in the best interest of program as a whole Lack of sufficient functional expertise in direct support of PMs and PEOs	Relates to Recommendations 1, 3, 5-6.
5. Strengthen the professional functional support to program managers and reduce the dependency on staff functional oversight of program execution. —Change focus of functional staff managers from involvement in programs to professional development of acquisition specialists.	Institutional tendency to regulate and check vs. make long-term systemic improvements. Historical lack of institutional motivators for functional specialists to remain at operational levels of organization.	Strengthen DODD 5000.52 to include central career management for all functional specialists. Discontinue use of DAB acquisition committees and Service equivalents to "prepare" programs for MS decisions.
6. Ensure that matrixed, functional, program support personnel are dedicated to programs through organizational alignment and incentives. —To the maximum degree possible, matrixed personnel should work full time and be rated by the PM.	Myth that matrix management of programs can be effective on a part-time, indirect consulting basis. Lack of institutional trust in PM/PEOs to consider functional input which may compromise cost, schedule or mission performance. Institutional attitude that PMs should *compete* against each other for resources.	See Recommendations 1, 4-5. Ensure PMs have rating and reward control over assigned functional specialists. Make functional matrix managers responsible for ongoing execution of system introduced in Recommendation 5.
7. Develop an on-line contractor performance history file which is available to the contracting officer.	Information is not currently collected or maintained in a DOD-wide system accessible to the contracting officer. System of evaluation must be objective and open to review. Service and agency difference in the approach to performance monitoring.	Using the DLA system as a base, link all DOD contracting officers and major ACOs with a data network.

TABLE 1 (CONTINUED)

SUGGESTED IMPROVEMENTS	INHIBITORS	IMPLEMENTATION
8. Establish the variable specification method of source selection.	Complicates the source selection process for non-systems procurements. Dependent on good specification definition with levels of acceptability. While no legal or regulatory restriction, it will be difficult to overcome institutional emphasis on acquisition price.	Select 25 developmental or upgrade contracts as a pilot test.
9. Adopt, communicate and enforce a policy of complete neutrality with regard to subcontract competition, including a cessation of data gathering.	Defense contractors react to what they perceive to be DOD's desire for full and open competition in subcontracting. This severely restricts effective partnering with suppliers and inhibits full application of TQM and JIT implementation.	Adopt, communicate and enforce the policy.
10. Use the contractor's cost accounting system and eliminate any duplicate reporting methods.	DOD's cost reporting system has become paper bound. The current CSCS system can provide information important to managing a program. The regulatory dilemma, companies decry the cost of regulation while exploiting the advantage of "knowing the system."	For all contracts which are not Firm Fixed Price, use the contractors data system for Cost schedule and control information. This information should be the same as that which is fed into the company's financial reports.
11. Waivers of policy and reporting requirements should be granted for an entire commercial activity for an extended period of time, not on a contract-by-contract basis.	Waivers on individual contracts are considered ways of bypassing costly elements of standard systems. Difficulty of startup implementation and determining how to react to poor performance on a single contract. Contractors performing on multiple government contracts adopt the standard.	Disapprove any deviation or waiver which is not company-wide.

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Background

There is a longstanding public debate over how the Department of Defense (DOD) acquires it's weapons; a debate fueled by periodic "breakdowns" in DOD's acquisition system. Recent, highly-visible breakdowns have eroded public and congressional confidence in DOD acquisition to, perhaps, an all time low; and the defense reform debate has increased in fervor and pitch.

One recurring theme of much of that debate is, why can't DOD simply "do business like business?"; in other words, why can t DOD adopt commercial ways of doing business in buying? Early thrusts in this direction centered around recommendations that DOD adopt the use of commercial products whenever possible. Some feel that if DOD would eliminate unnecessary specifications, it could purchase readily-available, off-the-shelf items, and by doing so, enjoy the benefits of the commercial marketplace (competitive pricing, the latest product development, and rapid availability, to name just a few). Arguments to this effect go back at least to the 1972 Commission on Government Procurement which acknowledged the merit of buying commercial products in lieu of items manufactured to federal specifications. That Commission called for a"...shift in the fundamental (DOD) philosophy relative to commercial product procurement...." Although the primary emphasis during this period was on the use of commercial products, the 1972 Commission seemed to have commercial ways of doing business in mind as well when they stated, "The system we advocate will enable the executive branch to ensure that procurement operations are businesslike and orderly and that goods and services are acquired efficiently."[1] The "busiesslike" operations referred to here are the forerunners of what later came to be known as "commercial practices."

It is important at this juncture to better define the semantical difference between "commercial products" and "commercial practices." While the two are closely related and often confused, they are distinctly different. "Commercial products" are off-the-shelf items developed to commercial standards for the commercial marketplace. "Commercial practices" is a much broader term, meaning the entire process by which commercial companies conduct their business. In the latter case, the focus on the business *process* rather than on acquiring the end-product.[2] While DOD's use of commercial products has been the subject of multiple studies since the 1972 Commission, the use of commercial practices suffers from a dearth of focused study. Accordingly, our research emphasis here will be on the use of commercial practices by the Department of Defense.

COMMERCIAL PRODUCTS	V.	COMMERCIAL PRACTICES
Off-the-shelf items developed to commercial standards for commercial markets.		Commercial ways of going about the full range of business activities.
Emphasis on PRODUCT		Emphasis on PROCESS

In the decade of the 1980s the defense reform rhetoric has been building to a crescendo, with recommendations to "do business like business" as an essential element of much of the debate. In 1981, then Deputy Secretary of Defense Frank C. Carlucci introduced a comprehensive reform package known as the Acquisition Improvement Program (although probably better known as the Carlucci Initiatives). This program embodied a number of recommendations, many of which are

based on commercial business models, such as the call for more responsibility, authority, and accountability for DOD program managers.[3] In 1983 President Ronald Reagan was so interested in the idea of running the government like a business that he asked industrialist, J. Peter Grace, to lead a study of how to achieve that objective. That study, known as the President's Private Sector Survey on Cost Control or the Grace Commission, came up with 2,478 specific recommendations that would yield projected savings of $424.4B over 3 years if implemented government-wide (not just DOD). In their report the Commission said these savings could be realized by applying "private sector management tenets" across the broad spectrum of the federal government.[4] Similarly, in 1986, the President's Blue Ribbon Commission on Defense Management (the Packard Commission) strongly advocated the use of commercial products, then went on to say, "Even when commercial products are not suitable for DOD's purposes, it can still use commercial buying practices to real advantage."[5] A 1986 Defense Science Board that was chartered to focus on the use of commercial products in DOD stepped outside their charter to reach a similar finding. They said, "...although the increased use of commercial equipment (in DOD) is good, the increased use of commercial *practices* could be even better."[6]

FIGURE I-1. "DOING BUSINESS LIKE BUSINESS"

Packard Commission 1986	"Even when commercial products are not suitable for DOD's purposes, it can still use *commercial buying practices* to real advantage."
Defense Science Board 1986	"...although the increased use of commercial equipment (in DOD) is good, increased use of *commercial practices* could be even better."
Grace Commission 1984	...apply "*private sector management tenets*" across the broad spectrum of the federal government.
Commission on Government Procurement 1972	We seek to "enable the executive branch to ensure that DOD procurement operations are *businesslike*."

The Congress apparently shares the belief that there is potential payoff in DOD's expanded use of commercial practices, enthusiastically embracing the findings of the Packard Commission. More recently, Dr. Robert B. Costello, while Under Secretary of Defense for Acquisition, identified commercial practices as an important element in the far-reaching Total Quality Management (TQM) initiative for the Department. At this point, it should be clear that there is a developing consensus favoring the use of commercial practices as a solution for some of the seemingly intractable problems facing defense procurement. Of course, this should not be viewed as a panacea, but rather a source of good ideas for selective application within DOD.

Institutional Impediments to Adopting Commercial Practices

Given this developing consensus for the use of commercial practices in DOD, why doesn't DOD simply adopt them and be done with it? Granted, some laws and regulations would have to be changed, but the lawmakers and regulators as parties to the consensus should be willing to do so. In reality, however, many of the impediments to DOD's adopting commercial practices are not based in laws or regulations, but are rooted deeper, in a more basic, institutional foundation.

Perhaps the most basic of these reasons is confusion over exactly what commercial practices are. At the macro level people seem to have a reason-

FIGURE I-2. INSTITUTIONAL IMPEDIMENTS TO THE GOVERNMENT USING COMMERCIAL PRACTICES

- —Confusion over specifically what they are
- —Sheer size of public sector
- —Inherent differences between the public and private sector

PRIVATE SECTOR	PUBLIC SECTOR
Single Constituency: "Shareholders"	Multiple Constituencies: "Stakeholders"
Singular Focus: "Efficiency"	Mixed Focus: "Efficiency" & "Equity"
Clear Measure of Success: "Bottom Line"	No Clear Measure of Success.

able understanding of what is meant by "doing business like business." They tend to think of less bureaucracy, faster, cheaper development cycles, more flexibility in decision-making, and, finally, greater accountability for results. But these factors are really benefits emanating from the idealized commercial acquisition system, rather than actual characteristics of such a system. What then are the specific business practices used in the commercial sector that yield these desirable characteristics? We must have this level of specificity before we can implement commercial practices in DOD, but it is here that the definition of these practices is unclear. It is not surprising that this lack of definition has worked against DOD's wholesale adoption of commercial practices.

Another factor that mitigates against adoption of commercial practices in DOD is the inherent difference between a public activity and a commercial one. A commercial activity has essentially a single constituency (the stockholders), and a singleness of purpose in pursuing their chosen business endeavor in the most efficient, effective manner possible. They have the bottom line of their profit and loss statement to objectively assess their performance toward that goal.

A typical government activity, on the other hand, serves a multitude of constituencies (the stakeholders), many of whom have different, often conflicting, expectations of that activity. A government activity does not enjoy the clarity and singularity of focus customary for a commercial activity. The focus of the government activity is likely to be ambiguous and rapidly changing, with changes made for political reasons rather than efficiency. In addition, the service provided by the activity may be abstract, making measurement of that service very difficult.[7] As such, an activity's success can not be measured easily by a single quantitative parameter such as the commercial firm's bottom line but, rather, by a general feeling of goodness.

Finally, commercial and government activities differ significantly in the flexibility they have in expending funds. The commercial activity is primarily concerned about the efficiency of an expenditure in furthering the objectives of that activity. On the other hand, since a government activity deals with public funds, there is a need for fairness or equity in their expenditure, as well as the need for some level of efficiency. Most Americans believe government funds should be expended in a forthright, fair, and accountable manner. They believe all citizens should have an equal chance to compete for a portion of those government expenditures. This longstanding principle of equity was reaffirmed by the Congress in 1984 with passage of the Competition in Contracting Act (CICA) requiring "full and open competition" in DOD procurement.[8] However, equity is sometimes achieved only at the expense of efficiency. The two concepts often conflict. Procurement procedures that ensure equity may be patently inefficient.[9] As Plato observed many centuries ago, a democracy is an inherently inefficient form of government, primarily because it is a government of compromise and consensus.[10] Consistent with that observation, in this country we routinely trade off efficiency to ensure that equity is preserved in government spending.[11] An example might be the mandate that a portion of government business go to small business firms. While arguments supporting this mandate are compelling from a equity standpoint, buying from small business may not necessarily be the most efficient way for the government to do business. Another example might be the CICA requirement that most government purchases be competitive, since competition connotes the fairness and equity the public expects. There are instances, though, when a competitive purchase may not be the most efficient, or even the most prudent way of doing business. Again, the concept of equity overrides what might be the best business practice.

This is not to imply that the public does not want efficiency in DOD procurement. Quite the contrary, Dr. F. Ronald Fox, speaking of the Packard Commission's 1986 survey of public attitudes, said, "The commission's survey made clear (that the public feels) that inefficiency in DOD spending is a problem of major proportions."[12] Many would argue that at this point in the defense reform debate, the public is *demanding* efficiency in defense procurement. However, they have not abandoned their desire for equity in order to achieve it.

These institutional differences between private and public activities are indeed significant; some

feel so significant that the government can simply never do business like business.[13] Others, notably the Packard and Grace Commissions, recognize the deep-seated differences, but still believe there are areas where the government can borrow selected business practices from the commercial sector to great advantage.

Commercial Practices: A System Worthy of Emulation?

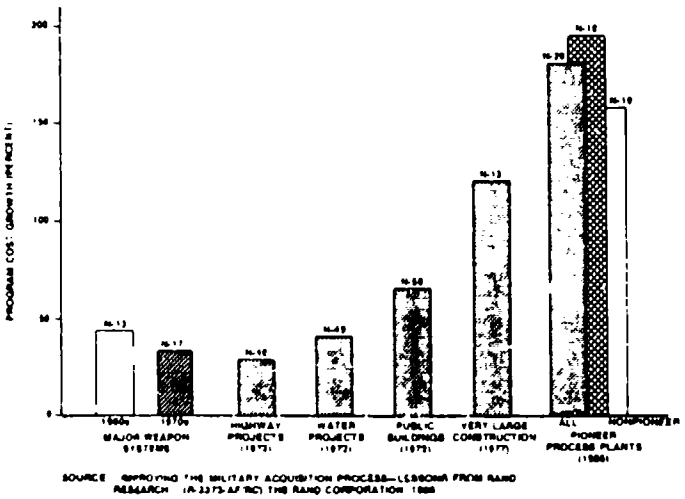
Finally, it is interesting and instructive to look at the actual performance of the commercial sector that the Department of Defense is being encouraged to emulate. In doing so it is important to recognize the technical complexity of many DOD acquisitions, with the typical program pushing the state-of-the-art in several technologies simultaneously. The findings of a study by The Analytic Sciences Corporation and another by the Rand Corporation suggest that given roughly equivalent project complexity (a large facility project for example), the commercial sector does no better than DOD in delivering a project within budget.[14,15]

The Packard Commission said of these studies, "The good news...is that DOD is no worse than other large bureaucratic organizations in managing major programs." However, Packard then identifies a number of specific commercial ventures that were, in fact, "models of excellence" worthy of emulation.[16]

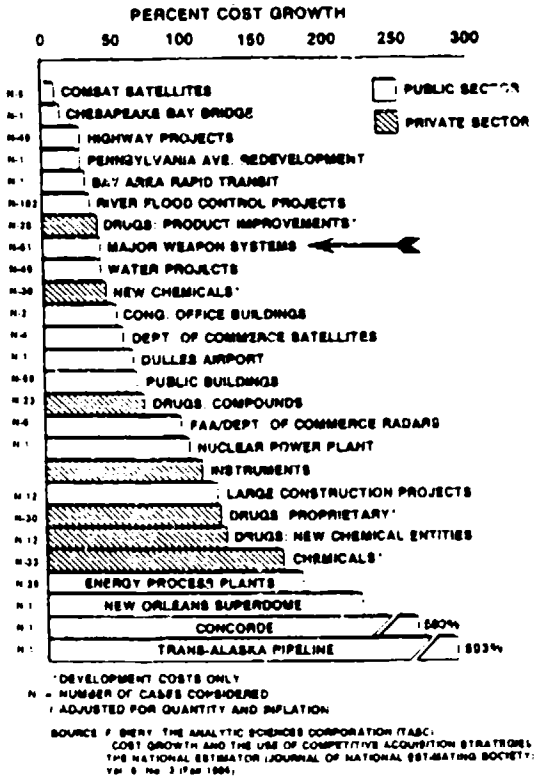
Notwithstanding this conflicting evidence, the general perception persists that the government can benefit from adopting commercial ways of doing business.

FIGURE I-3. COST GROWTH IN MAJOR PROJECTS

RAND



TASC



Direction and Scope of Research Effort

It is with a sincere belief that selected commercial practices can be of benefit to DOD, that we embarked upon this course of research. Briefly stated, our objectives were:

1) To define commercial practices

2) To identify practices which seem to be applicable to, and offer high payoff in DOD

3) To explore fully how to implement those selected practices.

Our approach in pursuing these objectives was partly driven by the nature and duration of the Defense Systems Management College (DSMC) research fellowship in which we participated. Early in that fellowship we attended an executive education program at the Harvard Business School (The Program for Management Development). This education program provided academic exposure to the latest in theory and practice of managing commercial companies. In addition to significant classroom experience, we were sequestered during the 12-week program with 135 classmates who were up-and-coming middle managers from many of the world's most prestigious companies. The combination of the two forums proved to be a superb learning experience and opportunity to "kick off" our research; we were able to effectively immerse ourselves in the ways commercial companies do business.

Because our research objective is to import some of these smart commercial ways of doing business into DOD, we focused on commercial business functions that were comparable to functions carried out by DOD. Specifically, we focused on how commercial companies develop new products, and how they acquire major capital projects. We felt these activities most closely parallel the acquisition of major military systems because:

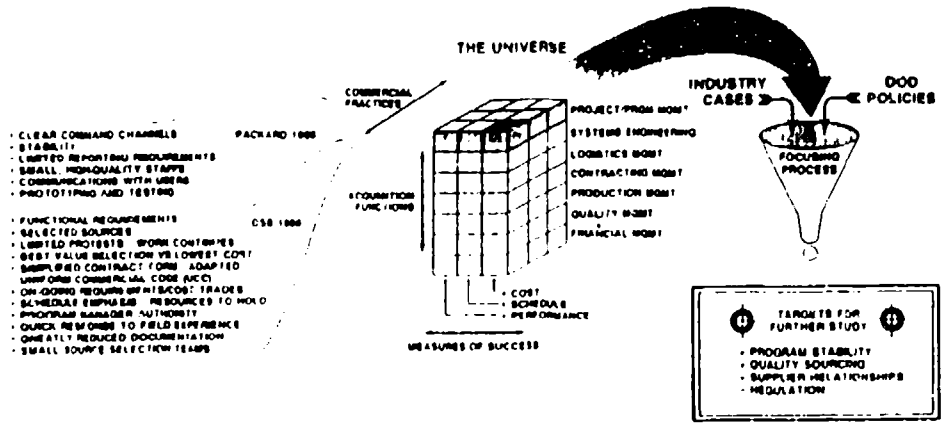
—Such products and systems require large commitment of corporate resources with extended payback periods.

—They often incorporate new technology and push the state-of-the-art.

—They require a comprehensive management system to integrate the efforts of many people, equipment and technologies.

Even with our focus constrained to new product developments and capital projects, it became clear that the universe of commercial practices was expansive. To conceptualize this universe, we developed a three-dimensional model as shown in this exhibit:

FIGURE I-4. RESEARCH MODEL



We designated the axes of the model as follows: on the X axis, the traditional measures of project success; on the Y axis, the functions or disciplines of acquisition; and on the Z axis, "commercial practices." Our objective here is to show not only the broad universe of commercial practices, but to show their interdisciplinary and interdependent nature. We will now briefly explore the variables that make up each of these axes.

The bottom line of any management practice is the degree to which that practice contributes to the success of the mission, and the success of a "project," whether commercial or defense, is judged on three variables: cost, schedule, and performance. Accordingly, we felt these success criteria should be an integral part of the analysis of any commercial practice. We include them in our model to reflect this importance. The three variables are so highly interrelated that the success of a project is dependent not only on each variable independently, but also on the effect that each exerts on the others. Mathematically, this relationship would appear:

SI = f (S, P, C)

SI = successful implementation

S = Schedule

P = Performance

C = Cost

The goal is optimization of the total equation rather than its individual variable values. The impediments to doing so lie in the complexity and amorphous nature of the interrelationships, as well as the difficulty of traditional, functional organizations to work across organizational lines. While it is possible to optimize one (or even two) component(s) of the equation, it is practically impossible to optimize all three independently.[17] The process of making effective trade-offs between variables is, therefore, critical to the overall success of any project. We found stark contrasts between how this process is treated in the defense acquisition environment versus the commercial world.

The second element of our model, depicted on the Y axis, is the array of functional disciplines implicit in acquisition. While many conventions were possible, we adopted the approach used by the Defense Systems Management College (DSMC). They include seven discrete disciplines under the umbrella of systems acquisition management; to wit: quality, systems engineering, production, contracting, logistics, program and business/financial management. Each interacts with the others, so that policy changes designed to improve one area may impact another, perhaps adversely. Each function has specific policy, doctrine, and culture, as well as multiple levels of advocacy within the acquisition hierarchy. Any analysis of commercial practices must, therefore, examine the impact across the entire range of disciplines, although this research is focused particularly on those of program management, quality, contracting and financial management.

The final axis of our model is the crux of this research effort—commercial practices. As a point of departure we used commercial practices identified by the Packard Commission and the 1986 Defense Science Board (shown on the left side of our research model). Our real target, however, was a level of specificity below those that the Packard Commission and the DSB identified. We sought to identify management techniques, strategies, and practices used in the commercial sector to develop major new products, or manage capital plant/equipment projects.

Again, our ultimate objective is "lessons learned" for DOD, so we constrained our focus to commercial practices that: 1) seem to be consistently successful, and 2) are different from those typically employed by DOD. We found many. Too many, in fact, for this research effort of limited duration and resources. Therefore, it became necessary to concentrate our in-depth research on a selected number of these practices. In choosing from among the many 'good ideas' for additional study we used the following criteria:

1) Commercial practices that DOD could implement within it's existing authority

2) Practices that offered high payoff if implemented in DOD

3) Practices that complemented the diverse functional background and interests of members of the research team.

This focusing process is depicted in the model as a funnel yielding an output of targets for further

research. It is important to note that this research effort does not purport to be an all-inclusive study of the commercial practices that might be applied to DOD. Rather, it is an in-depth treatment of several of those practices. The practices we chose to develop offer real advantage if adopted institutionally by DOD, but there was clearly an element of "randomness" in their selection. There are many more commercial practices that are worthy of further research, and we hope that this report will establish a framework for such research.

It is important also to note that we did not find any heretofore undiscovered, "gee whiz" panaceas from among the range of commercial practices that we examined. The term "commercial practice" really means "smart business practice." Most are strongly rooted in common sense. Many are already in use sporadically throughout DOD (reference appendix G discussion of MSE for example). In keeping with this perspective, recognize that our findings and are not novel or "inspired" but instead seek to report for widespread implementation some good things we saw consistently in successful commercial programs. We firmly believe the commercial practices identified can and should be implemented by DOD.

Research Approach and Case Studies

We relied on a literature search and our Harvard experience during the early phase of our research to identify the range of commercial practices. We assessed the various business practices in use in the commercial sector against the background of our individual acquisition experiences as Product Manager, Contracting Officer, Financial Manager, Technical Manager, Logistics Manager and Quality Manager in prior military assignments. By doing so, we identified several potentially high pay-off opportunities for in-depth research.

Once this focusing process was complete and we had specific targets for study, interviewing became our principle method of research. At that time we embarked upon a course of face-to- face, intensive, nonstandardized interviews with personnel at various management levels in a broad range of concerns.[18] These concerns ranged from companies with purely commercial business, to companies engaged in a significant amount of defense business, and finally to DOD program offices. Thus, we were able to compare and contrast management practices being used to accomplish like functions. The organizations that were the subjects of our interviews are shown in Figure 1.

FIGURE I-5. RESEARCH CONTACTS WITH INDUSTRY

WESTINGHOUSE •	• GENERAL ELECTRIC •
• GTE •	• DOW CHEMICAL •
• TEKTRONIX •	PUBLIC SERVICE GAS •
EASTMAN KODAK •	• BECTON DICKINSON •
ROCKWELL •	• PACIFIC BELL •
VALENTEC •	BOEING •
MARTIN MARIETTA •	• UNITED TECHNOLOGIES •
DIGITAL •	GEHL •
GENERAL DYNAMICS •	AT&T •
BRITISH AIRWAYS •	• HP •

• Interviews; • Commercial Case; • DoD Case

Based on the first round of interviews, several opportunities for program specific case studies developed. These are annotated on the exhibit.

FIGURE I-6. COMMERCIAL CASE STUDIES DEVELOPED

Scope

Case#	1	2	3	4	5	6	7
Co	UTC	HP	Dow	Tektronix	GE	PacBell	BDIS
Proj	PW4000 Engine	Several	Several	Several	Several	Adv Digtl Ntwk	FAC-Star
New	Prod	Prod.& Plants	Plants	Plants	Plants	Prod	Prod.
Time	4.5yrs	1-4yrs	18mos	1-2yrs	3yrs	27mos	18mos
Funds (ea)	‹$1B	‹$500M	‹$500M	‹$100M	‹$100M	Not Released	‹$10M

Figure 3. 1985 DSB Commercial Case Studies

Scope

Case#	A	B	C	D	E
Co.	AT&T	Boeing	SBS	IBM	MITRE
Prog.	EES-4 Switch	767 Aircraft	Comm Sat'llte	360 Computer	FAA Nat'l Airsp Sys
All cases were new product development.					
Time	8 yrs	4 yrs	34 mos	3 yrs	Unk
Funding was not identified in cases by DSB.					

We found the case study method for further data gathering most appropriate in order to investigate not only what commercial management practices were employed, but why, how, and how well. Further, in examining specific cases we could determine the interdependencies of the practices within each program. All case studies were developed without any preconceived bias as to which practices or techniques to include for assessment. The scope of each case study program is summarized below; the full case study narratives are in appendices. The cases cover a range of program sizes and types that we feel are comparable to defense system programs (all the commercial cases (1-7) were financed privately).

1. PW4000 is a high thrust, fuel efficient, turbofan engine for large, wide-body commercial aircraft developed by United Technologies Pratt and Whitney Commercial Engine Business. Cost $1B (approximately); 54 months from concept to deployment.

2. The Hewlett Packard (HP) Computer Business Organization's new product development management process was studied and documented in lieu of a specific case study. We discussed a major program, the "Spectrum" which was the total HP 3000-series computer hardware and software architecture development program conducted from 1980-1985 and funded at approaching $500M. Spectrum was not managed via the phase review process. Also, we discussed a major new surface mount technology facility program, now in process, in the HP Microwave and Communications Instrument Group. This latter program provides a state-of-the-art development and production facility. It is scheduled to last 3 years and will cost several hundred million dollars. It too, does not use the phase review process, which appears most applicable to product-line enhancement and customer-unique application projects.

3. The Dow Chemical Company's Michigan Division's new capital plant/equipment management process was studied and documented in lieu of a specific case study. The Michigan Division has four or five major capital programs underway at any point in time to build production facilities (e.g., aspirin plant, plastics plant, etc.). The typical program is on an 18-month schedule, from approval for preliminary engineering to production start-up and costs from several tens to several hundreds of millions of dollars.

4. Six separate capital plant/equipment projects were documented in the Tektronix case study. Design and implementation of the following plants is included: Integrated Circuit (IC) development and production facility (cost $53.4M; 21 months to completion in 1981); Gallium Arsenide (GaAs) IC development and production plant, designed into the IC facility (cost $1.7M; 14 months to completion in 1985); Automated Warehouse (cost $23M; 18 months to completion in 1979); Cathode Ray Tube (CRT) production plant; Hybrid Circuit production plant; and Circuit Board production plant. The latter three plants cost between $20-50M each and were completed by the mid-1980s.

5. The "Factory of the Future" was designed and built by General Electric Aircraft Engines. It is a fully automated machining facility for processing (i.e., turning, milling and drilling) rotating components of high performance jet engines. The project required 3 years from concept to initial production start-up and cost $52M.

6. The Advanced Digital Network (ADN) is a new digital line service customer providing full duplex, point-to-point or multi-point service with customer selectable data rates from 1.2 to 64 Kbps. It was implemented in 27 months from completion of concept development to deployment in 1989. Program costs are not releasable.

7. The Fluorescence-Activated Cell Sorter (FACStar), an automated system, identifies blood and tissue cells in a flow stream, separates them, and collects them for further analysis. It is the lead new product of Becton Dickinson Immunocytometry Systems (BDIS). The development program required 18 months and more than $1M. It was completed in 1985.

8. Mobile Subscriber Equipment (MSE) is a major U.S. Army program to acquire a complete tactical telephone, mobile-phone and facsimile system for the entire field Army at Corps-and-below levels. The system is provided by GTE Government Systems Division. It is a $4.3B NDI program requiring 10 years for system integration, testing, production and deployment. The MSE was selected for case analysis as a non-commercial program to determine what commercial practices

were employed and how they fared. The Army Communications Electronics Command had been directed to employ commercial management practices in the acquisition of MSE.

The 1985 DSB Summer Study developed the following five major new commercial product case studies; we considered their findings along with the cases developed above:

A. The EES-4 telephone switch developed by AT&T; 2 years from requirement to start of development; 8 years to deployment

B. The 767 aircraft developed by Boeing; long conceptual development period; 4 years to develop and deploy

C. Communications satellite developed by SBS; 14 months from requirement to start of development, 34 months to deploy

D. System 360 computer family developed by IBM; 12 months from requirement to start of development; 3 years to deploy.

E. The FAA National Air Traffic Control System developed by MITRE; schedule not provided.[9]

The "guts" of our research effort is contained in Sections II and III of this report. There, we present the findings of our research and make suggestions vis-a-vis implementing certain commercial practices in DOD. Section II is dedicated to the treatment of issues affecting program stability; Section III covers individual topics in acquiring quality systems, establishing buyer/seller relationships, and implementing certain regulatory issues.

We recognize that our approach and methodology to this research may not be considered "rigorous" from a purely academic standpoint. We do feel, however, that we garnered sufficient evidence, albeit primarily anecdotal, to strongly support our findings and suggested improvements, particularly when considered in the context of the broad acquisition experience of the authors. We believe DOD can, in fact, learn a great deal from the commercial sector, and this report provides a blueprint for doing so.

Endnotes

1. *Report of the Commission on Government Procurement*, December 1972.

2. Note: A third concept that may also prove confusing is Commercial Activity Contracting by the government. This is when the government contracts out a service that historically has been performed by government employees. An example is the contracting out of aircraft maintenance services to a commercial company, rather than continuing in-house maintenance.

3. Deputy Secretary of Defense Memorandum, "Improving the Acquisition Process," April 30, 1981.

4. "President's Private Sector Survey on Cost Control: A Report to the President," January 15, 1984.

5. "President's Blue Ribbon Commission on Defense Management, Final Report to the President," June 1986.

6. Office of the Under Secretary of Defense for Acquisition, "Final Report of the Defense Science Board, 1986 Summer Study," January 1987.

7. Under our system of government, the public sector steps in to provide a service only when the free market cannot, or has not done so. Good examples are national defense and police protection which simply cannot be provided effectively by the free-market system. These public services, by their very nature, are abstract and difficult to quantify.

8. Kirby, Wendy T., Esquire, "Expanding the Use of Commercial Products and 'Commercial Style' Acquisition Techniques in Defense Procurement: A Proposed Legal Framework," *A Quest for Excellence: Final Report by the President's Commission on Defense Management*, June 1986, Appendix H.

9. Musgrave, Richard and Peggy, *Public Finance in Theory and Practice*, McGraw-Hill Book Company, New York, N.Y., Fourth Edition, 1984.

10. Plato, *The Republic*.

11. Georgetown University, Center for Strategic and International Studies, "U.S. Defense Acquisition: A Process in Trouble," March 1987.

12. Fox, F. Ronald, *The Defense Management Challenge: Defense Acquisition*, Harvard Business School Press, Boston, Mass., 1988.

13. Hartle, Terry W., "Sisyphus Revisited: Running the Government Like a Business," *Public Ad-*

ministration Review, March/April 1985.

14. Biery, F., The Analytic Sciences Corporation (TASC), "Cost Growth and the Use of Competitive Acquisition Strategies," *The National Estimator*, Vol. 6, No. 3, Fall 1985.

15. The Rand Corporation, "Improving the Military Acquisition Process—Lessons from Rand Research," R-3373-AF/RC, 1986.

16. *A Formula for Action*.

17. Hayes, Robert G., Steven C. Wheelwright and Kim B. Clark, "Dynamic Manufacturing," *The Free Press*, New York, Chapter 11, 1988.

18. Non-standardized interviews are designed to elicit different information from each interviewee by tailoring questions to their individual background, experience and placement.

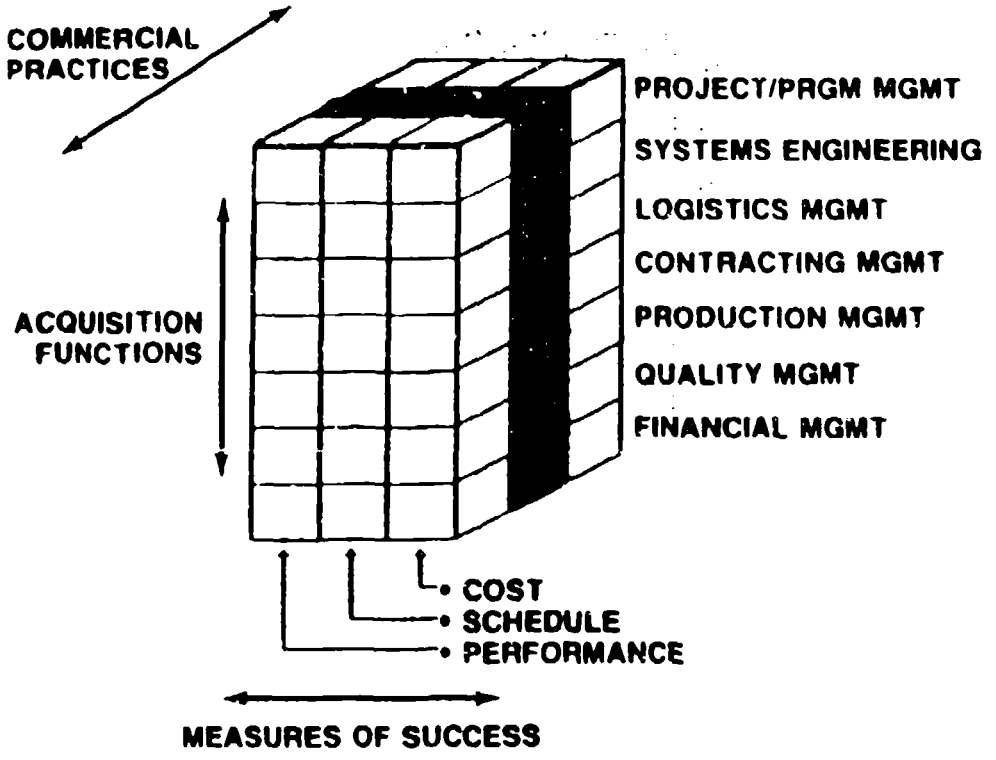
19. The DSB study did not identify development costs for the programs.

II

ENHANCING PROGRAM STABILITY

II

ENHANCING PROGRAM STABILITY



A fundamental commercial practice in successful major new product development and capital systems project implementation is program stability. The 1986 Packard Commission report highlights stability as one of:

> "six underlying features that typified the most successful commercial programs" and that "defense acquisition typically differs from the commercial model in almost every respect . . . (but that several) successful DOD programs have incorporated some or all of these management features to a greater or lesser extent."[1]

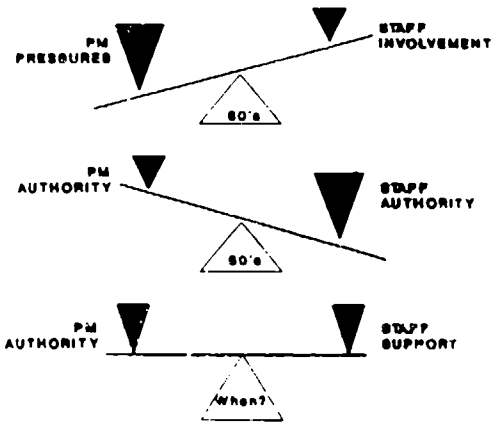
In this section, program stability is described; successful commercial business management approaches to stabilizing programs are identified; Department of Defense (DOD) policies and inhibitors impacting program stability and actual practice are discussed; and specific improvements are proposed for application via DOD acquisition policy changes. The motivation is to institutionalize the use of those good business practices which enhance program stability in the DOD acquisition system.

Program stability features ripple across all of the traditional functions associated with systems ac-

quisition. The obvious focus of this section is on program/project management functions, but our treatment of program stability must, and will, cross functional boundaries (i.e., engineering, logistics, and financial management) to deal effectively with the necessary complexity of system programs. The criteria for measuring success in systems acquisition—cost, schedule and performance—as impacted by stabilizing management techniques are the central treatment of Chapter 2.

The research model, introduced in Section I, is recast at the beginning of this section to highlight the commercial practice, program stability. We develop in Chapters 1-4 the principal management techniques impacting the stability of systems programs, major and non-major, which we observed employed in highly successful major commercial systems programs.

FIGURE II-1. ACHIEVING PROGRAM BALANCE



A Working Description

The key attributes of program stability are steadiness of purpose, a firmly established plan and a supportive system.[2] For a program to have stability it must have a goal of sufficient permanence that it outlives the time it takes to implement the plan. The program plan links the purpose to the resources (time, people, funds and technology) needed. It organizes these resources and defines the process for achieving consensus and approval to implement. It then guides the execution phase and provides for the integration of effort. The plan should be realistic and provide flexibility to adapt to unforeseen problems or modest changes in purpose and resource availability. In a bureaucracy, such as DOD, the approved plan should be a product of systematic consensus and a clear decision rather than the result of continual incremental decisions.

What's Wrong?

Figure II-1 dramatizes the issue, it represents the current imbalance of forces impacting program stability. This situation is the result of decades of piecemeal regulatory efforts to ensure against recurrence of perceived (including some very real) past transgressions. It shows DOD and Service functional organizations and staffs attempting to ensure against ineffective and excessively costly defense systems.

The misfortune here is that defense acquisition professionals are all on the same team but often act counterproductively and very inefficiently in both a micro and macro sense. Program Manager (PM) perception is that DOD and Service functional organizations and staffs are often the problem rather than team members in achieving program success. These organizations and staffs often operate as though PMs should not be trusted. In Section I, we mention that cost and schedule controls on major defense programs are no worse than on other public or private programs. We all recognize that cost, schedule and performance accomplishment in defense systems acquisition is not what it should be. Especially in times of decreasing budgets and increasing operations and maintenance needs, DOD must do better if it is to continue essential force modernization.

From the PM's perspective, the essence of the problem is instability. There are an inordinate number of often conflicting requirements and demands, coupled with a basic lack of authority (anywhere) to tailor them into a cohesive plan. And no one seems to remain in charge long enough to see the plan through. It is the singular intent of this section to identify and promote adoption of good business practices which can begin to bring our acquisition forces into constructive balance.

Commercial Practices Enhancing Program Stability--What Are They?

Our research used literature search and interviews of practitioners of commercial practice in major new product development and capital systems development projects. There is a wealth of literature in existence describing good and bad business management practices; in general, this material was useful to overview applicable philosophy, but not particularly informative in establishing how to implement the concepts. The best sources for implementation techniques were those which used the case study method based on real examples or those which documented real time issues and their resolution.

We anticipated researching only commercial capital plant equipment programs due to their functional similarity to defense weapons programs (e.g., size, funding, technology, purpose, complexity, etc.) but found that major new product-line programs were handled similarly. We decided to use evidence from both types of programs. On the surface, one might initially question the applicability of new product development techniques since commercial businesses tend to execute these programs internally versus contracting-out to a prime contractor--the typical defense system approach. We also found that all of the commercial capital programs we saw were internally managed and integrated, using contractors for component subsystems and supplies. We leave to you, the reader, the final call as to applicability under these circumstances, but expect you will recognize that the management techniques discussed here are no more than good management methods applicable to any large, complex program within a large bureaucratic organization.

Based directly on this research, we found that the good business practices contributing most to program stability are: (1) top management involvement, (2) on-time completion, and (3) the authority and accountability of acquisition line management. We also found the commercial techniques for implementing these practices; these are outlined in Figure II-2. Each is developed in Chapters 1-3 along with DOD environmental inhibitors.

FIGURE II-2. COMMERCIAL TECHNIQUES FOR ENHANCING PROGRAM STABILITY

1. Role of Top Management (Chapter 1)
   - Vision and Selectivity
   - Active Involvement
   - Supportive System
2. Cost, Schedule, Performance Prioritized (Chapter 2)
   - Meet Schedule
   - Sufficient Performance
   - Flexible Funding
3. Authority, Accountability, Resource Control and Responsibility to Line Management (Chapter 3)
   - Enable Line Managers
   - Focus Responsibility
   - Experienced People

Chapter 4 assesses several congressional and DOD policies which impact across program stability, and provides some suggested implementing steps for institutionalizing these techniques into the defense acquisition system.

Endnotes

1. President's Blue Ribbon Commission on Defense Management, *A Quest for Excellence Final Report to the President*, June 1986, pp. 40-51.

2. These derive directly from definitions of "program" and "stability," *Webster's New Collegiate Dictionary*.

1

THE ROLE OF TOP MANAGERS

FINDINGS

a. Active involvement of top corporate managers is essential to program success.

b. The commitment to program success crosses organizational lines.

DISCUSSION OF THE FINDINGS

> **1986 Packard Commission:** "At the outset of a commercial program, a program manager enters into a fundamental agreement or 'contract' with his CEO on specifics of performance, schedule, and cost. So long as a program manager lives by this contract, his CEO provides strong management support throughout the life of the program. This gives the program manager maximum incentive to make realistic estimates, and maximum support in achieving them. In turn, a CEO does not authorize full-scale development for a program until his board of directors is solidly behind it, prepared to fund the program fully and let the CEO run it within the agreed-to funding."[1]

We found that successful major systems programs (i.e., new product line, new capital plant/equipment) within the commercial acquisition environment are the product of unequivocal top management approval and support. In the *programs which reflect the strategic emphasis of the company*, there was clear linkage to organizational business strategy and direct involvement of the Chief Executive Officer. Involvement did not mean micromanagement, but an awareness of the program's current status, active questioning, and a willingness to commit organizational resources to resolve problems.

Strategic Vision and Selectivity

Best business practice is to develop project plans for new products, and any necessary new processes, from top management's *strategic vision* of *what* customers want and *when* it must be there to beat the competition. Top management of successful businesses identify customers needs/wants and what they are willing to pay; they are also very aware of what the competition is doing and likely to do.[2] These two factors allow top management to determine when they must bring in a new product or new capability to cover costs and make acceptable profits before the competition catches up. For example, Nissan's highly successful implementation of their truck and auto plant in Smyrna, Tenn., was, in part, attributed to senior management's focus on a single, simple goal: "To build the highest quality truck sold in North America."[3]

Figure 1-1 diagrams the relationship of top management to several key elements of program management. Basically, it shows the top manager is actively involved with strategic planning and decision making as it applies to major programs; it also shows top management commits to seeing programs through. Top managers are personally involved in making early trade-offs to get to a practical program baseline; and they select the PM. Not all projects, conceived and proven feasible in the bottom-up process most organizations use to identify new opportunities, will directly support such vision; those that do are seized upon and made to work.

Active Involvement

Our assessment of top management's role in the case studies (Figure 1-2) is that the predominant role is *active involvement*: either they *lead*, actively champion the important projects; or they *enable*, ensure the system functions whereby the whole organization actively supports, approved programs.

FIGURE I-1. ROLL OF TOP MANAGEMENT

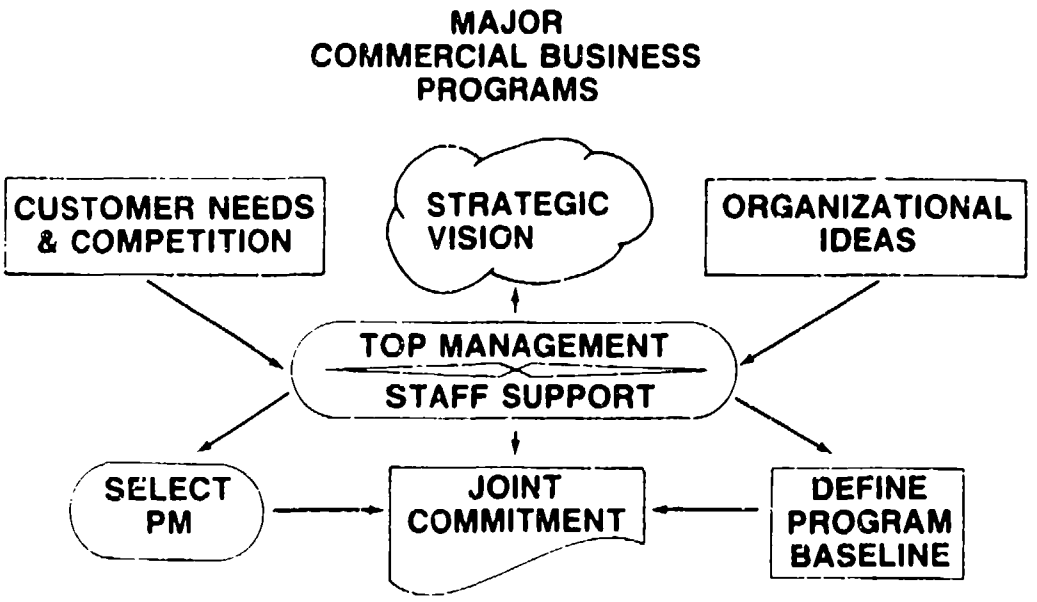


FIGURE I-2. COMMERCIAL CASE STUDIES

Case#	1	2	3	4	5	6	7
MODE	Lead	Lead	Enable	Lead	Enable	Unk	Lead
#Prog MSs	1	1,6•	2	2	2	2	1
Dcs'n Auth'y	Prog Dir	COO	PM	Gp VP	Mfr GM	Cmt'y	Div Pres

• Strategic Programs Had 1 Go/No-Go Decision

Although procedural methods of establishing program approval were not specifically investigated, we did note that such decisions were often based on intuitive judgment as opposed to detailed cost and benefit analyses. Top management actively participates in managing these selected programs to *ensure focus*, focus of program objectives and focus of organization effort.

A senior HP executive stated that the most damaging new product problem is failure to bring in a new system once development has begun.[4] Major projects in all seven commercial case studies were limited to *two or fewer "go/no-go" decisions*; typically, the first is a decision to create a design and a mini-business case; the second is approval to enter full-scale development and implementation. For example, UTC committed $1B on a new jet engine development (the PW4000) based on market research and a decision to be ready with a new proven product when the market needed it. There was no further need to reconsider the commitment as the work was being done.[5] Quinn went on to say that top management should establish a "few critical points" for intervention (i.e., it cannot be a continuous necessity) and not depend solely on elaborate planning and control systems. The number of intervention points varies, but is characterized by an acceptance of "chaos and replication in early investigations...(but at the) later stages, these managers have learned to maintain flexibility and to avoid the tyranny of paper plans."[6] We found that early conceptual planning is very decentralized to promote opportunities for good ideas to bubble up; whereas programmatic decisions following the approval for development/implementation were delegated to acquisition line management.[7] Smaller projects, such as product-life extensions or customer-unique appliques were more rigidly controlled by a formal, central decision process. Since these smaller projects were not central to the thesis of this research, we did not pursue this area in most case study efforts.

Supportive System.

Figure 1-2 also shows that in six out of seven cases a line manager had authority to make program decisions following BOD program approval. Approved programs were, therefore, no longer subject to program oversight by committee unless the approved baseline was expected to be breached. The environment was set for speedy and effective execution. In each of the companies visited there was a real *organizational commitment* to the success of approved programs. New product line development and capital acquisition programs are strategic commitments reflecting the company's future direction and emphasis. Such program go-ahead decisions are clearly communicated to all participants in the corporation. Along with vision and active involvement in creating and pursuing strategically essential projects, top management must *establish the environment for success*. This includes smaller projects which would fragment top management attention to oversee directly. Delegation of top management decision authority and resource control is the technique they use to provide smaller projects the same opportunity for success as major programs. Division presidents are the final decision authority on less-than-major programs once approved for development/implementation (e.g., BDIS case #7).

As stated earlier, the commercial marketplace severely penalizes companies which do not bring new products on line once the decision has been made to commit major resources (typically, entry into full-scale or detail engineering). The functional staffs, operational and program managers spoke of *shared goals and direction*. Functional organizations recognized that they were accountable to higher management for support of those programs. Managers of functional departments (e.g., VPs of marketing, engineering and manufacturing) were responsible for providing resources (the right people and technology) and assisting the PM in solving problems. They were not involved with program oversight and direction. Correspondingly, the program manager considered it to be in his best interest to accommodate the recommendations of departments such as engineering and manufacturing because they bring the best technical knowledge and experience to bear on individual program objectives.

For example, Sony feels top management must *manage the value system and atmosphere* not the details of all projects; nor should their staffs. Depending on the scale of projects, PMs should report as closely as possible to the management level making the critical decisions concerning the

project.[8] However, no "best management structure" evolves out of the literature. It is situational; various alternative approaches are needed depending on the projects, the market area and the people involved.

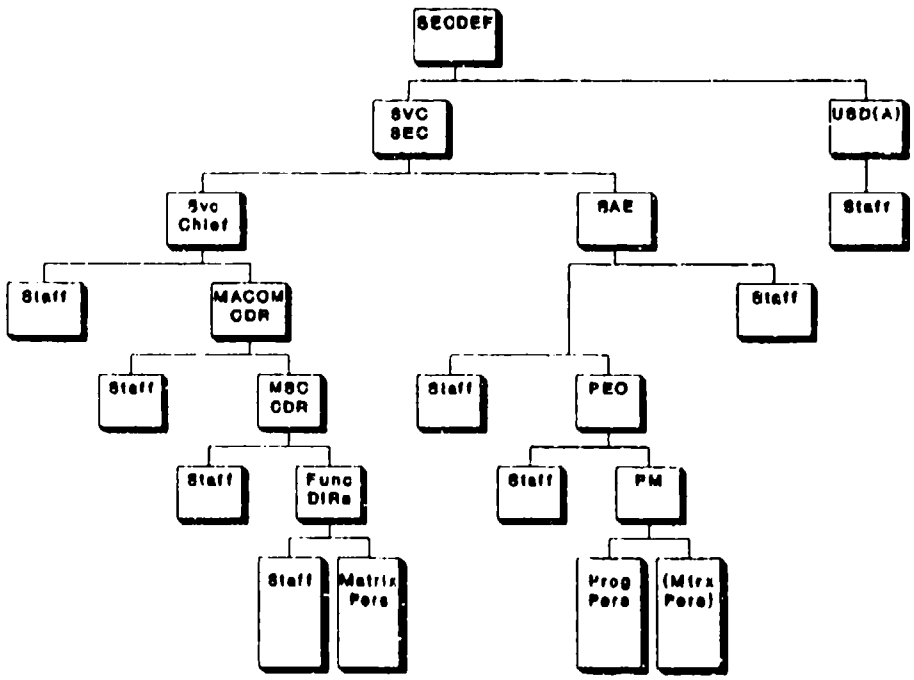
As a result of his investigation of decision-making in large conglomerates, Richard J. Marshuetz points out that these organizations must separate decisions supporting daily operations from those determining the future of the business (the same people who manage daily operations are not necessarily the right people to manage essential change). To do that the program management *process must be simple and efficient*. (Note, the process must be efficient, not necessarily the projects; we'll take that up later.) Typically, "business as usual" applies to daily operations but not management of essential change; that is the arena for line management.[9] There are sufficient layers of line management in DOD that a hierarchy of projects can be implemented, within resources, if line management takes appropriate actions.

A system that spreads program oversight and decision-making authority broadly, especially via large powerful staffs and functionally segregated organizations, but that fails to hold them accountable for program success, is counterproductive. Successful commercial companies recognize that staffs are necessary to manage ongoing business matters, but line management must assume the risks of change. In Chapter 3, the authority, accountability and oversight factors of stability will be treated in detail. They are mentioned here to establish the dependency on the environment set by top management.

DOD PRACTICE AND INHIBITORS

In DOD, it appears that our large senior staffs perform many of the roles associated with top management in the commercial world. There appear to be major distortions between the role of top management in competitive, commercial industries and DOD. In the former, the critical programs are recognized and made to work; in the

FIGURE I-3. DOD ACQUISITION MANAGEMENT ORGANIZATION



latter, it is often not clear which of the programs are critical. McDonough and Spital found three principle reasons for new project failures--appearance that success or failure *really doesn't matter* to top management; slips are *ignored*; and there is *no reaction* from top management to status reports.[16]

Historically, in the Services, systems acquisition has been an ancillary function of logistics support to the operation forces. As such, top Service management focused on other things; but, of course, had to approve major resource commitments. This beginning appears to have evolved to a *defense management system devoid of clear, CEO-like, top management*. Figure 1-3 depicts DOD's organizational structure for acquisition. The DAE is on the OSD staff; the SAE is on the Service staff, both are without control over the personnel resources who work for the military Chief.

The implementation of the PEO—the SAE relationship was very different in each Service; i.e., the Army PEO does not control personnel resources and, the Navy and Air Force PEOs have two different bosses.

The point here is that it is *not clear who should have and communicate his vision* as applies to acquisition priorities; this inhibitor contributes to those covered in Chapters 2 and 3. Senior, appointed managers in DOD and the Services are often transients who may never have the time to develop clear visionary strategy objectives which link to acquisition programs. One result is that the bureaucracy, the uniformed military and civil staffs, function in the absence of a clear relation to top management. These staffs and functional organizations have grown great institutional power which contributes to the Chapter 3 inhibitors. A second important result is that senior leaders and staffs manage via *committee consensus*, versus personally-attributable senior decision-making. This has bred a practice whereby individual decision-making is often ignored or watered down due to the continuous need to build and maintain consensus with the many heads of the bureaucracy, and committee consensus is rarely timely, especially when it must handle many diverse and complex projects on a continuing basis.

A typical, Services, commodity-oriented, buying command is responsible for support of current operations of fielded systems plus the design-through-implementation of new systems programs. (The Air Force is a major exception in this respect.) On one hand, we should expect feedback from current systems operating and support experience would be helpful in new systems. On the other hand, functional organizations (e.g., maintenance or supply-support directorates) must prioritize and standardize procedures for effectiveness and efficiency. They tend to institutionally impose many rigidly interpreted, *standard decision systems* optimized for dealing with support of fielded systems. This latter tendency flies in the face of effective innovation on systems in development.

SUGGESTED IMPLEMENTATION FOR DOD

Improvement in this fundamental area boils down to establishing who is in charge. Though layers of organization are a major complicating factor, the solution here is more one of delegation than reorganization. The practical authority of the DAE, in particular, is crucial. The DODD 5000.1 and 5134.1 must clearly provide the relationship of the DAE to the top DOD decision-making authority and DODD 4245.1 must similarly treat the SAE and the top Service decision-making authority. If these positions, DAE and SAE, are to be decision-makers, so state; if they are to be staff advisors to the Secretary, so state; but don't then confuse the direction with other names (e.g., Procurement Executive). This inhibitor is probably the toughest to fix, for many reasons, but it must be fixed if major improvement is intended. Suggested improvements in the following chapters do not depend on this one, but will be much enhanced if this problem is corrected. There are sufficient layers of line management in DOD that a hierarchy of projects by priority/resources can be implemented if a clear chain of authority for them is established from the top.

The 1986 Packard Commission concludes:

> "He (the PM) should be fully committed to abide by the program's specified baseline and, so long as he does so, the Defense and Service Acquisition Executives should sup-

port his program and permit him to manage it. This arrangement would provide much-needed program stability."[11]

Endnotes

1. *A Quest for Excellence, Final Report to the President*, p. 40.

2. Quinn, James B., "Managing Innovation: Controlled Chaos," *Harvard Business Review*, May-June 1985, p. 78.

3. Campbell, William H., CDR, USN, *Productivity Using Japanese-Style Management. Any Defense Industry Applications?* p. 31.

4. Interview with Carl Snyder, Director of Program Management, HP Computer Business Organization, Cupertino, Calif., March 21, 1989.

5. Interview with James Bruner, Director of PW4000 Engine Programs, Pratt and Whitney, East Hartford, Conn., April 14, 1989.

6. Quinn, p. 82.

7. This term means the program manager up through general managers to line vice presidents or division/business presidents; not all these levels are present in any one company.

8. Quinn, pp. 77-83.

9. Marshuetz Richard J., "How American Can Allocates Capital," *Harvard Business Review*, January-February 1985, pp. 87-88.

10. McDonough, Edward F. III and Francis C. Spital, "Quick-Response New Product Development," *Harvard Business Review*, September-October 1984, pp. 52-57.

11. *A Quest for Excellence, Final Report to the President*, p. 59.

2

ON-TIME COMPLETION

FINDING Schedule is first among cost/schedule and performance.

DISCUSSION OF THE FINDING

The 1985 DSB Summer Study on *Practical Functional Performance Requirements* found that in 5 successful, major commercial new product development programs differed from the typical defense program, of which 26 were analyzed, as follows:

- Financial and market considerations made schedule top priority
- Performance requirements are traded to hold schedule; block upgrades, P3I for new requirements
- Tendency toward proven technology as schedule is paramount
- Quick reaction to mandatory changes.

Of the primary criteria for success in major commercial capital investment or new product development projects, we found *on-time completion to be the first priority*. If the first entrant in a product field is considered to be a good value, it will sell. Product price and performance are the next most important criteria since the competition must bring in its competing products later at a better overall perceived value in order to take away market share from the leader.

Meet the Schedule

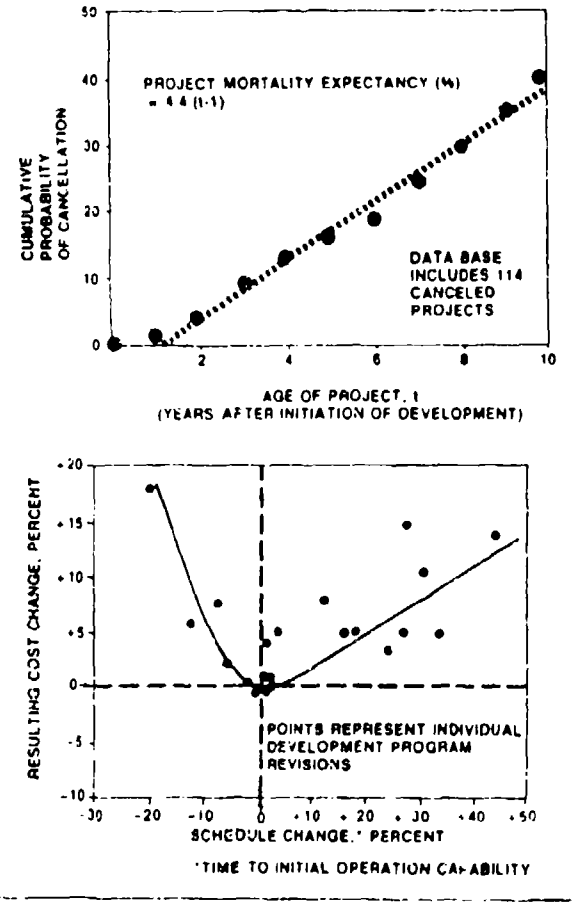
Without exception, schedule was the driving motivation, in the commercial acquisition environment, once a program was approved for development and/or implementation. This is not to imply performance or cost are ignored but, rather, they are considered principle variables which may be adjusted, following baseline approval, in order to meet the scheduled introduction. This practice is primarily market driven due to the implications of late entry on long term market share and the need to recover investment and overhead costs quickly. Seven out of seven first-hand commercial case interviews (Figure 2-1) systematically established a "must" schedule and traded cost and/or performance features to meet it.

FIGURE 2-1. COMMERCIAL CASE STUDIES COST VS. SCHEDULE VS. PERFORMANCE

Case#	1	2	3	4	5	6	7
Priority	Sked	Sked	Sked	Sked	Sked	Sked	Sked
Push Tech	Yes	Yes	No	Yes	No	No	No
Perf Trades	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Risk Buffer	10%	10%	10%	10%	10%	10%	10%

Program stability both enhances and is enhanced by a priority to on-time completion. First, a stable program can be executed more quickly than one which is continually changing or subject to change in an unforeseen way. Second, a project completed quickly is naturally subject to forces of change for the minimum time possible. Figure 2-2, borrowed from Norm Augustine's recent book *Augustine's Laws* shows that the absolute length of the program development schedule beyond its approval point is directly proportional to the likelihood of cancellation (left graph); and any attempt to change schedule (accelerate or stretch

FIGURE 2-2



out) will *always* lead to increased costs for the same capability.

The Final Report of the Defense Science Board, 1985 Summer Study, also concluded, "Schedule is paramount (in successful commercial programs), and resources—in terms of money and people—are planned to solve problems in an effort to hold schedule."[1] Two examples, previously introduced are:

—The PW4000, a $1B jet engine project, dependent first on completing development and FAA certification within 54 months of approval.[2]

—Nissen's Smyrna truck and auto plant, a $600M effort, required to be in full rate production within 42 months of groundbreaking.[3]

In industry, schedule is measured in *months, not years*. This related observation is significant in terms of tenure of program managers and senior decision makers. It is a "chicken and egg" problem. A short schedule facilitates maintaining tenure of management. Continuity in management reinforces rapid decision-making and thus, short schedules. If, as in DOD, system acquisition schedules are too long and management tenures are too short it becomes more and more difficult to acheive real program successes unless the reinforcing negatives (i.e., long schedules and short tenures) are broken.

Sufficient Performance

Performance features were next in priority. Successful non- DOD industry develops and proves-out new technologies and then introduces them into new products. *Sufficient performance* in terms of mission capability, supportability, life-cycle costs and unit costs, etc., was required. But *stretch goals* were also used, along with *contingency development* to facilitate trade-offs should the schedule be jeopardized or development costs become excessive. Typically, top commercial management recognized that not all technical goals could be achieved and *delegated to program management*, or first level general management, *authority to make required trade-offs*. The PM had authority to use the best technical support available in the company to assess relative costs and benefits of performance trades and to make timely trade-off decisions. Functional department chiefs supported program managers on performance trade decisions and in solving technical problems in a cooperative manner. Their motivation was frequently enhanced by pay incentives associated with program success.

It takes industry about 10-12 years to bring new technology into the market, so technology programs are usually separated from new product development. Preplanned product improvement and *evolutionary development* were the standard approaches to pick up desired technology or features not available at *planned schedule cutoff points*. The focus on new products is to get them into the market fast. This is done by applying available and *proven technology*. In this way, commercial industry takes low cost chances on small, new technology projects but few technical chances on new products or production capability which are too expensive to experiment on.

Planning for successful new products involves avoiding early detail since the design process is iterative and many decisions should be flexible so as to advantageously consider trade-offs as it evolves. Our first hand interviews with commercial firms established that seven of seven began development and implementation with flexible designs; seven of the seven indicated that they were prepared to, and did, trade off technical performance requirements for overriding schedule or cost reasons.

Flexible Funding

The commercial companies we researched had business planning systems not unlike our PPBS in most functional aspects. They were, barring major revenue problems, less constrained than DOD in committing funds over the full program investment phase. The keys to successful integration of business planning and stable funding in commercial business enterprises are: 1) realistic financial planning--using the business planning process in a disciplined manner to accurately forecast revenues and expenses, thus capital funding available; 2) selective advancement of program opportunities to BOD approved status--ensuring that all approved programs were affordable based on business planning; and 3) completing approved programs on schedule, thus supporting the program assumptions used in the business planning process.

Cost tends to be the buffer variable in the cost-schedule-performance criteria for measurement of project success in commercial industries. That does not mean cost is unmanaged; rather, budgeting is done to *expected cost* and *flexibility* is typically provided to acquisition line management to proceed as long as costs are within 10 percent of the approved budget. Robert N. Anthony and David W. Young, when describing management controls in non-profit organizations, identified two subactivities--accounting and performance. They attribute best accounting practice to include establishment of "guidelines" and not to focus on detailed resource breakdown (e.g., travel versus salaries versus materials versus contracts, etc.). *Best practice involves management authority and accountability* to meet project goals and *flexibility* to change plans, if needed. They also stated line management must have control over funds allocation and expenditure (versus funds control by functional management).[4] In six of seven out of our first hand cases, acquisition line management had direct funds control (if the PM didn't have funds control, his line manager did). This evidence reinforces the concept that fast, timely projects are predictable in terms of funding needs, and do more for effective cost containment than a priority focus on cost.

Of the twelve individual programs documented in the seven commercial case studies we documented, only two had overruns beyond 10 percent of the original estimated cost. The evidence strongly supports the conclusion that meeting schedule reduces risks of cost overruns by limiting expenditures for direct and overhead development costs.

DOD PRACTICE AND INHIBITORS

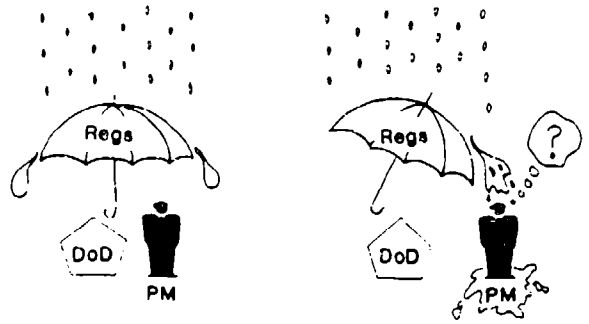
Of the fundamental criteria of project success, DOD, on the other hand, effectively prioritizes performance (overstated mission and administrative requirements and overly detailed specifications) and acquisition cost (or price) over quality. We have an institutional willingness to trade time for added funding or performance. Getting the "most bang for the buck" is not necessarily bad; but, it can be and is counterproductive if performance is optimized independent of cost and schedule objectives. Our historic failure to meet schedule objectives also promotes excessive requirements. Users must wait extremely long periods before their needs are satisfied; the further out requirements must be projected, the more technologically impractical they will be. If, in practice, system performance requirements are excessive they drive costs unnecessarily high and stretch out schedules.[5]

Typical DOD programs take 10-15 years to complete development, production and initial deployment. This is about twice as long as it takes to see fundamental changes in defense strategy goals with unique types and quantities of forces required to support it; and more than three times longer than line managers have to commit to executing approved programs. We must do something to turn this around or forego necessary force modernization in a constrained resource environment.

It is generally understood that DOD's systems are more complex than commercial. Thus, they tend

to suffer lower mean time between failure (MTBF) and availability, larger O&M costs and are produced in smaller quantities. The higher complexity and smaller quantities are sometimes unavoidable; but unnecessary complexity together with less mature production techniques (due to smaller quantities) may impact availability and O&M costs too much. Despite the obvious intent of functional departments and staffs at all levels of DOD to protect and "help" program managers deal with the complexity of new systems, they actually complicate the process and confuse PMs (Figure 2-3).

FIGURE 2-3. MANAGEMENT VIA DETAIL POLICY, PROCEDURE AND REGULATION



The impact of innumerable functional directives and regulations (many of which are countermanding of each other) is to dump more requirements on the programs in the form of excessive single interest "-ilities" which drive the total performance envelop, thus the time and cost to implement.

The job of trading-off counterproductive elements of performance is extremely difficult for most DOD PMs. The typical DOD PM is a colonel or Navy captain; whereas the "-ilities" functional specialists have, and use, their senior executives (who are usually generals, admirals and SESs) to support them. Thus, performance trades are forced up into "Flag Officer" channels or are not accomplished. We should not become slaves to unrealistic schedules; but we will perform better if we have an achievable schedule objective which is not compromised by inflexible, bureaucratic procedures.

We have an institutional aversion to budgeting for risk and contingency. Though the Congress has acted to permit a 15 percent cost growth in development on Defense Enterprise Programs (5 percent in production), as part of its milestone authorization process, the PPBS decision process doesn't provide such flexibility. Typically, any risk buffer is pulled out and committed elsewhere. Thus, when needed, it requires contributions from other "bill- payers," which ripple down through programs. Perhaps more important is our aversion to committing funds more than 1 year into the future, thus, limiting flexibility to change priorities annually. This latter destablizing effect is well documented and is above DOD's authority to direct change.

SUGGESTED IMPLEMENTATION FOR DOD

The DOD can simplify procedures and facilitate success in executing essential programs. We can simplify all programs, major and non-major, via disciplined, program specific decision-making (i.e., establishing priorities among programs and internal program objectives) from the top-down. The milestone decision process must establish the essential cost, schedule and performance criteria for the program. Best commercial practice suggests that: 1) performance should be treated with minimum detail, not reems of standard "-ilities" references; 2) a realistic schedule should be established; 3) with funding guaranteed for the duration of at least the development phase; and 4) the funding commitment should provide a buffer to the program manager to give him some flexibility to perform trade-offs and optimize the total equation.

Figure 2-4 portrays several interrelated features of *what could be* our PPBS and acquisition management systems. The diagram is adapted from one seen at HP's Computer Business Organization. We need to link decisions made in the acquisition management process to constrain future decisions in the PPBS process. To be fully consistent with successful commercial businesses, approval occurs at what effectively is our MS II for developmental programs (MS III for NDI programs). The diagram shows PPBS driving funding availability up to MS II, then being driven by acquisition program decisions at MS II and beyond. Implementation of this improvement would en-

tail phasing in Defense Enterprise-like Programs at all levels (major and non-major) with milestone-authorized stable funding for clearly essential programs. Key to this implementation is disciplined decision-making based on realistic planning and programming, and institutional follow-through based on commitment to and communication of strategic priorities.

Practical baselining of new systems requires a professional, disciplined organization and process. The suggested improvements of this chapter and Chapters 1 and 3 are so interdependent, a fuller treatment is provided in Chapter 4.

Endnotes

1. Defense Science Board 1986 Summer Study, *Use of Commercial Components in Military Equipment*, January 1987, p. 10.

2. Bruner interview.

3. Campbell, p. 30.

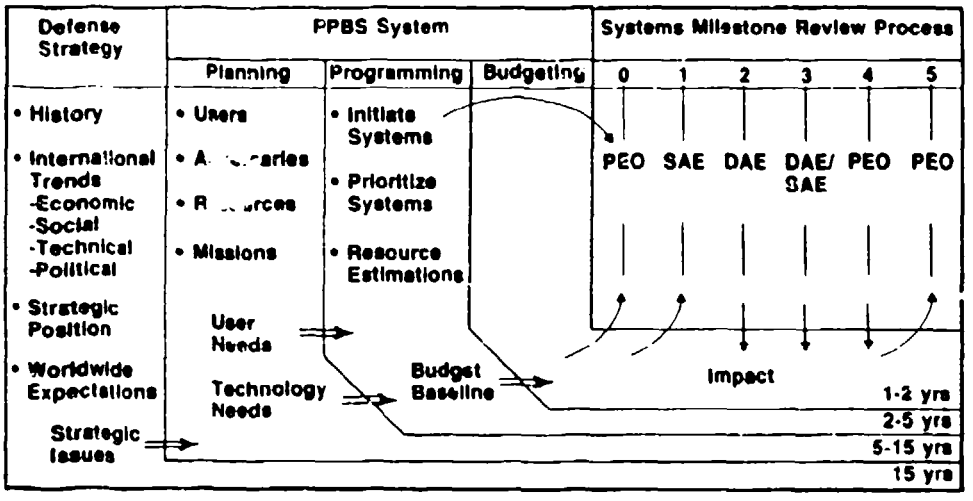
4. Anthony, Robert N., and David W. Young, *Management Control in Nonprofit Organizations*, pp. 537-541.

5. Cohen, Barry L., CMDR, USN, and Stewart L. Manley, CMDR, USN, *An Evaluation of the Packard Commission Recommendations Encouraging Commercial-Style Competition and Expanding the Use of Commercial Products*, p. 2.

6. A general conclusion drawn from the book by Robert P. Haffa, Jr., *Rational Methods, Prudent Choices: Planning U.S. Forces*, December 1988.

FIGURE 2-4. LINKING DEFENSE STRATEGY, PPBS, AND MAJOR SYSTEMS ACQUISITION MANAGEMENT

Objective: Provide capable systems to our users, efficiently and on time.



The MS II (MS III for NDI programs) is the critical point in the life of a program where the baseline is defined and committed. The PM/PEO should be given flexibility and authority to make trade-offs to achieve an optimal mix of cost, schedule and performance within flexibly defined limits (the MS II baseline agreement). This improvement depends on how the program authority, accountability and resource control aspects of Chapter 3 are handled.

The key policy directives applicable are DODD 5000.1 and 5000.45 which should be revised to emphasize stability and flexibility. Many lower tier directives and procedures detail how to do many of the "-ilities;" these need to be consistently treated in order to emphasize objectives and facilitate effective, tailoring to individual program, acquisition strategies.

3

PROGRAM AUTHORITY, ACCOUNTABILITY AND RESOURCE CONTROL

FINDING Program managers are afforded significant authority and resource control, and are held personally accountable.

DISCUSSION OF THE FINDING

> **1986 Packard Commission**: "We must give acquisition personnel more authority to do their jobs. We must make it possible for people to do the right thing the first time and allow them to use their common sense."[1]
>
> **1986 DSB Summer Study**: "The commercial program manager has very great authority and responsibility. His review levels are very few—2 or 3 at most."[2]

We found that program stability in successful commercial projects is fundamentally dependent on *clear delegation of program responsibility, authority, accountability and resource control.* Accountability, as used here, includes line management's accountability and the accountability of all program participants (e.g., functional specialists, functional management and senior staffs) for program success. Resource control is further narrowed to mean control of participants; funding stability is not a central focus of this study due to the reality in DOD that funding is not going to be independently stabilized without statutory changes; materials are not a central focus for DOD acquisition programs because most of that is provided by the prime contractor involved. The other primary resources, time and technology, we've addressed in preceding paragraphs.

Enable Line Managers

Program management authority in commercial systems programs is assigned to a clearly visible acquisition line manager whose title may be program/project manager (PM), vice president (VP), or general manager (GM). Program authority was not shared with functional managers. Acquisition line managers generally are "captains of their ships" held responsible and accountable for the success of the project but given the authority to: 1) make timely decisions and, 2) control critical resources (especially participating personnel). This finding is intrinsically tied into the findings in Chapter 1. Our first-hand interviews (see Figure 3-1) established no consensus on (1) absolute authority to the project manager (PM), (2) who has absolute control of program resources nor, (3) showing clearly the "best" project management organizational approach. The best commercial practices in this area of authority and accountability go deeper.

FIGURE 3-1. COMMERCIAL CASE STUDIES AUTHORITY AND RESOURCE CONTROL

Case#	1	2	3	4	5	6	7
PMO	Ded.	Matrix& Ded.	Mix	Matrix& Mix	Mix	Mix	Matrix
Type PM*	PM	PC or PM	PM	PC or PM	PM	PC*	PC*
Res. Auth'y	PM	GM or PM	PM	VP or PM	PM	Matrix	PM

PC no control; PC some control, PM full control

Best commercial practice is to place authority and resource control in the hands of acquisition line managers; then, they are fully accountable for

program success. Career success of the PM in the company is linked to his project, but bad news is not punished. Problems discovered as the project progresses, if reported quickly and accurately, do not reflect poorly on the manager. Hiding problems, even if the project is deemed a success, would result in separation from the company. At Tektronix, for example, there was a 50 percent overrun in a critical, major capital project which was not reported by program management to corporate management; responsible line managers were replaced, but the company philosophy and system of total project authority and resource control to acquisition line management was not changed. The real issue was not the overrun; it was the matter of line management failing to report a cost problem, thus surprising top management when it was too late to consider alternatives.[3] This example applies as well to the environment (Chapter 1) for program success; the rules were not changed just because someone disobeyed the old rule.

Jerry L. Chapin, in comparing major program management at John Deere, HP and Boeing with DOD, attributes small central staffs and line management authority and accountability as best business practices.[4] In a recent example, McDonnell Douglas Aircraft Company was reorganized to remedy a burgeoning $2.6B backlog in orders to "end the fingerpointing and frustration caused by lack of authority and accountability." The solution included elimination of all five senior vice presidents and provided each aircraft program with departments for engineering, finance and procurement. The latter change was made to avoid delays in ordering parts, hiring people and getting other necessary support.[5] The lesson here is *to enable line acquisition managers.*

Focus Responsibility

Successful commercial programs are also dependent on focused decision-making up the line; PMs of major systems have and use direct access to top management to keep the CEO, or surrogate (for example COO, a VP or GM), up-to-date and to resolve problems beyond the capability of the PM. Staff review of the program prior to PM access to the CEO is unusual since it would fragment line management's responsibility and slow down decision making. Senior functional officers (e.g., VPs of marketing, engineering, manufacturing, etc.) are charged with providing support to line management but not direction of lower-line program management. The primary support they provide is experienced, professional personnel to give the PM every opportunity to get it done right the first time.

Quinn observed that bureaucrats require many approvals in the "name of efficiency." Successful, competitive, commercial businesses know that such "efficiencies" are not affordable in a competitive marketplace. Some inefficiencies are directly attributable to the way a specific program is run but the concern here is the inefficiency systematically imposed on all programs by a large bureaucracy if it is not held accountable for project success; nor is it accountable for the overhead costs it embodies.[6]

In another recent example, Goodrich announced the elimination of many vice presidential positions and staff; the new CEO observed that "The company had VPs of every function imaginable" when he joined the company. He systematically went about eliminating most of the people in "approving" types of jobs. He recalled that when he had been a division general manager he had to obtain corporate approval for $25,000-plus purchases.[7]

As seen in Figure 3-1, matrix management or a mix of some dedicated project staff with matrix support is normal. The way industry provides the professional work force to the PM is to *focus the responsibility of matrix functional managers* and make them accountable for program success. The result is they provide responsive support or must answer to top management directly. Companies visited seemed not to require frequent top management intervention to solve people problems because everyone understood the vision and top management's commitment to successful projects. As well, these *functional departments are given no project oversight role;* they are a resource provider. Their only means of contributing to project success is to be responsive to acquisition line management, not by finding fault.

During our interview with the PW4000 Program Director, he was asked about the role of senior functional management; specifically, what reports were required of him to assure them of proper execution in their functional area? His answer was

in line with that of other companies visited but still surprisingly concise; it was: "I don't; they assure me!"[8] Successful commercial companies typically minimize project reporting requirements to those essential to keeping upper *line* management informed. The companies we visited did not formally involve functional management in the post-approval program review and decision process.

Experienced People

> **1986 Packard Commission**: "Generally, commercial program management staffs are much smaller than in typical defense programs, but personnel are hand-selected by the program manager and are of very high quality. Program staff spend their time managing the program, not selling it or defending it."
>
> "They involve, above all, trust in people. They involve the belief that people in an organization want to do a good job, and they will, if given the opportunity..."[9]

A key prerequisite for decentralized management control is an *experienced professional acquisition work force*. Successful businesses appear to employ such a work force on projects which are determined necessary to the future of the business. Project manager selection criteria varied across the companies visited. But there was a strong tendency to appoint a technically oriented PM for the early "sell" phase leading to project go-ahead decision and then replace him with a strong "organization" (business or production) oriented PM to implement and initiate operations.

Commercial businesses (e.g., GE, P&W, Tektronix, HP and Nissan) also focus much attention to prequalifying and selecting the right people into support positions on project dedicated staffs or from matrix departments. They also intentionally kept the skill categories few, preferring generalists who can appreciate the project goals over the narrow disciplines traditionally available from functional departments. Mr. Quinn also observed (during several years via many industry case studies, including Sony, IBM, AT&T, Intel, HP, 3M and Honda) that a clear long term vision by top management will attract quality people, focus creativity and channel action to the high payoff opportunities.[10]

The best available people are recruited for the program support positions and they are accountable to only the PM. Their best efforts are orchestrated by the PM and compromise among competing interests is handled at that level, not by the corporate functional staff. Senior level (corporate staff) expertise is invited by the PM, not the supporting functional specialists, if help is needed.

Though virtually all companies were matrix organized, with many functional specialists assigned to programs in a task organized fashion, all functional personnel assigned to support a program look only to the program manager for program direction and decision-making. Program managers, in turn, depended on the expertise and recommendations of their assigned functional specialists.

DOD PRACTICE AND INHIBITORS

A key difference between best commercial practice and typical DOD practice is that commercial projects encourage compromise and consensus building up to the point that the program is approved, then all participants support the solution. In DOD, typically, the functional specialists continue attempting to optimize according to their special interest and are supported in doing so by policy (e.g., each OSD functional staff office publishes detailed procedures for all components to follow; these are translated and "enhanced" by Service and command level regulations) and reporting structure (OSD, the Services and all levels of command have staff functional chiefs, some of which are entitled "advocates"). Resolution of conflicts over functional issues often depend on the Secretary's personal involvement and decision, one case at a time. This is very impractical due to time constraints on the Secretary, so many counterproductive compromises are agreed to if only to get on with something; lost is the optimal, tailored solution. The DOD acquisition culture has become one of extremely strong central control of the details of execution via committee consensus. The overwhelming strength of our senior functional staffs has robbed: 1) PMs of any significant discretion in making program execution decisions and, 2) functional participants of opportunities to compromise in the best interest of the program.

Functional and special interest advocates exert

significant influence over the systems acquisition process. They often can stop or delay actions to ensure their particular interest is accommodated; and the defense bureaucracy is constructed so the senior advocates outrank many PEOs and most PMs. This latter feature causes PM/PEOs, who may disagree with senior advocates from time-to-time, to have to consider career-risking, "fall-on-your-sword" encounters with top acquisition line and staff management every time (it could be often) there are disagreements.

Economic utility theory provides a useful means of analysis of our advocacy situation.[1] It stipulates that each program participant has a unique set of indifference curves which , for example, represent his willingness to trade off program performance and schedule (cost is held constant for this example). The participant is equally satisfied anywhere along a curve, but feels better off on a higher curve. The point of tangency between the program budget line and the highest utility curve provides the optimal point for the participant whose indifference curves are employed.

The dilemma is to identify the participant who is best able to evaluate this trade-off. Whose utility function should be maximized?

Figure 3-2, for example, represents the impact of compromise between a program manager and a special interest advocate or narrowly defined functional participant. The graphs are simplified to show performance versus schedule indifference at a constant cost. Here, performance is a composite of mission performance and all "-ilities" which impact the work effort on the project. The left graph shows at point O(PM) the optimal intersection of the program budget line with the PM's utility function at U=4. The right graph shows that the same budget line applied to a functional specialist's utility function yields an optimal utility at O(F) where, coincidentally, his U=4; his indifference curves are significantly biased toward some added performance feature(s) and a willingness to trade schedule as necessary for it. Attributing such bias may seem unfair but it is typical in DOD given the direction of accountability of many functional specialists. The O(C) is a hypothetical compromise along the budget line between the PM and the functional specialist. Of course, compromise yields less utility for each participant, U(PM)=3 and U(F)=3, in this case. This compromise process is healthy if concluded prior to program approval; but is unhealthy if it continues following that point.

FIGURE 3-2.

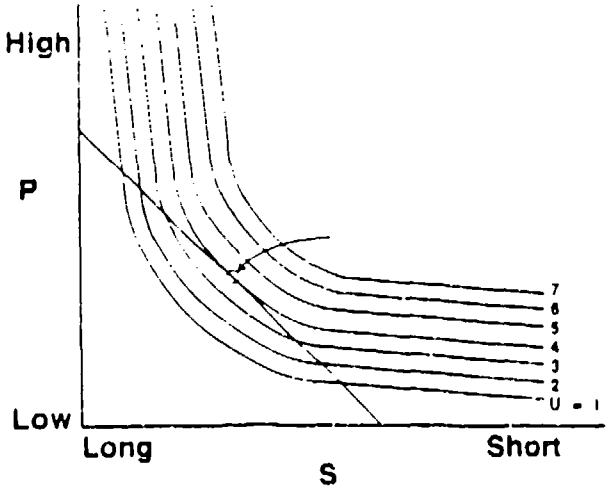
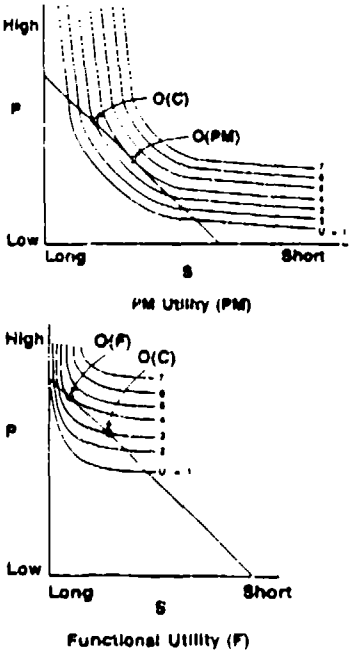


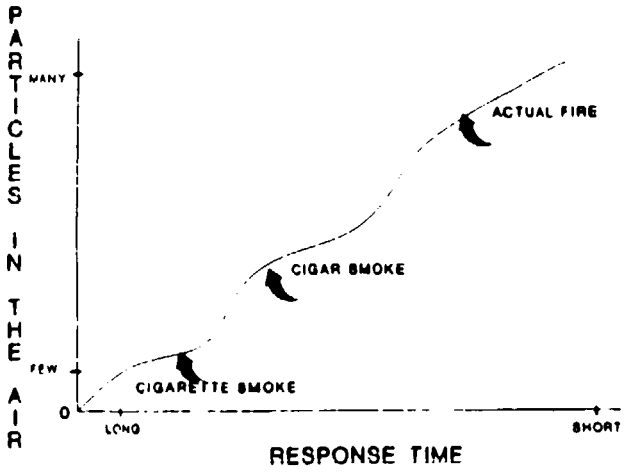
FIGURE 3-3.



Considering the impact these advocacy offices have on the program decision process, it is important to understand their genesis. They largely evolved in response to some real or perceived problem.

Conceptually they can be considered like a fire alarm system:[12]

FIGURE 3-4. FIRE ALARM



This graph shows the trade-off between the alarm sensitivity setting (which represents a special interest being advocated) and response time (representing the impact that failure to accommodate the special interest may trigger). A low alarm setting (greater sensitivity) provides more response time in the event of a real fire but also may result in false alarms; false alarms tend to reduce attention given to the alarm system.

As problems are identified in the defense acquisition system, alarm settings have been made more sensitive to prevent possible reoccurrence. However, in doing so, the effectiveness of the system to identify real problems or make practical trade-offs between conflicting special interest demands, has been reduced.

Rosabeth Kanter, in her 1983 book, *The Change Masters*, defines two different organizational cultures: 1) the "integrative" organizations which minimize conflict between subunits; whereas, 2) the "segmentist" organizations which are anti-change and compartmentalize issues and people. The "segmentists" approach, where the subunits are kept separate from each other, causes hostility and difficulty in achieving consensus.[13] The segmentist attitude pervades defense acquisition. we have evolved to the point that most DOD participants in systems acquisition are checking to see what the other guy is doing wrong. Compromise is required continuously in order to overcome the short memories of transient participation at all levels. The incentive for many seems to be, "How can I keep anything from going wrong on my shift?" Instead, it should be, "How can I help this program succeed?"

Another important inhibitor to professional functional expertise to PMs in DOD is the civil service system which requires people to be promoted to earn more money. Promotions are tied to organizational positions; the higher grade positions are on headquarters staffs, not in program or functional operations offices.

The myth that fewer functional people can accomplish more in a part-time, indirect, consulting role has further reduced the effectiveness of defense acquisition. All programs are not alike; to effectively tailor standard solutions to program unique situations requires functional knowledge, program experience and an ability to trade-off. Typical, offsite matrix management approaches preclude functional participants from gaining program experience and from feeling a part of the program they must support. It boils down to there being no positive motivators for such matrixed personnel to do their best and to accept some risks.

SUGGESTED IMPROVEMENTS

Following approval for a program to enter full-scale development, the PM and PEO should be empowered to use the best expertise available to them to solve problems and perform trade-offs as necessary to complete the program within baseline constraints and without independent program oversight and direction from functional staff managers. The SAE or DAE should be kept informed of progress and problems, directly by the PM, on a quarterly basis. The SAE or DAE should then be the link to the DRB and the Congress should there need to be a significantly altered program baseline.

Implementation of this improvement would entail the decision-maker, at MS II, committing to the program baseline with all subordinate acquisition line managers and ensuring the baseline objectives were sufficiently prioritized that acquisition managers had flexibility to solve problems encountered during execution.

Professional functional support to program managers should be strengthened and the need for staff functional oversight of program execution greatly reduced. Professional functional expertise should be assigned in *direct support* of program management. The thrust of this improvement is to implement, within DOD, a system whereby top functional executive staffs are primarily focused on creating and managing a system to educate, train and govern the careers of acquisition professionals. Such a system would provide PMs and PEOs the functional expertise they need to plan, organize and direct programs right the first time and be much less dependent on program review by functional managers at all levels. A collateral benefit is that programs would be less exposed to the diffusion of responsibility associated with committee decision-making.

Matrixed, functional, program support personnel should be dedicated to programs through organizational alignment and incentives. To the maximum degree possible, matrixed personnel should work full-time for, and be rated by, the PM. In some of the Services and many subordinate commands, functional acquisition specialists and PMs/PEOs have different chains of command. The thrust of this suggestion is to provide PMs and PEOs the functional expertise they require, and deserve (dependent on program priority) to plan and execute the program. The policy should be in the form of principles and goals, not directives, due to the need to provide flexibility to local commanders to optimize the use of scarce personnel expertise. Adoption of this approach should reverse the growing trend in some commands to place functional participants (even those full-time on specific programs) under the control and evaluation of the functional matrix manager.

Endnotes

1. *A Quest for Excellence, Final Report to the President*, p. 42.

2. DSB 1986 Summer Study, p. 10.

3. Interview with Alan Patz, former Director of Finance and Operations at Tektronix, Beaverton, Ore., March 30, 1989.

4. Chapin, Jerry L., *Government and Industry System Development Models: A Review and Comparison*, p. 33.

5. Valente, Judith, and Roy J. Harris, Jr., "McDonnell Douglas, Flush With Orders, Overhauls Management of Aircraft Unit," *Wall Street Journal*, Feb. 15, 1989, p. A6.

6. Quinn, p. 77.

7. Deutsch, Claudia H., "Goodrich Finally Gets It Right," *The New York Times*, March 12, 1989, pp. 1, 8 (business section).

8. Bruner interview.

9. *A Quest for Excellence*, pp. 42, 50.

10. Quinn, p. 78.

11. Browning, Edgar K., and Jacquelene M. Browning, *Microeconomic Theory and Applications*, Boston: Little, Brown and Co., 1983, Chapter 2.

12. The convention was suggested by Dr. Elizabeth Pate Cornell of Stanford University in several articles dealing with building codes for earthquakes and the dangers of nuclear waste.

13. Dean, James W., Jr., *Deciding to Innovate - How Firms Justify Advanced Technology*, pp. 25-27.

4

DOD ACQUISITION POLICY

WHAT IS IT?
HOW SHOULD IT BE IMPROVED?

1986 Packard Commission: "The program manager finds that, far from being the manager of the program, he is merely one of the participants who can influence it. An Army of advocates for special interests descends on the program to ensure that it complies with various standards for military specifications, reliability, maintainability, operability, small and disadvantaged business utilization, and competition, to name a few. Each of these advocates can demand that the program manager take or refrain from taking some action, but none of them has any responsibility for ultimate cost, schedule, or performance of the program. None of the purposes they advocate is undesirable in itself. In the aggregate, however, they leave the program manager no room to balance their many demands, some of which are in conflict with each other, and most of which are in conflict with the program's cost and schedule objectives. Even more importantly, they produce a diffusion of management responsility in which everyone is responsible, and no one is responsible."[1]

In this chapter we look at recent congressional guidance and statute as applies to program stability then assess DOD's major applicable directives and instructions.

Congressional Guidance. Though there are several statutes and implementing regulations controlling relatively detailed aspects of procurement practice, recent congressional guidance and statute are noticably in line with our previous descriptions of best commercial practices as applies to program stability: (1) baselining; (2) multiyear authorization commitments, (3) Elimination of the need to follow policy and regulations and reduced reporting channels for PMs of designated major programs; (4) the need for a plan for improving professionalism in acquisition managers; (5) buffers in cost threshholds and milestone dates; (6) limits in SECDEF authority to stretch out programs solely for budgetary reasons; and (7) direction to SECDEF to review all programs transitioning from development to production by 1993 to minimize the demands for very limited funds. These are all statutory attempts to get DOD to stabilize major programs. Limiting aspects of these laws include the emphasis on independent Cost Estimating and Operational Testers. Though these latter constraints do run counter to best business practice as they impact DOD leadership, the general thrust is for DOD to implement stabilizing features in major programs. Some of the committee language accompanying the acts indicates congressional intent to ultimately mandate more stability yet, to wit: (1) HASC and SASC desire for all major programs to be milestone funded; (2) joint authorization conferees desire for SECDEF to make recommendations to reduce test time and eliminate philosophical problems in current test approaches. (3) The SASC encouraged SECDEF to develop a system whereby PMs and contracting officers have appropriate decision-making authority and greater impact on the PPBS process; (4) the Congress chided DOD for not linking programs to strategy, policy and operational concepts.[2] If the latter is not considered fair criticism, then DOD should clear up the appearance of lack of continuity between strategy, policy, operational concepts and system acquisition programs.

The DOD Policy

Next, we evaluate the key DOD acquisition policy

which tends to promote instability despite its stated goal of facilitating stability. The top two DOD policy documents dealing with acquisition are DODD 5000.1, "Major and Non-major Defense Acquisition Programs," and DODI 5000.2, "Defense Acquisition Procedures." The former captures, fairly concisely, the essence of congressional guidance, but with many counter-stabilizing measures. The latter is, as entitled, a procedures document. We will not repeat the contents of these documents but critically identify aspects which appear directly contrary to the effective adoption of best commercial practice in defense acquisition.

(1) The DODD 5000.1 directs the policies, principle and objectives in managing major DAPs be applied to non-major DAPs. However, *the principles and objectives are not stated*; they should be, as lower-level staffs tend to overapply detailed policy and procedures when in doubt. (2) The DAE is described as an advisor; the SECDEF is the decision-maker. This appears contrary to the Packard Commission recommendations. With the SECDEF, USD(A), Service Secretary and SAE in the chain of command and authority for defense acquisition, there are six *levels of acquisition line management* in DOD from the PM to the SECDEF; each layer has a staff checking on the efforts of lower managers and staffs. What's wrong with SECDEF and Service Secretary permanently delegating acquisition systems decision authority to the DAE and SAE respectively? (3) Five phases, with six DAB milestone reviews are directed. This conflicts directly with best business practice of two or fewer go/no-go program decisions; these should be our MS II and MS III at maximum. We cannot afford, any better than industry, to second/third/fourth/etc.-guess our approved programs. The MS 0, MS I and MS IV reviews are appropriate but should not be DABs. These reviews should be left to the PEO and user communities. The MS V is a duplication of MS 0 and should be eliminated. (4) Affordability should not be reconsidered at each milestone, only once; MS II is optimal with adjustment at MS III if necessary. (5) The ten DAB acquisition committees diffuse responsibility from line management and set an example for lower executive staffs. The requirement that they use senior staff consensus to identify program issues and make recommendations to the USD(A) thence to the SECDEF ensures time is wasted while line management is put through a wringer. These committees should be reduced and redirected to review and advise the DAE but not have any directive power over programs. For example, they should not meet with the PM/PEO/SAE prior to and separate from the full DAB. Senior functional staff, freed from these committees, could then be assigned to proactive work in managing the career system for acquisition specialists, or to PM and PEO staffs. (6) The Directive subordinates Acquisition Decision Memoranda (ADM) to the PPBS without qualification; PPBS should be subordinated to ADM baselines from MS II-on.

The DODI 5000.2, the second acquisition policy in precedence, is a procedure. If a staff procedure is necessary, and it probably is, it should be an internal OUSD(A) SOP; it should not be applicable directly to the DOD components. The bulk of the document directs procedures for milestones and the preDAB process for which the latter should be discontinued. Those enclosures which would still be revelant to the DAB main decision reviews (MS II and III only) could be appended to DODD 5000.1.

The DODD 5000.45 and 5000.52 are key policy directives directly impacting the culture of defense acquisition. The former establishes baselining, whereas the latter establishes certain objectives for acquisition career management. They both need strengthening to establish the intent to provide authority, accountability, resource control, and reasonable flexibility in the management of defense acquisition programs.

This criticism has been brief and direct; there are at least 50 second- and third-tier DOD directives and instructions (and hundreds at lower tiers) that add excruciating detail to OSD acquisition policy and cascade down to Service staffs who must implement via service directives, regulations and procedures. All these should be reviewed keeping in mind to eliminate or redirect are procedures for internal OSD staff.

For DOD to emulate best commercial practices will be difficult because the true solutions will cut deep into our bureaucratic organizational overhead. Successful commercial companies are lean; DOD is fat. To begin providing effective

authority and accountability to acquisition management, functional staffs must be removed from program oversight and direction roles.

> "The fundamental intent of the (Packard) Commission's recommendations is to simplify the acquisition system by consolidating policy and oversight, reducing reporting chains, eliminating duplicative functions and excessive regulations, and establishing an environment in which program managers and their staffs can operate as centers of excellence. This should allow for a substantial reduction in the total number of personnel in the defense acquisition system, to levels that more nearly compare with commercial acquisition counterparts. Eliminating a layer of management by moving the functions and people of that layer to some other layer clearly will not suffice."[3]

Thus, stability in defense acquisition programs boils down to the presence of strategic goals which top management has committed to—a full organizational commitment to on-time completion, and the clear delegation of top management's authority to acquisition line management to get it done. Congressional impact upon DOD system acquisition is probably exaggerated. Yes, the Congress does overly micromanage projects; but it is less likely to step in if it, too, can identify the strategy goals of the project and, most importantly, it is confident that the project will deliver a satisfactory product, on time and within cost allowance.

An Example, Mobile Subscriber Equipment

It can be inferred from our comparisons of successful program management in commercial companies and in the DOD environment, that there is room for improvement in DOD acquisition policy. Without enumerating all problems (that would take more room than appropriate here), an example of a major Army program ultimately designated as a Defense Enterprise Program may be illustrative. As part of our research, we investigated the Mobile Subscriber Equipment (MSE) program and a case was developed which is included as Appendix G. The MSE acquisition strategy was an experiment by then Under Secretary of the Army (USA), the Honorable James Ambrose, prior to the aforementioned congressional acts, but which incorporated many of their features. A look at the features of the MSE case is instructive to see what good business practices were employed and several that were not (see Figure 4-1). Many techniques like those attributed to best commercial practice were used in MSE with the result that it has been much more stable than most major DOD programs. However, we will focus on commercial practices that were not employed as they illustrate the essence of some remaining problems. Do not miss the point that MSE is exceptional in the degree that innovative, good business practices were used. A reading of the MSE case will underscore the institutional difficulties MSE encountered in employing many good business practices even with top-level commitment and support. Unfortunately, just because practices (see Figure 4-1) were used to advantage in MSE, it would be wrong to assume DOD has institutionalized them. Rather, the good techniques used in MSE were due to extraordinary top-management efforts and an unusually long, stable tenure of key program management personnel.

FIGURE 4-1. COMMERCIAL STABILIZING FEATURES OF MSE ACQUISITION

1. Those employed:
   - Schedule prioritized over performance
   - Top management (SAE) involvement
   - Freedom from policy, regulation
   - Fewer Go/no-go decisions (effectively 3)
   - Flexibility to use program savings
   - Test schedule flexibility
   - Competed once for life of program
   - Used available production technology
2. Contrary practices employed:
   - Special interest and functional staff oversight
   - No buffer to bottom line cost (Congressional cap)
   - PM/PEO continual fight for people and travel funds

The Under Secretary of the Army made the unique acquisition strategy work for MSE. The PM and later the PEO, once appointed, are more like project coordinators than directors. Due to the Army's implementation of the PEO concept and,

within AMC, the simultaneous restructuring of the functional matrix, there was a need for the PM, with PEO support, to continue to fight for people resources and travel funds and with senior functional and special interest executives to stay with the program baseline and acquisition strategy decisions made by the Secretary of the Army when he approved entering full-rate production in 1985. The DEP designation helped force practical trade-off decisions, but they had to be made at the major general level and above (the PM is a colonel; the PEO is a brigadier general) to override the institutional biases of the lower-level acquisition bureaucracy. These lower-level functional staffs continue to try to standardize the "-illities" aspects of the program rather than proactively applying their innovative, functional expertise to optimize program success. The PM, Colonel John Power, has committed to seeing MSE through deployment. In doing so, he provides the continuity essential to a management system which quickly forgets earlier program decisions. His tenure as PM, MSE is expected to be 5 years—about twice the norm for PMs and key program participants in the Army.[4]

Conclusion

If we in DOD can clearly link each major acquisition to the strategy supported; if we can show the product being acquired is a practical, sufficient product; and we remain on a practically achievable schedule; we should expect the Congress to recognize the need to continue necessary funding. If DOD top management can prioritize systems needed and plan around reasonable funding levels for all programs, then the project managers of those truly essential systems can focus on system capabilities and on-time delivery. The authority requirements for acquisition line-management success are really just good people-management techniques. It is through our people that we conceive, plan and implement projects.

We have recommended that acquisition line managers be given clear authority to implement approved projects without the intercession of independent review authorities and senior staff bureaucrats, and be given the functional personnel resources to get the job done right the first time. Inherent in this recommendation is the understanding that not all programs are needed "now" and that top DOD management must decide which ones must be accomplished and when, and communicate these decisions to the field.

Our recommended authority and resourcing approach demand that all program participants be directly accountable to an acquisition line manager. These acquisition line managers are few by law; they are: the Project Manager, the Program Executive Officer, the Service Acquisition Executive, the Service Secretary, the Defense Acquisition Executive, the Secretary of Defense, and the President (the SECDEF and Service Secretaries could be eliminated via proper delegation of authority). Staff executives and staff officers, by definition, are not in the line-management chain; therefore, they must not have power to influence programs executed at lower organizational levels, except through line management and then only via policy, not program specific, direction. This recommendation would remove staff elements from any review or approval role as pertains to individual programs. Staff responsibility must be to create and maintain concise policy so the acquisition system works for line management, thus facilitating the accomplishment of the programs and the strategic goals which are the domain of line management.

Each Service has implemented the PEO concept differently, but each approach can work, and work well, if the following inhibitors are removed:

—Staff executives who have direct program impact such as resource control (i.e., personnel, funds, schedule and other equipment) or program approval

—Functional personnel resources assigned and accountable to other than acquisition line management (e.g., directorates of the Services' materiel commands or subordinate commodity commands).

To effect such changes in DOD, which has grown a large number of executive staff directorates, the executive staffs must be reduced and functions limited. Also, the Services' commodity or product divisions and headquarters, which provide the functional participants to programs (e.g., engineers, contracting officers, logisticians, testers, controllers, etc.) must allocate their personnel to

acquisition line managers for the duration of needed services without imposing additional layers of program oversight. The key to an effective transition for such functional staff elements from program oversight roles to program support is to ensure professional development and experience of such personnel and program managers. This can be done without major reorganization by the senior functional staff at each organizational level, once properly led and directed.

A good beginning would include a total rewrite of DODD 5000.1, elimination of DODI 5000.2, and review of all DODDs and DODIs with the intent to eliminate most. Our recommendations to senior defense acquistion leaders for enhancing program stability are provided in the executive summary.

In conclusion, the 1986 Packard Commission report points out:

> "Instead of concentrating on the things that are being done wrong and trying to fix them with more laws, more regulations, more inspectors, DOD should concentrate on those things that are done right and use them as models."[5]

Endnotes

1. *A Quest for Excellence, Final Report to the President*, pp. 46-47.

2. Office of the Under Secretary of Defense (Acquisition), "Legislative Guidelines Data Base," January 1989. An analysis and summary of 1986-88 Senate and House legislation and public law.

3. *A Quest for Excellence*, p. 55.

4. Interview with Colonel John R. Power, USA, Project Manager, Mobile Subscriber Equipment, January 18, 1989.

5. *A quest for Excellence*, p. 42.

III

INNOVATIONS IN THE SOURCING PROCESS

III

INNOVATIONS IN THE SOURCING PROCESS

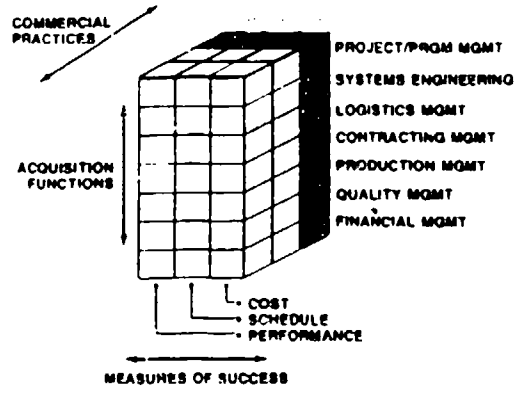
The previous section dealt with program stability as fundamental property of many successful commercial practices. The focus was on how companies internally manage a project in order to enhance the project's stability, and correspondingly, the project's chance of success. The management practices described were applicable to projects performed in-house as well as those performed by an external concern (i.e., contracted-out). Differentiation between in-house and external projects was not relevant in Section II, because the focus there was on project management practices internal to the company; practices found to be surprisingly consistent regardless of the source of the project's execution.

In this section we direct our focus external to the company, to the processes by which companies go about procuring or sourcing from outside vendors, suppliers, or subcontractors (terms which will be used interchangeably throughout). Like program stability, this area is a fundamental component of successful business management. In the context of our research model, this change can be characterized as a shift from focus on the stability "slice" of the model, to other "slices" representing various other commercial practices.

Several factors are at work in today's business environment, making this focus on external sourcing particularly relevant. First, companies are increasingly giving suppliers a greater "share of the action." In the manufacturing sector the amount of "action" placed with suppliers is currently 60 percent and rising.[1]

Second, the entire area of sourcing has been extremely dynamic over the last decade, with some fundamental changes, particularly in relationships existing between buyers and sellers in the commercial marketplace.

FIGURE III-1.



This change, perhaps best described as an evolution toward a more cooperative buyer/seller relationship, will be explored fully in this section. Specifically, the nature of the commercial buyer/seller relationship will be examined, then some lessons will be drawn for import into DOD's way of doing business. Chapter 5 examines the relationship as it pertains directly to the government purchase decision, with particular focus on how quality is made a viable factor of that sourcing decision. Chapter 6 will drop a level, and examine the relationship as it pertains to purely commercial companies and DOD contractors alike, as they make sourcing decisions.

Finally, Chapter 7 provides a brief discussion of the pervasive influence of government regulation on sourcing, and all other decisions, of defense contractors.

Endnote

1. Leenders, Michael R., and David L. Blenkhorn, "Reverse Marketing - The New Buyer-Supplier Relationship," *The Free Press*, New York, N.Y., 1988, p. 8.

5

QUALITY SOURCING

FINDING Price is but one element in the purchase decision.

DISCUSSION OF THE FINDING

The Packard Commission, identified the difference in approach toward price between the commercial and defense decision processes and suggested that industry practice could be adapted as follows:

> Commercial procurement competition simultaneously pursues several related objectives: attracting the best qualified suppliers, validating product performance and quality, and securing the best price...Defense procurement tends to concentrate heavily on selecting the lowest price offer, but all too often poorly serves or even ignores other important objectives.[1]

Throughout the United States there is renewed emphasis on the importance of quality in all aspects of the manufacturing and production process. Within the Department of Defense, this emphasis has been shaped within the framework of Total Quality Management as developed from the works of W. Edwards Deming, Dr. J. M. Juran and Mr. P. B. Crosby. Because this concept was successfully applied first in production and manufacturing organizations, it is not as clearly defined to defense purchasing. In defense purchasing there are countervailing forces based on law and regulation which restrict its full implementation.

We found that ownership costs and dependable quality are the dominant variables in commercial buying decisions. Purchase price was not ignored, but it was a variable which would be traded off for desirable features, uniformity and dependability.

Purchase decision-making in support of systems programs was decentralized and geared to the requirements process. In systems programs, the ultimate source selecting authority was the program manager. Firms tended to employ strong technical (engineering) background in the purchase department so that they not only knew the marketplace but also could understand the requirement.

Quality in many firms is becoming a total company commitment with access and input to supplier quality data base information being made available to more organizations in the company. Firms are developing systems to factor quality performance into their source selection decisions and are communicating their use of these systems to their suppliers.

Purchasing involves a complex ranking and evaluation of objective and subjective factors. These factors may be addressed explicitly in the form of objective criteria or implicitly based upon judgment or taste. Personal, commercial/industrial, and governmental purchases all adhere to the "classical" definition of the purchasing objective:

> Buy materials and services of the right quality, in the right quantity, at the right price, from the right source, and at the right time.[2]

The extent to which selection of the "right source" may be based on subjective factors accounts for the differences in personal, commercial/industrial and government purchases.

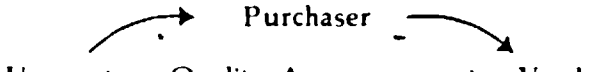
In personal purchases, in contrast to those in the commercial/industrial and governmental environments, selection may be completely subjective based upon a mental evaluation of how a given product meets the personal requirements of the individual. The selection process is likely to be

unstructured, may change over time, and only needs to satisfy the individual.

By comparison, in most government and industrial offices, purchasing is structured in method, centralized to some extent to provide consistency, and open to audit and review. In government and industry, the purchasing office takes written requirements from the requesting office, matches them with available suppliers, and negotiates the most favorable terms for the purchase. Their success in selecting the right supplier is important to the efficiency and effectiveness of any firm or government agency. However, despite certain common procedures, there are fundamental differences between government and commercial organizations in terms of their status, accountability, process complexity, and objectives.[3] These differences result in a significantly different approach to value of quality and the role it plays in the purchase decision.

It is useful in looking at the sourcing decision to develop a simple, conceptual framework of an organizational purchase decision. Such a simple model includes only a user, purchaser, vendor and quality assurance inspector. The loop begins and ends with the user. The purchaser and the quality assurance inspector act as the user's agents. This model is diagrammed below:

FIGURE 5-1. THE FORWARD PURCHASE FLOW



Each individual in the purchase flow has multiple objectives and incentives. For simplicity, we consider only the most significant. The user has a requirement, a budget and is responsible for the costs of owning the item. The purchaser must conform to established organization practice, convert the requirement into contract terms and evaluate bids received from vendors. The vendor must understand the requirement, produce the item and be paid. Quality assurance inspects the item to ensure that it meets the terms of the contract.

Recalling the concept of competing utility functions from Chapter 3, we can see the potential of competing functional goals and objectives which may lead to compromise solutions.

The flow of information becomes complex: it is difficult to design a feedback loop which allows the user, purchaser and quality assurance individuals each to accommodate each other's function and incentives. As organizations become larger, with centralized purchasing, the distances and barriers grow. In the study of government contracting officers and industry purchasing agents previously cited, there was a definite correlation between the size and centralization of purchasing and the quality information which the purchaser had at the time of making the source selection.

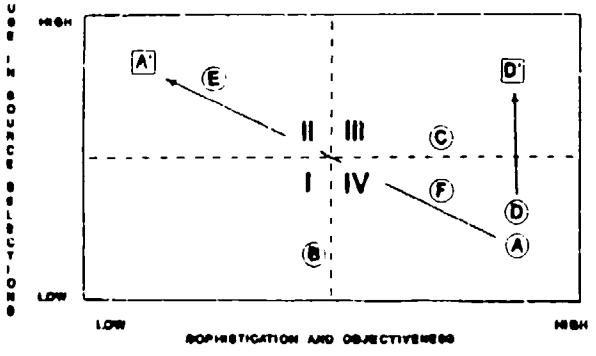
Within this model, purchases are based upon the purchaser's evaluation of price, quality and ownership costs. Price is a concrete decision measure, which represents an outflow of today's budget. Quality and life cycle considerations account for later year expenditures which may not be visible at the time of the particular purchase decision. Incentives placed on the purchaser in the form of business practice are extremely important. If such incentives emphasize price reduction, this reduction may come at the expense of quality or ownership costs. Trade-offs made by the purchaser among price, quality and ownership costs, may conflict with user preference. This problem is compounded because often no accepted measure of quality exists.[4] By comparison, price can be easily and accurately measured.

Recognizing problems associated with obtaining a workable definition of quality, competing utility functions for the players in the model, and the need for a systematic approach to improving quality, the following convention is developed.

Along the X axis is the sophistication in the quality information available. The Y axis represents the use of the information in making source selections.

In Quadrant I, the organization has a limited quality collection system and no objective way of evaluating quality when it makes source selections. It must rely on subjective emphasis on quality and hope that its suppliers will provide adequate quality.

FIGURE 5-2. APPLICATION OF QUALITY DATA



In Quadrant II, while there is an a ence of comprehensive qual ty information, there is a commitment to use that which is available to make future selections. Such systems are generally tied to a single measure such as schedule or are based on inspections of supplier facilities and procedures. Because they are based on limited or incomplete information they may measure and emphasize measures not accurately reflecting the quality of the material being received. Type II cases, however, provide a strong indication to suppliers that quality is important and the firm will use the data available to discriminate between its suppliers.

Quadrant IV reflects an objective quality data collection system, but little use of the information in making selections. There are two primary reasons for its lack of use in making selections. First, this information is often collected in different parts of the organization and not integrated in a fashion which permits easy application in purchase decisions. Second is the question of professional competency and relationship to suppliers. An experienced purchasing agent knows the market, coordinates with the manufacturing elements of the firm, monitors the performance of suppliers, and enjoys the confidence of management in making the subjective evaluation of which supplier will be selected. Such experienced purchasers may not need a systematic quality-based selection system because they subjectively make quality-based selections.

Quadrant III shows a high level of sophistication in data collection and a willingness to use it. Unlike Quadrant II, the bid factors are based on a wide range of integrated data, closely monitored and updated. It seeks to systematize the professional evaluation discussed above into a method which is objective and perceived as fair.

For most large firms, it would be preferable to operate in Quadrant III, however for the reasons already discussed most firms find themselves in Quadrant IV. The following are some examples of systems in use.[5]

—Company A

This large firm has a significant quality-control organization and a large centrally-managed purchasing department. For most purchases, historical quality information is available in addition to price information for review by the purchasing department official. Selection of a higher-priced item can be made only with the approval of the purchasing supervisor.

In one division of the business, a comprehensive supplier qualification and rating program has been established. It looks at the quality control documentation and system which is installed at suppliers' plants. Based on an annual review the vendor is given a rating factor which is then applied to all purchases from that vendor. The price basis is adjusted by this quality factor.

—Company B

This large organization has an elaborate quality collection system which records the results of facility certifications, on-site inspections and problems reported on receipt or users. Purchasing is a separate organizational entity. Source selections are made based upon competition with only limited prequalification of the suppliers, and without consideration of past history.

—Company C

The company implemented their quality system in the early 1980s and following several refinements, 40 percent of its production purchases are made through the system. It is based on an on-line computer system which contains information provided by vendors as well as past company purchase data. It concentrates on items with a significant dollar volume or for commodities which when taken together are significant. A value

analysis approach employs commodity-teams early in the requirements process. These teams include people from engineering, purchasing, manufacturing, and marketing as well as vendors, end users and customers. The result is a total systems approach for those items which meet the criteria for inclusion in the system. The company believes that it is achieving cost savings and obtaining better quality items.

—Company D

This large firm has long collected quality information from various sources. Recently, its efforts have focused on the integration of this information into a computer data base which is jointly maintained by purchasing and quality and which can be used by the purchaser when making a source selection. The system produces a supplier evaluation rating ranging from outstanding to unsatisfactory. Elements factored into purchase decisions include past delivered performance and a graduated assessment of any problems with the supplier. Theassessment becomes progressively more severe as problem discovery moves from the supplier's self-identification to a problem reported in an installed piece of equipment.

Presently, the rating system requires substantial justification if a source selection is recommended for a marginal or unsatisfactory vendor. Likewise, substantial justification is required to select other than a low bidder. It is planned that weighting factors which will adjust the price basis to account for past quality performance.

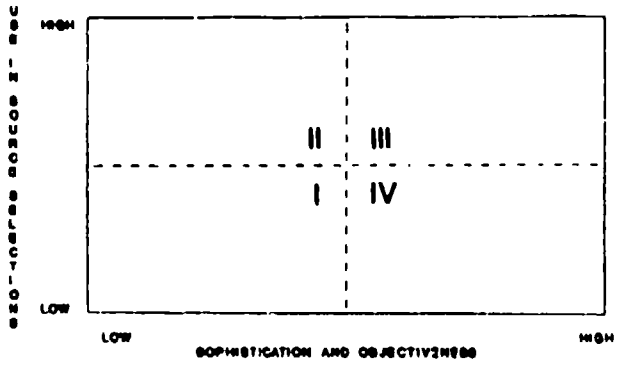
—Company E

A vendor rating system was established to systematically evaluate price, delivery and quality. Its goal is to allow the purchasing agent to select the best vendor based on past performance. It is purposefully simple to ensure that suppliers understand the requirements. Each bid price is adjusted by applying evaluation factors to established prices. Evaluation of delivery at 100 percent is based upon receipt plus or minus 7 days of the established date, 75 percent if received 8-14 days early and 50 percent if received 8-14 days late. Quality adjustments to this rating are based on sampling of incoming parts, and input from the company's quality control department.

—Company F

This large firm is developing a vendor performance improvement system which stresses improved communications between buyer and seller. Early involvement in new product development projects by potential suppliers, supplier process controls including statistical qualification of processes, and delivered performance measurement are included. It is an integrated system which will provide the firm with the ability to rate a supplier's performance accurately. However, it does not employ a bid factor to adjust the relative prices between suppliers. Placing the six companies on the conventional diagram, most fall in quadrant IV. The ability to use quality information to adjust prices is not common. The efforts made by Company D to move in this direction seem to provide the most promising example for government procurement since the method of selection will be open and objective.

FIGURE 5-3. APPLICATION OF QUALITY DATA



INHIBITORS

The policies, pressures and practices of government purchasing places the DOD source selection process in a unique environment. Individual source selections must be made fairly and openly with each being defensibly based upon legal and technical criteria which can be demonstrated to auditors, unsuccessful bidders and other interested parties.

A definition of quality in the purchase decision is murky.

Defining quality is complicated because in many organizations, including the Department of Defense, quality organizations have been separate from line management. Major advocates of quality have focused on the importance to overall corporate goals of a strong quality organization and economic/profit benefits from a directed approach led by these quality organizations. Such an approach concentrates primarily on improved manufacturing methods and the need for top management support and has a twofold objective:

(1) The scope and authority of the quality control organization should be expanded.

(2) Top management must become personally involved in promoting quality.

Since this emphasis is primarily outside the purchase function and organization, it is not surprising that the principle advocates provide only a minimal treatment of the purchase function.

Mr. Crosby, in his book *Quality Is Free*,[6] defined quality as "conformance to requirements." His major thesis was that the cost of scrap, rework, service, warranty, inspections and tests which result from "non-conformance" cost much more than efforts to produce products which "do not fail in the field." However on the subject of purchasing quality goods, Mr. Crosby devotes only two pages of his work. He describes the futile effort as follows:

> "Traditionally purchasing's job has been to take an order constructed by some other department and place it. The operation has not usually been involved in whether the item specified offers the best purchasing opportunity. The shortest time lag in the operation is usually spent searching for the best supplier in terms of quality, cost and delivery. Most of the time is spent in product development or conceptual design. Purchasing has little opportunity to do a selection job, and quality doesn't really know how to help them."[7]

Mr. Crosby's assessment of the utility of the traditional audit and inspection approach was equally pessimistic:

> "A tour of potential suppliers, conducting "quality audits," is next to useless. Unless the vendor is a complete and obvious disaster area, it is impossible to know whether their quality system will provide the proper control or not. You can only know by being inside of the vendor's company."[8]

The solution he posed to his problem was that quality control personnel should get involved earlier in evaluating key items that will be bought. Such actions are evident in many commercial firms.

Dr. Juran's definition of quality is "fitness for use."[9] This determination is made by the user, based upon features the user recognizes as beneficial. His development of the concept of "fitness for use" is quite comprehensive. He describes the interrelation of quality parameters in a "tree" leading from fitness for use through quality of design, quality of conformance, availability, and field service to a further breakdown of twelve components.[10]

The comprehensive nature of Dr. Juran's work makes specific application complex. Representative of this dilemma is the following:

> For important purchases it is well to use multiple sources of supply. A single source can more easily neglect to sharpen its competitive edge in quality, cost and service. Despite the evident advantages of multiple sources, there is an enormous extent of use of single sources....These operations are quite successful in using monopolistic sources of supply because they solve their quality problems through a combination of managerial tools.[11]

Dr. Juran's all-inclusive approach typifies the difficulty in quantifying and measuring quality in purchased goods and materials. In a later book, *Quality Planning and Analysis*,[12] he includes a chapter on how to foster cooperation with the vendor without offering suggestions other than two inspection sampling techniques. Dr. Juran is perhaps the best advocate of the importance of a strong quality control organization, but like Mr. Crosby, he provides no objective measures to be used in purchasing quality supplies.

Dr. Deming is perhaps the most widely-known and respected person in the field of quality. He

is credited by many for the successful implementation of a total quality approach in Japanese manufacturing.[13] He does not try to provide an operational definition of quality. Instead, he views the concept in terms of who should judge quality. The closest he comes to defining the term is in describing the difficulty of the task.

> The difficulty in defining quality is to translate future needs of the user into measurable characteristics, so that a product can be designed and turned out to give satisfaction at a price that the user will pay....The quality of any product or service has many scales. A product may get a high mark in the judgement of the consumer, on one scale and a low mark on another.[14]

Dr. Deming's thesis is that only a total approach to quality will be successful. In his "14 Points for Management," a comprehensive cultural change in operations is advocated; however, the method of accomplishing the change is left to the manager. Dr. Deming's focus has been on the benefits to top management of adopting a total quality management program. While he fails to provide a specific process, the success attained by firms which have adopted his methods make it believable.

Of Dr. Deming's fourteen points, two deal with the purchase of items from suppliers. They state:

> # 3. Require statistical evidence of process control along with incoming critical parts.
>
> # 4. The requirement of statistical evidence of process control in the purchase of critical parts will mean in most companies a drastic reduction in the number of vendors with whom they deal.

David A. Garvin in a 1984 *Sloan Management Review* article[15] reviewed five approaches to defining quality. His definition framework is summarized below:

> The **Transcendent Approach** is the philosophic concept of "innate excellence" which is both absolute and universally recognized. It cannot be analyzed but is recognized through experience.
>
> The **Product-Based Approach** focuses on the quantity of some ingredient or attribute possessed by a product. As in the amount of cream in ice cream it can be assessed objectively and is based on more than preferences alone.
>
> The **User-Based Approach** begins with the premise that quality "lies in the eyes of the beholder." Through maximization of the composite individual preferences a "proper" quality is determined. It is subjective and rooted in consumer preferences.
>
> The **Manufacturing-Based Approach** focuses on engineering and manufacturing practice. It identifies quality as "conformance to requirements" and it is equated with meeting specifications or making a product right the first time.
>
> The **Value-Based Approach** defines quality in terms of costs and prices. Quality provides performance at an acceptable price. The phrase "affordable excellence" summarizes the dilemma. There are no defined limits and no means of application.

The five approaches often conflict and, depending on the perspective taken, lead to disparate conclusions. Under the product-based definition of quality, we expect to pay more for quality because we expect better materials, workmanship and inspection were applied to achieve this quality. Theoretically, from the product-based paradigm, there should be a positive correlation between the price of a high quality item over one of lower quality. This is a marketable attribute which, regardless of whether it is based upon fact, reputation, or simply impression, can be applied when marketing under the user-based perspective. The lack of precise information on the true attributes of the product encourages managers to set higher prices to "imply higher product quality."[16]

Within the user-based paradigm, quality is an attribute by which consumer goods are marketed. Many products are labelled using adjectives such as "choice," "select," "prime," "superior," or "distinctive" to demonstrate the perception that quality is important and valuable. Perhaps nowhere else is quality more extolled than in the automobile industry. For reasons beyond the

scope of this research the American automobile manufacturers lost considerable market share to the Japanese and German auto makers on this issue.[17] However, slogans such as "the quality goes in before the name goes on," and "quality is job 1" indicate a focus on the manufacturing-based definition of quality. Ford Motor Company adopted a "defect prevention" approach to quality which while manufacturing based, has yielded dramatic improvements and boosted Ford's standings in consumer quality ratings.[18]

Numerous studies have shown that in many consumer products people will pay a premium for real or perceived quality.[19] In such simple items as a pen or a pencil, suitable value-based products can be found for under a dollar, while there are also many value-based products marketed at a much higher price. Production management and quality sampling techniques which operate under the manufacturing-based definition can ensure that the established quality standards for both the Number 2 wooden lead pencil and the precision drafting pencil are maintained. However, the premium that will be paid for quality is determined by the market mechanism within the user-based definition.[20]

No concise view of defense acquisition quality emerges, rather one can infer, based on organizational structure and implementing policies. Dr. Robert E. Costello, former Under Secretary of Defense for Acquisition, in establishing a Total Quality Management Program for the Department argues that efforts toward a continuous improvement process are necessary. The following excerpt from Costello's speech to the Defense Logistics Agency Commanders' Conference in November 1987 establishes his desire to push for a change in focus:

> For much too long we have been following the concept of "minimum acceptable" quality. America's manufacturers and our maintenance depots have pursued this concept with the placid resignation that a persistent level of errors, perceived as irreducible is a way of life....The process should continuously strive for improvement rather than accept a predetermined level of imperfection.[21]

The concept of continuous efforts toward improvement, abandoning "minimum acceptable" quality, are philosophical shifts which have major implications for defense acquisition practice.

The operational definition of quality which was used to develop a plan to implement Dr. Costello's approach in DOD, was:

> Conformance to correctly defined requirements satisfying customer needs.[22]

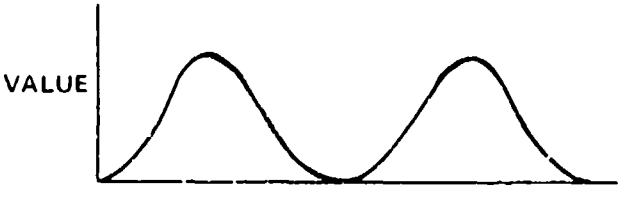
This definition closely resembles a combination of those of Mr. Crosby and Dr. Juran. It was also the most commonly cited definition by industry and government contracting officials in a survey conducted during the Summer of 1989

Cooperation and Competition Are Mutually Exclusive

Companies are dealing with fewer suppliers. This is not an abandonment of competition but a recognition of its limits. Practices such as Just-in-Time (JIT) and Material Requirements Planning (MRP) depend on reliable deliveries of uniform quality from suppliers. Performance information is being collected on suppliers and is beginning to be used in the purchase process.

In an interview with Dr. Broedling,[23] she expressed the conflict in terms of the bi-polar model illustrated here:

FIGURE 5-4. VIEWS TOWARD ACHEIVING BEST VALUE



One pole is centered on competition and the positive effects it has on price and the other centered on cooperation as the most important in quality decisions. The benefits of each can be illustrated by analogy to team sports. Individuals on the team must cooperate rather than compete with each other to be successful while they are simultaneously competing rather than cooperating with their opponent.

Dr. Deming views competition on a much larger scale than an individual purchase decision. Competitiveness in the international arena requires cooperation in the many small purchase decisions which impact a firm's product. What emerges is not wide-open competition for each item but a limited competition in which repeat business, stability and product improvement are emphasized.[24]

There is a definite conflict between free and open competition (required by law in government purchasing) and the cooperative concept. Dr. Deming explained the justification for limiting suppliers as follows:

> We can no longer leave quality and price to the forces of competition -- not in today's requirements for uniformity and reliability. Price has no meaning without a measure of quality being purchased. American industry and the U. S. Government are being rooked by rules that award business to the lowest bidder.[25]

The recent awakening of the importance of quality in American products has greatly expanded writings in the field. Most authors, in discussing quality, focus on application of one or more of the principles discussed by Mr. Crosby, Dr. Juran and Dr. Deming and adopt a "conformance to requirements" type of definition. Those attempting to deal with the role of purchasing focus on reducing the number of suppliers and increasing the level of cooperation between the requiring and supplying companies.[26]

The dominant role that price plays in government purchases stifles creativity and innovation. Objective evaluation, as practiced in government purchasing, requires that there be little innovation in the suppliers' approach because the competitive decision process becomes one that is based on price. Dr. Harry Page described this process as follows:

> It has become traditional practice in government to write purchase specifications in such a way that any potential supplier can produce the item, and award can be based upon lowest price.[27]

Since passage of the Competition-In-Contracting Act (CICA) in 1984, the view that defense procurement overemphasizes the importance of price intensified. While not criticizing the intent of CICA, the Packard Commission identified three problems with its implementation by the Department of Defense:

> (1) Interpretation that the government must buy from the lowest price bidder
>
> (2) The notion that CICA precludes qualification criteria, consideration of technical expertise, or life cycle costs
>
> (3) The resulting focus on the number of competitions rather than the success the competition achieves in terms of reduced prices for current items or better products.

The Commission concluded that the full potential of CICA could not be realized until these problems were overcome.[28]

Recommendation F of the Packard Commission's final report was to "Increase the Use of Competition" which was explained as follows:

> Federal law and DOD regulations should provide for substantially increased use of commercial-style competition, emphasizing quality and established performance as well as price.

In the government, procurement awards are made within an environment influenced by history, social legislation, budget pressures, a distinction between price and cost, specification complexity, a definition of what distinguishes suitability from gold-plating, a preference for fixed-price contracts and a preference for competition. Individually and collectively, these environmental influences may skew any procurement decision.

It is apparent that the theoretical foundation for objective quality measurement is not established well enough to facilitate objective evaluation of quality factors in either the government or commercial/industrial environments. The principle authors in the field of quality: Mr. Crosby, Dr. Juran and Dr. Deming fail to provide objective methods of obtaining quality purchases. Current conventional wisdom in obtaining quality is to work toward development of long-term symbionic relationships with suppliers. Such relationships are impossible to attain under the current environment of government rules and practice.

SUGGESTED AREAS FOR IMPROVEMENT

On-Line Contractor Performance History File

The first step in using quality information in making source selections is to make it available to the contracting officer. The elements of the file need to be established and should include indices for price, delivery, and reported quality problems.

Second, the ability to input and access the files throughout DOD must be established. A partial net will not be sufficient, since it will fail to provide the objective information needed eventually to make source selections.

Third, once the network is functioning, quality factors can be established to adjust bid prices to reflect the value associated with variations in schedule, quality or other performance features.

There are several innovative techniques being tried to implement such a system. We are aware of efforts being sponsored by the Defense Logistics Agency,[29] and the Services; but, they are limited in scope, not exploiting the potential for more accurate measurement, which is essential to their widespread acceptance and application and their ability to withstand administrative protest.

Quantification of Non-Price Factors

There is a need for a method to quantify evaluation of factors in addition to price. Adapting the dimensions of the quality framework established by David Garvin, it is possible to segment quality into dimensions which could be weighted, ranked and evaluated. A quantifiable, auditable and defensible means could be developed for the DOD contracting officer to use when evaluating source selections.[30] The challenge is to develop an objective quality system which can operate effectively in the defense acquisition environment.

A review of the regulatory and policy directives established no specific prohibition to the use of quantified non-price factors. The FAR specifically states that source selections are to be made based on price and other factors. The reason for their lack of application is the lack of a generally acceptable, theoretical criteria for quality. Measurement of quality is identified consistently as a major stumbling block. As discussed earlier, this is because any system requiring information can only be as good as the information input. The problems associated with quality feedback in DOD also contribute to the need not only for an on-line contractor performance file but improvements in quality data feedback. However, several examples of attempts within DOD to apply quantitative past performance to source selections should be noted. For example, the "Blue Ribbon Supplier" systems being established in the Services and DLA recognize a supplier's past performance and apply a percentage cost bonus in subsequent source selections.[31]

A Variable-Incentive Specification

The current method of establishing a minimum specification which, if satisfied, permits the selection to be made based on price, should be selectively replaced by a method through which performance specifications define the value of variable features. Performance feature variations would be evaluated using a preestablished and published cost/performance criteria.

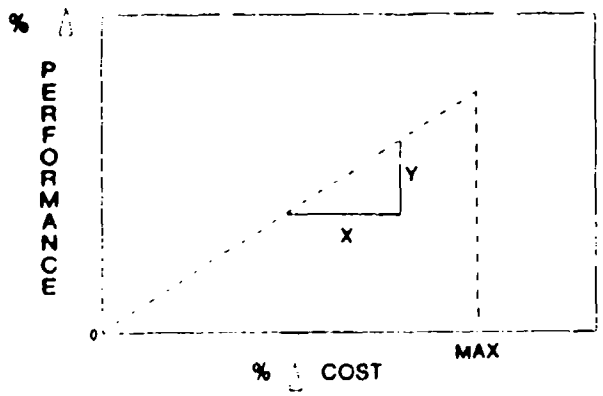
Such a method would preclude the need to "gold plate" specifications. It would provide incentives for contractor who have better ways of meeting the requirement to be selected over contractors who barely meets minimum requirements at the lowest cost. Presently there is little incentive for a contractor to innovate or exceed the minimum.[32] Such a focus on low price makes the rules of competition easy to apply, focusing principally on price, with results such as those reported in *The Washington Post*:

> The Defense Department inspector general's office, testing random samples of parts bought by the Air Force the past two years, estimated that as much as 98 percent of the money spent for the spare parts surveyed went for items with major or minor defects.[33]

To shift the emphasis from price competition, it is important the vendor recognizes that something more than price will go into the source selection; that there will be an incentive provided for delivering a better product even at a higher price.

What makes a product better must be established clearly in the solicitation, as must the value of the incentive. This can be viewed in terms of percent improvement in the designated performance element for a percentage difference in price with an

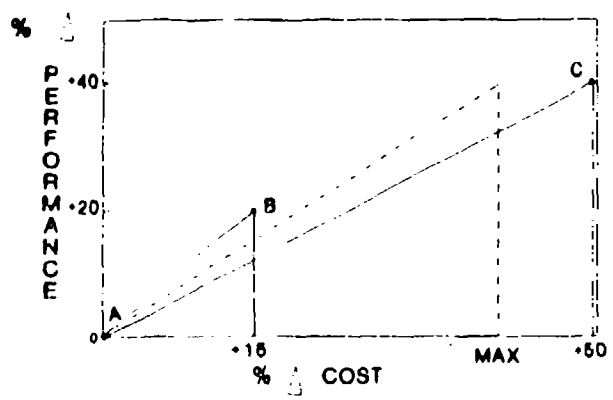
FIGURE 5-5. VARIABLE SPECIFICATION



upward bound as illustrated in the following figure.

This can raise the specter of "gold plating" and too much subjective judgment. However, discussions with senior DOD contracting officials confirmed that, provided the relationship was clearly stated in the solicitation and applicable to all vendors, there is no impediment to its adoption.[34] The following examples illustrate the concept.

FIGURE 5-6. VARIABLE SPECIFICATION



PERFORMANCE QUALITY FACTOR

An aircraft program has a need to reduce weight of installed equipment. Assume the current standard communications radio weighs 10 pounds and costs $100, and there is some value for a reduction in its weight. The current contract method would specify 10 pounds or some lighter weight. Contractors would then seek to minimize costs to meet that specification, perhaps ignoring weight savings which might cost "a little more." Simplistically, the proposed quality factors contract would be structured as follows:

QUALITY FACTORS CONTRACT SPECIFICATION

> All other performance specifications are unchanged. An incentive of 10 percent of total price for each pound less than 10. Maximum price incentive is 40 percent.

Assuming that three bids are received which satisfy all the specifications as follows:

	Company A	Company B	Company C
Weight	10	8	6
Price	$100	$115	$150

Selection would be for Company B, because its price is within the range specified for the incentive and beats the cost/performance trade-off ratio. The product proposed by Company C would not be selected because the preestablished weight/price relationship is exceeded and it provides less relative benefit per extra unit of cost.

RELIABILITY QUALITY FACTOR

Reliability improvement may also be desired for the same ratio. If the current ratio has a Mean Time Between Failures (MTBF) of 100 hours, a similar relationship could be set where a 10 percent improvement in MTBF would be valued at 5 percent of the acquisition price. The contract solicitation would be structured as follows:

QUALITY FACTORS CONTRACT SPECIFICATION

> All other performance specifications are unchanged. An incentive of 5 percent of total price for each 10 percent improvement in the MTBF up to a maximum of 60 percent price incentive.

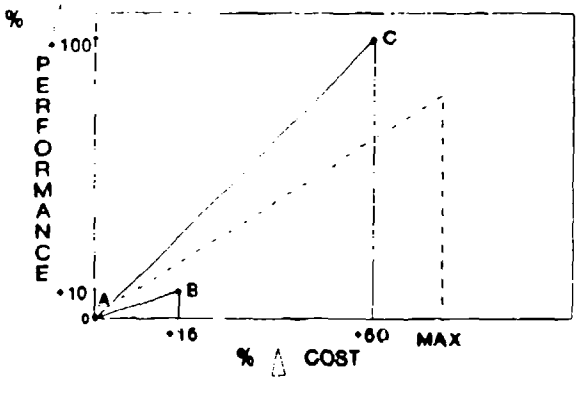
Assuming that three bids are received which

satisfy all required specifications, they would be evaluated as follows:

	Company A	Company B	Company C
MTBF	100	110	200
Price	$100	$115	$150

Using this specification, the selection would be Company C's product.

FIGURE 5-7. VARIABLE SPECIFICATION



GENERALIZED APPROACH

From examples discussed, the contract proposal process has become more complicated for the supplier. No longer will attainment of the minimum specification be sufficient. A product which exceeds the specification in a quality factor considered valuable to the requestor may be selected over one which meets the specification. The examples cited are simplistic but not impractical for application. Of course there is the potential of adding so many incentive systems that the process would become one of linear programming; but, even in this case, the evaluation of the criteria would be based objectively. It provides a means to change the focus from lowest price to one of best value.

One of the major distinctions between the government and commercial purchasing practice is that this relationship must be clearly stated in the request for bids. Because of the absolute requirement for fairness, all interested parties will need to understand the relationships proposed and the evaluation criteria.

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6

SOURCING BY DOD CONTRACTORS

FINDING Companies are adopting more cooperative relationships with their suppliers.

DISCUSSION OF THE FINDING

We have examined, in some detail, the nature of the buyer/seller relationship in the commercial marketplace, with particular emphasis on how that relationship is evolving to improve quality. This chapter continues that examination, looking specifically at the buyer/seller relationship in the context of commercial companies and their suppliers and subcontractors (a.k.a. sourcing). We established the prevailing commercial practices in this area, and examined how they may differ for companies operating under the umbrella of a DOD prime contract. Our premise at the outset was that defense contractors are uniquely constrained or inhibited from using certain innovative commercial practices in sourcing.

One need not look far to discover evidence that commercial companies are definitely changing their relationships with suppliers. They are moving down the continuum toward more cooperative supplier relationships and away from the traditional, competitive way of doing business.

This new relationship goes by many names (partnering, strategic alliances, comakers, value-added partnerships, etc.), but the central elements are common. All are long-term arrangements with a small number of high quality suppliers; relationships characterized by mutual dependence and open communications.

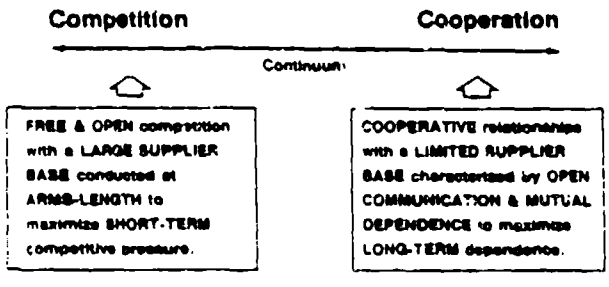
Note that our focus in this chapter is exclusively on relationships between companies and their suppliers. What we do not discuss is the "teaming" of major companies to spread the risk and return of a major development effort. Also not discussed is a company's internal "make-or-buy" decision. While "make-or-buy" is a critical element of any sourcing decision, we examine here relationships external to the company.

To fully understand the forces driving companies toward cooperative relationships with their suppliers, it is important to understand first the forces that drive the traditional way of doing business.

Traditional, Competitive Buyer/Seller Relationship

The dependence theory of bargaining (Bacharach and Lawler, 1981) provides an excellent conceptual framework for understanding the traditional, competitive approach to the buyer/seller relationship, a relationship often referred to as "competition". The dependence theory asserts that the power of buyer or seller is based on the degree of dependence the other party in the relationship has on the first. This degree of dependence is driven principally by two factors—commitment of each party to an outcome, and the degree to which each party has alternative means of satisfying that outcome.[1] In the normal course of the buying/selling process, each party seeks to maximize their power by making the other party more dependent on them (in reality or perception), and/or making themselves less dependent.

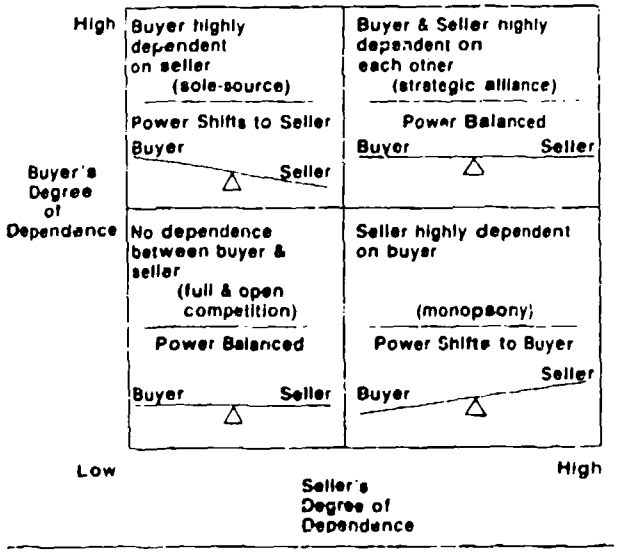
FIGURE 6-1.



Traditionally, most relationships with suppliers have followed this competitive model. Companies go to great lengths to avoid being trapped in a sole-source position with its associated loss of bargaining power. They feel the pressure of competition is the best tool to avoid becoming overcommitted to a supplier, thereby maintaining parity in the bargaining process. If this competitive pressure is lost, companies fear their suppliers will exploit the power of sole-source status, and take advantage of them. Chester Karrass, a noted expert on practical negotiation techniques, says of this sole-source situation, "Buyers fold like a tent in front of a seller who has no competition."[2]

Conversely, suppliers go to great lengths to maneuver themselves into a sole-source position so they can take advantage of the power differential. They employ what the *Wall Street Journal* calls a "get-it-while-you-can strategy"; recognizing that when the tables turn, as they inevitably do, their profits will be "cut to the bone."[3] Each side inherently distrusts the other, and an arms-length, often adversarial, relationship develops.

FIGURE 6-2. DEPENDENCE THEORY OF POWER IN BUYER/ SELLER RELATIONSHIP



Classic economic theory is useful also in understanding this competitive approach to the buyer/seller relationship. Competition is a fundamental element of our free enterprise system. With multiple buyers and sellers in the marketplace, the laws of supply and demand make price essentially self regulating. This is the situation most buyers desire. Conversely, if there is only one seller (a monopoly), or one buyer (a monopsony), or if the marketplace is not "free" (regulated or collusive), then the laws of supply and demand cannot be relied on to determine price effectively.

This traditional approach to the buyer/seller relationship is by no means passe, but is still the favored approach by many in industry, and by most in the government. However, there are an increasing number who are employing, and benefiting from, more cooperative approaches in dealing with their suppliers.

Innovative Trends in Commercial Supplier Relationships

The current literature of manufacturing science is replete with examples of the "new" supplier relationship. Hayes, Wheelwright, and Clark of Harvard Business School found that one important characteristic of what they termed a "world class manufacturer" (i.e., a manufacturer able to compete on equal footing with the Japanese) was a redefined relationship with a small cadre of top quality suppliers. Specifically, they assert:

> "it is essential that suppliers change from arm's-length adversaries to co-makers. Under the co-maker view, the buyer organization seeks close working relationships with a few key vendors over the long-term."[4]

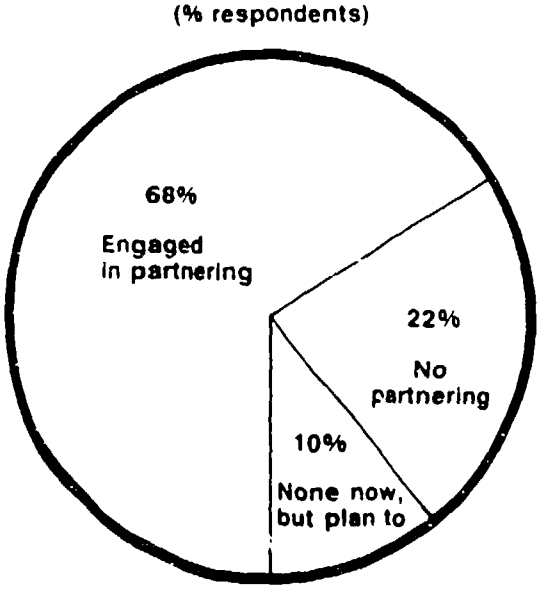
Elwood Buffa of U.C.L.A. made a similar finding in *Meeting the Competitive Challenge*:

> "there are economies that result from intelligent, cooperative buyer-seller relationships,...which may even result in single sourcing with the supplier located close to the buyer."[5]

Finally, Richard Schonberger, a noted manufacturing consultant, said that a world-class manufacturer found one good source of supply for each part, and then treated that supplier as a comaker.[6] These expert opinions are representative of what can be found in the current literature.

They are also consistent with our findings after visiting an array of commercial firms for this research project; *every* firm visited was attempting in some systematic way to reduce their supplier base, and many were trying to fundamentally redefine their relationship with suppliers. *Purchasing*, a journal of the commercial purchasing profession, found in a 1988 survey that 68 percent of respondents use some form of partnering with suppliers, and another 10 percent said they planned to do so in the next year.[7]

FIGURE 6-3. SEEKING PARTNERS



There are a number of innovative commercial practices that are, at least in part, responsible for this trend toward a closer, more cooperative relationship with suppliers. One practice, as discussed earlier, is total quality management or TQM. One aspect of TQM that is particularly relevant to this discussion—TQM philosophy with regard to the supplier relationships. The Godfather of TQM, Dr. W. Edwards Deming, rejects the idea that "competition in the marketplace gives everyone the best deal." He argues that the leverage of competition may get the best price *in the short term*, but at the cost of reduced quality, which in the long-term reduces value. Dr. Deming argues that long-term, sole-source relationships with suppliers are the answer.

Another commercial practice contributing to redefined supplier relationships is the increasing use of Just-in-time (JIT) manufacturing. The JIT is a material management philosophy borrowed from the Japanese designed to reduce inventory and its associated costs. This is done by placing greater reliance on suppliers to deliver the item to the production site literally just-in-time for that item to be incorporated into production. Since safety stocks are minimized (or non-existent), the reliability of supplier's deliveries are critical. As such, just-in-time systems require closer, "open kimono" relationships with sources and tend to rely on a small number of highly-reliable sources.

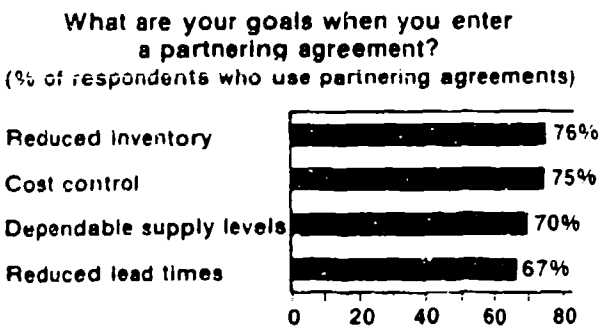
The evidence is clear, more commercial firms are recognizing the long-term benefit of concentrating purchases with one or a limited number of sources, and substantially altering their relationship with those suppliers. They find a supplier that can meet their quality and schedule requirements and enter into long-term buying relationships with that supplier. Without competitive pressures on each purchase, the instant unit price may be higher, but that price is typically offset by improved quality, schedule performance, and/or lower life-cycle cost. With one vendor supplying a firm's total requirement for an item, quality should become more consistent, causing fewer rejects and less rework. Similarly, a single vendor should be more consistent and reliable in deliveries allowing the firm to maintain smaller inventories of the item, hence saving money. If a firm concentrates their purchases with one supplier they should enjoy greater influence over that supplier since they represent a significant portion of the supplier's total business. The level of communication and cooperation between the firm and the supplier should increase, as each has a greater stake in the success of the other.

In these cooperative arrangements, the buyer and seller are agreeing to become more dependent on each other for the overall success of both companies. Some would argue that this refutes the dependence theory of the buyer/seller relationship, the cornerstone of which is minimizing your dependence on the other party. On the other hand, proponents of the cooperative approach

would argue that in the long-term, power is maximized on both sides of the ledger when each becomes dependent on the other. Graphically, this would be seen as a shift to the upper right quadrant in the graphic shown earlier in this chapter.

It appears that commercial firms are realizing major benefits from adopting more cooperative relationships with a limited base of suppliers. *Harvard Business Review* attributes partnering with suppliers as a major factor in the recent turnarounds of both Ford and Chrysler.[8] The *Purchasing* survey cited earlier found that 80 percent of the respondents who use some form of partnering, found it met their goals of reduced inventory, cost control, dependable supply levels, and reduced lead times.[9]

FIGURE 6-4. PARTNERING GOALS



Government Attitude Toward the Buyer/Seller Relationship

Like many other organizations with large procurement budgets, the government is interested in the economic merits of bargaining parity and a self-regulated price offered by competition. It is a widely-held perception in government circles that competition does, in fact, lead to a superior product at a lower price. Beyond these economic considerations though the government embraces competition because of another important dimension--the connotation of equity it conveys. Full, open competition conducted at arm's length gives the public a perception of fairness and integrity in the use of their tax dollars, since everyone is able to compete equally for a portion. (Chapter 1 contains a more through treatment of the concept of equity in public spending).

Consequently, at least since 1809, the government has favored using competition in its purchasing. The Armed Service Procurement Act and the Federal Property and Administrative Services Act require that government procurement be competitive to the maximum extent practical. The July 1984 Competition in Contracting Act (CICA) broadened the requirement for competition in federal purchasing, and reaffirmed this need for equity in defense spending.

Benefits of competition from an economic and an equity standpoint can be compelling. The equity consideration alone is so compelling it is unlikely the U.S. Government will ever abandon competition as the preferred method of government procurement. It should be recognized, though, that in the commercial environment the need for equity becomes much less compelling, and competition must stand on economic merits alone.

INHIBITORS

Clearly, commercial firms are increasingly using new, cooperative supplier relationships to advantage. When the commercial firm is a DOD contractor, however, are they able to take full advantage of these innovative commercial ways of doing business? The answer appears to be "no." Research did not indentify even limited cases where a defense contractor sought sole-source alliances with suppliers, regardless of arguments for doing so. It is clear these contractors feel, to some degree, inhibited from entering into this type of arrangement, so they avoid them. All had supplier reduction programs, but never with the intent of reducing to a single supplier for a given item. A typical arrangement was for the defense contractor to partner with several sources for each item, thereby preserving competition, but potentially at the cost of watering-down the benefits of partnering. Alternately, defense contractors might have a sole-source of supply, but with periodic (annual) competition. Again, the full benefits of partnering are not being realized.

On the other hand, purely commercial companies (i.e., those with little-or-no DOD business), were not reluctant to enter into long-term, sole-source arrangements when the business situation warranted it. Interestingly though, Dr. Deming and

the current literature to the contrary, these firms (some of whom have industry-leading quality records) typically do not use sole-source arrangements on a wholesale, across-the-board basis. Rather, they tend to use them very judiciously—only for the procurement of selected items of strategic importance. In a majority of the cases these companies *compete* their supplier requirements because it is in their best business judgment to do so. Unlike DOD contractors, however, they seem uninhibited in using whatever supplier arrangement the business situation dictates.

We will now examine what seem to be the major inhibiting factors to DOD contractors.

The DOD Intervention in Contractor's Internal Management

One could argue that a DOD prime contractor, as a commercial firm, should have complete flexibility dealing internally, and externally with other commercial firms. However, this is not the case. The DOD imposes a plethora of requirements dictating how it's contractors conduct their business. Many of these requirements flow through the prime contractor directly to the subcontractors and suppliers. The Defense Science Board observed in 1986, "A typical military contract contains 214 general and special provisions, 144 of which flow down to subcontractors."[10] Ostensibly, each of these provisions has some impact on how that company (or subcontractor) conducts business. In contrast, the Defense Science Board found that in a purely commercial environment, even a complex contract would more typically have about 45 of these types of provisions. Of course, DOD's requirements on its contractors are not imposed arbitrarily; each requirement is designed to elicit desired behavior on the part of the contractor (hiring from areas of high unemployment, for example). The weight of many requirements when taken in aggregate, however, can have the opposite effect and elicit undesirable behavior, such as bureaucratic lethargy or resistance to innovation.

The DOD Intervention into Contractor's Sourcing Decisions

The DOD is particularly interested in how its prime contractors carry out their sourcing function. Ideally, DOD seems to want its contractors to emulate the methods and procedures it uses in awarding prime contracts, including the use of free and open competition. To maintain this oversight and control, the government uses the Contractor Purchasing System Review (CPSR), the subcontract consent and notification requirements, and the subcontract plan requirement.

A CPSR is designed, "to evaluate the efficiency and effectiveness with which the contractor spends Government funds and complies with Government policy when subcontracting."[11] In conducting a CPSR, a team of government specialists critically examines a prime contractor's purchasing system, with the objective of approving that system if it meets government requirements. The degree to which the system "provides for full and open competition, or obtains competition to the maximum extent practical" are central to the government's decision to approve or disapprove.[12] Where competition is not obtained, the system must ensure that its absence is fully justified.[13]

If a contractor does not have an approved purchasing system, each individual subcontract action falls subject to the subcontract consent or notification requirements. The consent requirement means the prime contractor must obtain prior written consent from the government before they subcontract for work that is particularly complex or of high dollar value. Subcontracts for less complex purchases are subject to the less stringent notification requirement. Notification means the prime contractor must notify the government of certain subcontract awards; no prior written consent is necessary.

The subcontract plan requirement is levied on a contract-by-contract basis, usually only on major contracts. It is often tailored to the specifics of the situation, but typically requires contractors to submit subcontracting plans up front for evaluation during the source-selection process. The degree of competition expected is often a critical element in the evaluation of such plans.

The purchasing system review, consent and notification processes, and subcontract plan requirement provide a systematic framework under which DOD can have a direct influence on how prime contractors do business with subcontractors and suppliers. The degree to which DOD

exerts that influence to advocate competition in awarding those subcontracts will inevitably affect the degree to which DOD contractors pursue more cooperative relationships with their suppliers. Accordingly, a closer examination of the nature and degree of DOD's advocacy for subcontract competition is called for.

Government Attitude toward Subcontract Competition

As we established, the government has compelling reasons to be interested in competition at the prime contractor level. They have established competition advocates through various levels of the government to maximize prime-contract-level competition, and annually establish specific competition goals for each department. Beyond this, there are reasons why government leaders have also become interested in the once neglected area of competition at the subcontract level. On one hand they are faced with tremendous pressure from the Congress to increase the use of competition as a panacea for the ills of the procurement system. On the other hand, less and less of DOD's procurement budget is staying with prime contractors, but rather, is flowing through the primes to subcontractors. Recent estimates place the percentage of subcontracted content as high as 75 percent and rising; this is up from about 50 percent in the early 1960s.[14] With an increasingly smaller percentage of DOD's procurement budget actually subject to prime-level competition, it could be argued that the government should, therefore, subject all subcontracts to competition, as well. Therein lies a major impetus behind DOD's burgeoning advocacy for competition below the prime contract level.

In 1984 the Deputy Secretary of Defense in a memorandum entitled, "Increasing Subcontract Competition," identified circumstances where subcontract competition should be of particular interest, including instances where large quantities of high priced components were being subcontracted. The Congress began showing an interest in subcontract competition in 1983 in the law reauthorizing the Office of Federal Procurement Policy (OFPP). In that legislation, they specifically required the administrator of the OFPP to, "conduct studies...on the extent of competition in the award of subcontracts by federal prime contractors including an evaluation of the data available on subcontracts awarded...." This interest in data is significant since any effort to expand subcontract competition must start with a quantifiable baseline from which to measure success. While the government collected data on competitive expenditures at the prime-level for many years, there has not been a reliable way to collect data on competition at the subcontract level. In response to congressional interest, DOD began capturing some data on subcontract competition, an action some predicted would be a precursor to actual advocacy for subcontract competition. This prediction proved to be true.

The U.S. Navy is on the forefront in actively advocating competition at the subcontract level. It charges buyers to analyze carefully a prime contractor's make-or-buy decision to ensure they are maintaining "competitive pressure on cost or quality." The Navy's *Competition Handbook* says, "Subcontractor competitions...can have dramatic cost savings," and cites examples where they have done so. The Air Force, Army, and DLA are less aggressive in advocating subcontract competition, but all seem to do so subtlely through the CPSR process which evaluates and approves purchasing systems based on that system's ability to ensure "adequate price competition," among others. High-level DOD officials resisted attempts to mandate subcontract competition goals or have advocacy institutionalized through legislation, but they do advocate competition at the subcontract level on any prime contract awarded without competition. In some instances, this advocacy manifests itself through language on a specific contract that provides monetary incentives to the prime contractor based on the extent to which he attains subtier competition. This approach is, by definition, very narrow in application since it must be applied on a contract-by-contract basis.[15]

The primary inhibitor to effective supplier partnering by defense contractors is DOD's advocacy for free and open arms-length competition for subcontracts under defense contracts. While the strength and form of this advocacy are somewhat amorphous, they seem to be sufficiently clear to signal defense contractors on the desires of DOD. Since, for most, DOD is their dominant customer, they react to those desires, and use partnering only

on a limited basis, stopping short of entering into sole-source arrangements.

SUGGESTED AREAS FOR IMPROVEMENT

Adopt a Policy of Neutrality Regarding Subcontract Competition

Because competition connotes fairness and equity in expenditure of government funds, it will likely be the preferred method of government procurement for years to come. The need for equity is much less compelling at the subcontractor level, however, and the degree of competition or cooperation with suppliers is a business decision. In many or perhaps most cases, prudent business judgment will warrant using some form of competition; but, in others, the benefits of improved quality or reduced total costs will call for a sole-source, cooperative arrangement. The DOD should not restrict its contractors from using the best business practice; then, as always, hold them strictly accountable for ultimate results.

Two opposing arguments typically arise. One is, "DOD doesn't advocate subcontract competition, they just track it"; the other, "DOD only wants subcontract competition in cases where they don't have prime competition." Both are tantamount to advocating subcontract competition across-the-board. Tracking conveys the perception that DOD wants it; the contractors react accordingly. Requiring it on a single contract results in the contractor adopting a single system to ensure competition on all purchases (reference Finding 7). Further, the move toward partnering, TQM, etc., requires a fundamental philosophical shift that cannot readily be turned on and off on a contract-by-contract basis.

Notwithstanding these arguments, it is clear that DOD contractors when making business judgments vis-a-vis relationships with suppliers, are factoring in DOD's real or perceived desire for subcontract competition. Accordingly, if DOD wants the benefit of business judgments without this bias, it should adopt and communicate a policy of *complete neutrality* with regard to competition at the subcontract level. The degree of competition or cooperation with suppliers would then, like other business judgments, be left to the discretion of the prime contractor. Only by granting this flexibility can the defense industry be expected to fully implement new ways of doing business like TQM.

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7

SOME REGULATORY IMPLICATIONS

FINDING Companies Adopt Uniform Administrative Systems.

DISCUSSION OF THE FINDING

Discussion of business management approaches with several firms which conduct both military and commercial business (i.e., General Electric, United Technologies, GTE and Westinghouse Electric) showed that generally, these companies segregated their business units so commercial and military business was not collocated or comanaged. In an advertisement, a Washington-based law firm highlighted the reasons for such barriers as follows:

—Minimizing the cost of necessary controls

—Managing certification requirements

—Localizing cost accounting standards compliance

—Using exemptions from cost and pricing data disclosure

—Limiting access to company records

—Protecting rights in technical data

—Narrowing exposure to suspension and debarment.

In addition, there is a strong preference to employ one set of administrative procedures. If the firm was producing a military item and a commercial item on the same floor, they would adopt the *military* approach to sourcing, inspection and quality control for *all* items on the floor. For examples of this, look at the MSE/GTE, and GE cases in the appendices. The cost of managing two systems was deemed too expensive and confusing to the work force. We also found that relaxing a standard for a specific DOD contract was counterproductive because a firm would not want to be penalized for using a commercial practice on a subsequent military buy. Generally, if a company had other defense contracts, it would impose the defense requirement on itself so it would not lose certification of its process. This has a significant policy implication because we may consider that relaxing the requirements for a good contractor will allow cost savings to be applied to the contract. This may not be the case where a contractor has other government business which will not be affected, or may wish to compete for other business for which the waiver of the requirement may not be granted.

INHIBITORS

The discussion of the finding has, in itself, been a discussion of the inhibitors. The regulatory aspect of governmental purchasing is recognized in industry as a fact of life in doing business with the government. The problem highlighted in this section is the difficulty in selectively applying good ideas. In our research, we spoke with several individuals from programs designated as Defense Enterprise Programs (DEP) which, theoretically, could be excluded from governing policy directives. Unfortunately, viewed from government and industry, DEP designation made little difference in the management and operation of these programs. Simply stated, trying to gain acceptance of the exempt status from the functional staffs and organizations in DOD became more difficult than simply adhering to the policies and regulations.

The need for uniformity in industry/government dealings is based on sound principles. It was largely responsible for the consolidation of procurement regulations into the Federal Acquisition Regulation. Uniformity on the other hand, does make selective relaxation of requirements theoretically feasible, but extremely difficult to implement in practice.

SUGGESTED AREAS FOR IMPROVEMENT

Use the Contractor's Cost Accounting System

The original intent of the Cost Schedule and Control System (CSCS) was to use contractor-provided data to monitor the performance under the contract. In intent and design it is not significantly different from the systems described as in place to monitor commercial capital improvement or new product development programs. Unfortunately, the CSCS system has become a source of contention between the government and the contractor in its application. Despite observations about the extra costs of multiple control systems, it can be advantageous to the contractor to maintain two cost accounting systems—one for internal management and one as a CDRL requirement under the contract.

Commercial program managers find that the CSCS system provides too much information. They use a system providing summaries of cost and schedule progress, timely (i.e., actual, vice massaged data) and accessible on a daily basis. Detailed backup information, available on an query-response basis, is used to investigate problems highlighted in the summaries. The CSCS reports, a data-deliverable rather than a real-time management system, delay status reporting and focus too much time on extreme details and formatting. Consider again the fire alarm convention introduced in Chapter 3. The CSCS system, as currently employed, provides too much detail about what happened weeks or months before but has become useless in real-time management.

There are unique instances in which the government and prime defense contractors are working from the same status data base. They are exceptions to CSCS requirements and we believe they provide a more effective system for joint government-industry program management. A successful example is highlighted in the MSE/GTE case; a Defense Enterprise Program (Appendix G).

Policy or Reporting Requirement Deviation and Waivers Should Be Granted Only for an Entire Commercial Activity and Only for an Extended Period

We investigated commercial and defense businesses and it became obvious that commercial entities and the military departments could use similar standards to advantage. Policies encouraging perception of uniqueness in defense systems management are counterproductive, especially if the different administrative systems serve only the burgeoning DOD bureaucracy. As discussed in the inhibitors section, each Defense Enterprise Program (DEP) prime contractor contacted (i.e., General Dynamics and GTE) indicated there is little difference in the requirements under which they and other non-DEP defense programs operate. Commercial business leaders felt it was "too expensive" to operate parallel systems that must meet different policy or reporting requirements.

We believe policy or reporting changes need to be implemented company-wide and for an extended period if positive results can be expected. The target company must be convinced the rules will not be changed often so it can have confidence to employ best business practices across-the-board.

IV

CONCLUSIONS AND SUGGESTED IMPROVEMENTS

IV

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CONCLUSIONS

Our opportunity to research systems acquisition and purchasing management has been unique; for 7 months, we assessed private industry's management of systems programs and purchasing. The field of study we chose is great. The allegorical analogy is that of a 7-year old child given $10 to spend at a toy store. In our case, there was so much to investigate. Though time, our main resource, seemed substantial at the start, it ran out long before we could satisfy all our research desires.

We approached this research to find good ideas and techniques; not more problems; the Press, GAO, and the Congress have done enough of that. Instead, we sought to build on our experience in program offices, buying commands and at Harvard Business School to improve the defense acquisition process. Focusing on commercial practices permitted detailed investigation of various topics and scoped the potential for further research in the field.

The scenario of major commercial new product development and major capital plant/equipment programs closely parallels the acquisition of major defense systems. Such programs involve many years; major expenses upon which the future of the company depends; often new technology, and comprehensive employment of people, equipment and services into an integrated whole.

Building on our defense acquisition experience and the Harvard "case study" method, we investigated literature for best business practices as applicable to systems program management. Then we developed cases based on program examples offered by industry contacts. We found several commercial management practices definitely applicable to how we do business. These are:

Finding 1. Active involvement of top corporate managers is essential to program success.

Finding 2. Commitment to program success crosses organizational lines.

Finding 3. Schedule is first among cost, schedule and performance.

Finding 4. Program managers are afforded significant authority and resource control, and are held personally accountable.

Finding 5. Price is but one element in the purchase decision.

Finding 6. Companies are adopting more cooperative relationships with their suppliers.

Finding 7. Companies adopt uniform administrative systems.

Each chapter of the report supports these individual findings from published sources, our industry interviews and the case studies.

The findings are not unique; with some differences in approach or emphasis, they parallel those of the Packard Commission and other studies of government acquisition. To underscore this commonality, reference was made to specific sections of the Packard Commission report as the findings developed.

Our contribution is not that we discovered something new but, rather, we have assessed inhibitors to easy implementation within the defense acquisition environment and generated some practical, implementable, policy-level suggested improvements. The suggested improvements that follow have been provided to senior Department of Defense and military departments' acquisition leadership.

We do not believe defense acquisition is beset with rampant fraud, waste and abuse. Rather, it is a huge, bureaucratic system operating in an environment of conflicting objectives and expectations and, thus, unacceptably inefficient. Also, we reject the naive perspective that all answers can be found in private industry because problems can also be found in many failed products. Looking at how industry acquires capital and develops new products, we focused on successful programs, identified contributing management practices and recommended adoption of these practices for use in defense acquisition.

SUGGESTED IMPROVEMENTS

Improvement 1. Establish at MS II (MS III for NDI programs) the *relative priorities* of program cost, schedule and performance in the baselines.

—Give the PM/PEO flexibility and authority to make trade-offs within baseline constraints.

—Ensure there is maneuver room between stretch goals and practical, minimum requirements.

At MS II, the baselined schedule should be as short as practically achievable via prudent cost/performance trade-offs made during the program planning process. Performance features should be designated between minimum requirements and stretch goals. "Performance" means all features directly influencing design, engineering, production, operation and support of the product or system; thus, it includes such things as unit cost, life-cycle cost, reliability and maintainability, as well as mission features (i.e., speed, range, accuracy, etc.). Stretch objectives should be incorporated if technology permits, or reserved for evolutionary upgrade if technological availability threatens the schedule. The PM should have authority to use and the best functional support available, and his judgment, to assess relative costs and benefits of performance trades and to make timely trade-off decisions. A cost buffer of 10 percent should be made available to PMs/PEOs, without need to revisit the PPBS or program baselining process, to maintain schedule and solve technical problems.

Unless our program schedules can be shortened and met consistently, we will continue to be unable to generate real teamwork so essential to program success. Top defense leaders, program managers and functional specialists must operate as teams, with confidence in each other attained through demonstrated, on-the-job performance. With long and still unrealistic program schedules, few reach this level of shared confidence; thus, teamwork suffers. Obviously, this aspect of improving systems acquisition is heavily dependent on the professionalism and experience needed on the part of all team members; Improvements 5 and 6 are key to implementation of this one.

Improvement 2. Subordinate PPBS funding decisions to DAB or SSARC approved program baselines at MS II and beyond.

—Recognize approval at MS II as a commitment for the life cycle.

Commercial companies we researched had business planning systems not unlike our planning, programming and budgeting system (PPBS) in most functional aspects. They were, barring major revenue problems, less constrained than DOD in committing funds resources over the investment phases to new programs. The keys to successful integration of business planning and stable funding in commercial business enterprises are: 1) realistic financial planning—using the business planning process in a disciplined manner to forecast revenues and expenses, thus capital funding available; 2) selective approval of program opportunities—ensuring all approved programs were affordable based on business planning; and 3) completing approved programs on schedule, thus supporting the program assumptions used in the business planning process.

Implementation of this improvement would entail:

1) Phasing in Defense Enterprise Program-like (DEP) programs (major and non-major) with milestone-authorized stable funding

2) Subordination of future PPBS decision-

making to program baseline decisions at MS II and MS III (too often budgetary cuts are applied "across the board" as though no priorities exist).

Key to this implementation is disciplined decision-making, based on realistic planning and programming; and institutional follow-through, based on commitment to, and communication of, strategic priorities.

This Figure portrays the point that PPBS drives funding available to programs prior to MS II, then it is driven by MS II and beyond program decisions. Thus, Milestones 0, 1 and 5 would be subordinate to PPBS, while PPBS would be subordinate to Milestone 2-4 decisions. The Figure also supports aspects of the next improvement to reduce the number and level of program milestone decisions.

Improvement 3. Reduce the number and level of program decision milestones

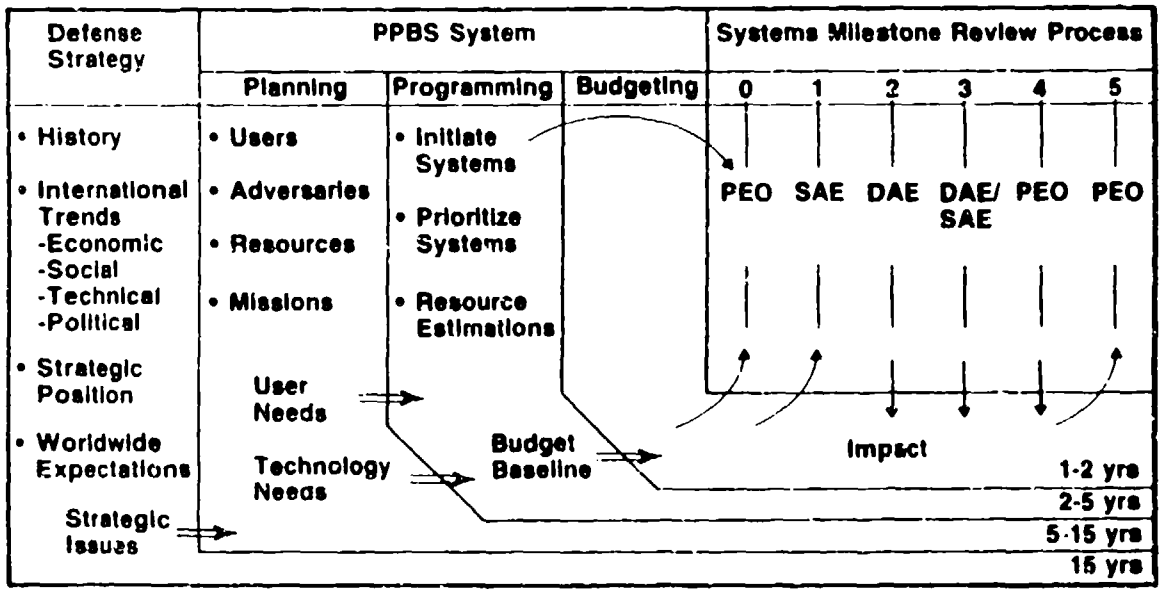
—Only MS II need be a DAB-level decision.

Large commercial programs had only one or two go/no-go program decision milestones. Typically, the organization conceived of many technological or market-driven opportunities which were winnowed down by committee action, advance business planning and feasibility studies to a relative few. Based on strategic vision and resources available, top management and the Board of Directors (BOD) approved selected programs for development and implementation. If substantial technological uncertainty existed, a second milestone was required to ensure there was sufficient likelihood of success before major resources were committed. The initial committee screening of program possibilities was done at low levels within the organization as part of periodic business planning; line acquisition management, without staff or committee oversight, was then fully empowered to execute the program. The CEO, or CEO-surrogate, stayed informed and assisted line management as necessary throughout the life cycle of approved programs.

Implementation of this improvement within DOD

FIGURE IV-1. LINKING DEFENSE STRATEGY, PPBS, AND MAJOR SYSTEMS ACQUISITION MANAGEMENT

Objective: Provide capable systems to our users, efficiently and on time.



would entail limiting DAB oversight and decision to MS II only, for DOD major programs (SSARC II only for component programs); accordingly reduce the preceding and succeeding milestones one level; and delegating all other milestone decisions to the PEO in coordination with the "user" (surrogate user).

Improvement 4. Empower acquisition line managers (i.e., PM, PEO, SAE and DAE) to make program decisions, within approved program baseline constraints, without interference from functional staff advocates at higher organization levels.

This improvement augments Improvement 1. Industry PMs and their first-line general management are empowered to execute their programs without external interference as long as baseline requirements are met.

Following program approval as discussed in Improvement 3, to enter full-scale development, the PM and PEO would be empowered to use the best expertise available to solve problems and perform trade-offs as necessary to complete the program within baseline constraints and without independent oversight or direction from functional staff managers. The Service Acquisition Executive (SAE) or Defense Acquisition Executive (DAE) should be kept informed of progress and problems, directly by the PM/PEO, on a quarterly basis. The SAE or DAE would then be the link to the Defense Resources Board (DRB) and the Congress, should the program baseline need altering. Should "fact-of-life" strategic events occur, such as a major force reduction, the DAE and DAB should act to implement applicable changes to the baselines of impacted programs.

Implementation of this improvement would entail the decision-maker (SECDEF, Service Secretary, or manager with delegated program approval authority depending on program scope), at MS II, committing to the program baseline with all subordinate acquisition line managers, and ensuring the baseline objectives were sufficiently prioritized so that acquisition line managers (PM, PEO, SAE and DAE) have flexibility to solve technical problems during execution. A real budget buffer is essential to success of this improvement.

In DOD, our large senior staffs perform many of the roles associated with top management; systems acquisition is an ancillary function for senior defense leadership, providing logistics support to operational forces. We have evolved to an *acquisition system devoid of clear, CEO-like, top managers*. The DAE and SAE are staff elements, both are without control over personnel resources (who work for the military chiefs), and without full decision authority over all acquisition functional directors within the Department or Service, respectively. The result is transient leadership, temporary policy, and a huge functional bureaucracy *which manages by continuous committee consensus*.

Improvement requires clarification and simplification of who is in charge. We must establish who (singular) has program decision authority over the whole acquisition process, once a program is approved at MS II. The DODD 5000.1 needs revision to define, clearly and simply, *who (singular) can make program specific decisions involving trade-offs, personnel assignments and priorities*.

Improvement 5. Strengthen the professional functional support to program managers and reduce the dependence on staff functional oversight of program execution.

—Change the focus of functional staff managers from involvement in programs to the professional development of acquisition specialists.

Successful commercial programs were remarkable in the degree of organization commitment to program success noted. Our discussions with program and functional managers showed strong, mutual, shared goals and commitment to success. This is due partly to recognition of the importance of specific programs to achievement of the corporate business strategy, and partly to the availability of professional functional expertise in direct support of program management. Though virtually all companies were matrix organized, with many functional specialists assigned to pro-

grams in a task organized fashion, all functional personnel assigned to support a program look only to the program manager for program direction and decision-making. Program managers, in turn, depended on the expertise and recommendations of their assigned functional specialists.

The thrust of this improvement is to implement, within DOD, a system whereby top functional staffs are focused primarily on creating and managing a system to educate, train and govern careers of acquisition professionals. Such a system would provide PMs and PEOs the power to make essential personnel and program decisions and the functional expertise to plan, organize and execute programs right the first time. A collateral benefit would be less exposure to the diffusion of responsibility associated with committee decision-making.

This approach to matrix management is used effectively in military combat units where the "headquarters commandant" (consider like a functional organization manager) provides staff assets to unit commanders. The commanders make mission decisions and the staff members are not authorized to disagree. In the acquisition arena, the PM/PEO must act with the user as "advocate" for the system up to MS II. Following MS II, the "selling" aspect of advocacy can end while the PM/PEO and user shift full attention to leadership of problem prevention and solution. This can work only if real program execution authority rests solely with the PM, PEO, SAE, DAE chain of command.

Improvement 6. Ensure matrixed, functional, program support personnel are dedicated to programs through organizational alignment and incentives.

—To the maximum degree possible, matrixed personnel should work full time for, and be rated by, the PM.

Program managers in successful commercial programs have the full, dedicated support of functional specialists. The PM has hire-and-fire authority and evaluates the performance of the specialists assigned (dedicated and functional matrix). This improvement is intended to augment Improvement 5 by extending implementation to the acquisition and materiel commands of the Services where, in many cases, the functional acquisition specialists and PMs/PEOs have different chains of command. The thrust of this improvement is to provide PMs and PEOs the functional expertise they require, and deserve (dependent on program priority) to plan and execute the program right the first time. We must get away from the climate in which senior military and civilian leadership tolerates, even encourages, PMs to compete with each other for adequate resources, and accepts the divided loyalty engendered in our special advocacy system. These senior leaders should stop acting as "judges" of programs and actively manage the acquisition system.

Our policy should be in the form of principles and goals, not directives, due to the need to provide flexibility to local commanders to optimize the use of scarce personnel expertise. Adoption of this approach should reverse the growing trend in some commands to place functional participants (even those full- time on specific programs) under the control and evaluation of the functional matrix manager, thereby taking authority from the PM/PEO and diffusing responsibility for program success.

Improvement 7. Develop an on-line contractor performance history file which is available to the contracting officer (source selection official in systems programs).

This improvement is directed at procurement of non-system equipment and services which usually do not rate a source-selection-evaluation process. Some elements could, as well, be applied to major system acquisition, for example, the excellent initiative of the Air Force Systems Command's Contractor Performance Assessment Report (CPAR).

The first step in using quality information in making source selections is to make it available to the contracting officer. Implementation of this improvement should be phased. First, elements of the file should be established and should include indices for price, delivery and reported quality problems.

Second, the ability to input and access the files throughout DOD must be established. A partial net will not be sufficient, since it will fail to provide the objective information needed to eventually make source selections.

Third, once the network is functioning, quality factors can be established to adjust bid prices to reflect the cost of schedule or other problems. (In systems programs, past performance, including quality, would be evaluation factors independently considered along with price cost.)

There are several evolving approaches to implementing aspects of such a system. We are aware of efforts sponsored by the Defense Logistics Agency and the military services to move in this direction. These are limited in scope and do not exploit the potential for more accurate measurement. This is essential in the acceptance of such systems and their ability to withstand administrative protest.

Improvement 8. Establish a variable specification method of contract source selection for non-system procurement.

The current method of establishing a minimum specification which, if satisfied, permits the selection to be made based on price, should be selectively replaced by a method through which target performance specifications are set. Variations around this target will be evaluated using a preestablished and published cost/performance trade-off formula. For example, life-cycle cost elements of performance/quality (i.e., reliability, maintainability, etc.) could be quantifiably related to adjustments to the price basis for award. The U.S. Army Communications Command has been doing this successfully for several years in their non-developmental item (NDI) program to acquire commercial electronic test equipment.

Such a method would preclude the need to "gold plate" specifications, and would alter the incentive systems for contractors. It would provide incentives for contractors who have better ways of meeting requirements to be selected over contractors who barely meet the specification, as written, at the lowest cost.

Improvement 9. Adopt, communicate, and enforce a policy of complete neutrality with regard to subcontract competition, including a cessation of data gathering.

Because competition connotes fairness and equity in the expenditure of government funds, it will likely be the preferred method of government procurement for future years. The need for equity is much less compelling at the subcontractor level, however, and the degree of competition or cooperation with suppliers is a purely business decision. In many or perhaps most cases, prudent business judgment will warrant the use of some form of competition; but, in others, the benefits of improved quality, or reduced total costs will will call for a sole-source cooperative arrangement. The DOD should not restrict its contractors from using the best business practice; then, as always, hold them strictly accountable for ultimate results. Only with this flexibility can the defense industry be expected to fully implement new ways of doing business like TQM.

Typically, two opposing arguments arise. One is, "DOD doesn't advocate subcontract competition, they just track it"; the other, "DOD only wants subcontract competition in cases where they don't have prime competition." Both are tantamount to advocating subcontract competition across-the-board. Tracking conveys the perception that DOD wants it; the contractors react accordingly. Requiring it on a single contract results in the contractor adopting a single system to ensure competition on all purchases (reference Finding 7).

Improvement 10. Use the contractor's cost accounting system and eliminate duplicate reporting methods.

The intent of the Cost Schedule and Control System (CSCS) was to use contractor-provided data to monitor the performance under the contract. In intent and concept, it is not significantly different from the systems described as in place to monitor commercial capital improvement projects or new product introductions. Unfortunately, the CSCS system has become a source of contention between the government and the contractor in its application. It can be advantageous

to the contractor to maintain two cost-accounting systems—one for its internal management and a separate one as a CDRL requirement under the contract so as to limit exposure to external review.

Taken from the perspective of the commercial program manager, the CSCS system provides too much information. What is truly needed is a system which provides top-level overview of cost and schedule progress and which is timely (i.e., actual, vice massaged data) and accessible on a daily basis. The detailed backup should be available on an "as needed" (query response) basis to investigate any problems highlighted in the top-level document. Presently, the time delay in reporting is too long, and too much time is spent investigating particulars of the reporting system.

Improvement 11. Waivers of policy and reporting requirements should be granted for an entire commercial activity for an extended period of time, not on a contract-by-contract basis.

Commercial entities need and employ consistent standards for administering activities. Policies that encourage a perception of uniqueness in defense procurement are often counterproductive because commercial business administrative systems have difficulty adapting to them. Each of the prime Defense Enterprise Program contractors contacted indicated they saw little difference in the requirements under which they operate and that of other programs. Similarly, in the commercial environment, it is felt to be just "too expensive" to operate parallel systems which must meet different policy or reporting requirements.

Policy or reporting changes need to be company-wide and for an extended period if any positive results can be expected.

APPENDIX A
UNITED TECHNOLOGIES CORPORATION CASE

PROJECT NAME: PW4000 Engine

COMPANY: United Technologies Corporation, Pratt and Whitney

DATE OF VISIT/INTERVIEWS: 14 April 89

PERSONS INTERVIEWED:

Mr. James Bruner, Director, PW4000 Engine Programs, Pratt and Whitney
Mr. Roger Chericoni, Vice President, Group Product Integrity, Pratt and Whitney
Mr. James Ward, Manager Internal Audit United Technologies Corporation

DESCRIPTION OF SYSTEM

The PW4000 is a high thrust (50,000-65,000 pound), fuel efficient, turbofan engine for use on large wide-body commercial aircraft. The PW4000 was initially designed, developed, and FAA certified to cover a broad spectrum of aircraft applications. It was then adapted to, and recertified with, each aircraft type it powers. It is u to power the Airbus A300 and A310, Boeing 767 and 747 and MD 11 airliners. The engine development goals, compared with its predecessor engine JT9D-7R4, were low fuel consumption (7 percent less), low maintenance costs (25 percent less) and low manufacturing cost (50 percent less). The thrust goal of 60,000+ pounds was established as a result of forecasting efforts in 1981 o predict commercial aircraft needs of the 1990s (the JT9D thrust was 56,000 #). The June 1986 FAA certification deadline was established to ensure availability of a mature engine system in time to meet airline company needs and airframe company offerings projected for 1987. Pratt and Whitney (P&W) personnel explained that it takes airframe companies about 3 years to develop a new airliner but 1 5 years to develop a new engine so they had to start before the airliners were designed

SCOPE OF PROJECT

1. **Timeframe.** Study Phase - 1981
   BOD Approval: Fall 1982
   FAA Certification (PW4000): June 1986

2. **Funding.** Up to $1B were invested by Pratt and Whitney to design, develop and certify the PW4000 and its principle aircraft applications. Of this, approximately 60 percent was for design, development and certification of the basic PW4000, with the remaining 40 percent for applications and improvements.

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

1. Program/Project Management

a. The PM (termed Program Director at P&W) was given "carte blanche to do things differently" if necessary to meet the program goals. This was interpreted to include coordination with, and solicitation of, suppliers; such as inducing them to "buy in" to the future business opportunities of a long-term strategic alliance; another "sacred cow" attacked in the PW4000 program was "in-series design and development."—that is, maximizing concurrent engineering. Responsibility and

authority to circumvent "business as usual" attitude and procedures was driven down to the lowest level in the organization.

b. Dedicated project team of 1,200 persons, including matrixed specialty support, as required. The PM's office was staffed by 250 personnel who performed business management, design (120 mechanical designers), management of development, management of manufacturing and analysis and marketing. Logistics management was done in the support matrix. Excluding the design effort, the immediate PM office was moderate in size for the project scope.

c. Mr. Bruner indicated that he and each subordinate manager had direct input to the selection of all directly reporting personnel. The PM had significant personnel management power and could rapidly direct increases and decreases in manpower applied to functional efforts; the matrix was there to respond to the immediate needs of the project using an "equal hurt" philosophy. To ensure high-quality participants, some start-up manpower allocation efforts lagged.

d. The total programmed funds were committed by top management at the beginning and total control of the funding was provided to the PM annually. The PM had flexibility to transfer funding between elements of the program as required, providing he stayed within annual budget increments. He could move effort between years as long as total annual expenditures were according to plan.

e. Pratt and Whitney Commercial Engine Business manages about 8-9 engine projects at any time; these are managed under Program Directors. The PW4000 is currently the largest, but extensive management is applied to other current engines and some developmental projects. A larger thrust than the PW4000 engine appears to be in the conception stages. It was noted that all projects were funded according to expected needs, they used the term "smooth funding" to distinguish from other techniques which may involve large annual budget jumps or drops. The PW4000 was approved and funded by the United Technologies Corporation (UTC) Board of Directors. Smaller projects are approved at the same level but funded and managed by Pratt and Whitney.

f. The Director, Mr. Bruner (referred to as the PM throughout) reports through the VP, Engineering, to the President of the Commercial Engine Business Division, thence to the President of Pratt and Whitney and finally to the Chairman of UTC.

g. Mr. Bruner indicated that his career has been principally in project management which includes aircraft integration and customer support. Program participants were free to pursue their own career paths into and out of project management.

2. **System Engineering Management.**

a. Key to accomplishing most program goals was the first 6 months in which detail planning and design was done by a team of design and manufacturing engineers. This team created a contract between designers and manufacturing on features and technology to be used in the product. This contract essentially was a functional specification to guide and constrain design engineers. Using the production source for development hardware enhances learning and lowers initial product cost, but does require significant compromises in a volume driven facility.

b. The PW4000 pushed the state-of-the-art in several areas (e.g., compressor airfoil aerodynamics). Most efforts involved backup designs using more conventional technological approaches should difficulties be encountered. Technical problem-solving was done by the PM in concert with his peer leaders from the applicable technology areas.

c. The PW4000 PM had total responsibility and authority for configuration control.

d. The test plan was developed by the PM in coordination with Directors (peers) of various engineering elements of Pratt and Whitney. The test program was directed by the PW4000 project team, not an independent tester. The FAA certification testing was planned and conducted by the project team; the FAA monitored tests of choice, the project team wrote and submitted test reports. The PM had authority to schedule, reschedule and resequence tests as he felt necessary to meet project goals.

RESULTS ACHIEVED

The PW4000 has already been a major success for Pratt and Whitney. Certification was completed on time, June 1986, within budget. Of the program performance goals, thrust and maintenance cost goals were met; fuel consumption is not quite as desired primarily due to competitive pressures requiring further improvements. Post certification improvements have been identified and are being incorporated. The competition still lags in all aircraft installations. Manufacturing costs are still slightly higher than the goal termed a "stretch goal." Improvement efforts are underway to meet or beat original goals. Sales of the PW4000 thru 1988 were in excess of $4B despite the primary U.S. competition introduction of an enhancement of a current engine design 21 months ahead of P&W. It appears that P&W's strategic forecast correctly targeted the timing of the market need and necessary features for success.

APPENDIX B

HEWLETT PACKARD CASE

PROJECTS: New Product and New Product-line Development and Capital Systems Implementation

COMPANY: Hewlett Packard Microwave and Communications Group (MCG), Santa Rosa, Calif.
Hewlett Packard Computer Business Organization (CBO), Cupertino, Calif.

DATES OF VISIT/INTERVIEWS: 21-22 March 89

PERSONS INTERVIEWED:

Mr. Joe Gattuso, Defense/Aerospace Programs Manager, Hewlett Packard MCG
Mr. Douglas Scribner, Group Manufacturing Manager, Hewlett Packard MCG
Mr. Don Wolf, Quality/Customer Support Manager, Hewlett Packard Signal Analysis Division, MCG
Mr. George Bodway, Director of Product Development, Hewlett Packard CBO
Mr. Carl Snyder, Director of Program Management, Hewlett Packard CBO
Mr. Dean Morton, Chief Operating Officer, Hewlett Packard CBO
Mr. Bob Walker, Office of the Chief of Financial Management, Hewlett Packard CBO

DESCRIPTION OF SYSTEMS

Three types of systems programs were reviewed at Hewlett Packard facilities:

1. **Phase Review Process Systems.** These are typically programs composed of hardware, software, and/or customer-unique application developments building on the computer system baselines in existence at HP Computer Business Organization. The phase review process, described herein, has been in place for about 3 years and is intended for management of all systems programs at Hewlett Packard (HP) CBO.

2. The **HP "Spectrum"** was a major program to develop the HP 3000-series computer hardware and software architecture baseline from which most HP computer systems have evolved during the past 5 years. Spectrum did not use the current phase review management process.

3. The **HP MCG** is implementing a surface mount technology facility. The new facility will improve prototype turnaround capability, build production capacity, provide for controlled expansion capability, increase automation, control growth in incoming parts, and facilitate reduction in circuit board size. The management of this facility project does not use the CBO phase review process.

SCOPE OF PROJECTS

1. The phase review process is intended for programs/projects which span 6 months to 3 years duration (all phases) and of any funding scope up to the largest approaching $500M investment cost.

2. The "Spectrum" program required 4.5 years from program approval to market and several hundred million dollars invested.

3. The surface mount technology facility will span 3 years from approval to full break-even operation (the facility will bring in revenues at least equal to expenses by the third year). Several hundred million dollars are budgeted for implementation.

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

Due to the diversity of the programs and management techniques employed for each, the following are organized by interview versus a functional presentation.

1. **Interview with Mr. Scribner, MCG Manufacturing Manager.**

a. **Subject:** *Business Planning at Hewlett Packard.* The process highlights how HP establishes business plans which facilitate attainment of strategic objectives and enable effective new product/process management.

b. The business planning process includes 10 parts; it is prepared to cover a 5-year period and is updated annually:

—Statement of purpose

—Specific objectives to achieve during a 5-year period

—Description of customers and channels of distribution

—Description of competition

—Description of necessary products and services

—Plan for development or purchase and introduction of products and services

—Financial analysis of costs and returns

—Potential problem areas

—Recommendations

—First year tactical plan.

c. Business planning is a bottom-up process, responding to periodic top management guidance, reviewed and approved annually by the Chief Executive Officer (CEO).

d. Mr. Scribner's philosophy is that the operational paradigm must change when you can see recurring, fundamental problems. He defined paradigm as:

—A set of rules (usually unwritten)

—The way you view your environment

—How things "get done around here."

e. He described the paradigmatic responses of the 1980s to the natural contradictions in business:

—High Quality vs. Low Cost > > > Total Quality Control

—Responsive Delivery vs. Low Inventory > > > Just In Time

—Innovation vs. Large Organizations > > > Management by Objectives

—Rapid Design vs. Low Development Cost > > > Design for Manufacturability.

He described the following contradiction and operational paradigm for the 1990s:

—Low Cost Production vs. Rapid Customer Solutions > > > Strategic Alliances.

f. During use of the above planning process, Hewlett Packard's Microwave and Communications Group proposed establishing a surface mount technology facility. For this capital project, a PM had been selected; he was a divisional VP, R&D laboratory manager, and is expected to manage the facility into production. The PM is assured continued employment at HP even if the project should fail. The project has been chartered to break even within 3 years. It is budgeted annually but stabilized by the strategic decision to invest over a 3-year period. The PM must submit quarterly reviews to top management.

2. **Interview with Mr. Wolf, MCG Quality and Customer Support Manager**

a. **Subject:** *Quality Management at Hewlett Packard.*

Mr. Wolf has substantial experience with DOD quality requirements.

b. The most significant difference between DOD and HP in managing quality is that DOD focuses on paper systems to document quality management process whereas HP focuses on measurable results. He explained that the cost of quality documentation on DOD purchases of HP products adds about $1,000 to each end item purchased and has resulted in less actual quality than the same items delivered to commercial customers. This is due to the fact that HP must employ someone to create the paper; they employ their field service force to unpackage the end items and run them through tests on field support systems which are frequently not as accurate as the in-line manufacturing process delivers.

c. He acknowledged that DOD is apparently unable to feed back specific field failure to HP in a timely manner to support fundamental corrective actions. He described quality feedback as an essential element of any viable quality system.

d. Hewlett Packard, on the other hand, reacts quickly to returns from the field to subject failed

items to analysis; reasons for failure are then arrayed by type failure and cause and subjected to pareto prioritization to preclude recurrence. This may require a change to HP's processes (40 percent of the time), a change to HP's purchase specifications (30 percent of the time), communication with parts vendors for warranty correction (20 percent of the time), or other actions.

e. He explained that during the past 15 years, defects of vendor supplied items have been driven down to 28 parts per million. Given that rate, HP feels its approach to forming strategic alliances with suppliers is correct and it need not implement incoming screening procedures. Normal assembly testing and final assembly testing is considered fully adequate. The purchasing system is very decentralized and involves few "how to" procedures. There is no specific corporate requirement to compete purchases, nor is there any second guessing of single source purchasing decisions. In fact, one of HP manufacturing's strategic visions is to procure commodities from "a minimum number of long-term, world-class suppliers" who would be "partners in success." Mr Wolf described a recently concluded alliance between HP and an OEM manufacturer for a component common to many of HP's products. He did not appear concerned about potential loss of leverage associated with committing to a single supplier for a long period of time.

f. He feels that MIL-Q type requirements of DOD are written to the lowest common denominator of supplier quality and a fundamental change is necessary for DOD to see quality deliveries on the order of HP's.

g. It was observed at HP that a good rule of thumb for tracking and systematically improving quality in their products was to trend end item failures per $1000 of end item cost. In 1976 the rate was 10 percent/$1000 (that is: .1 end-item failure per year per $1,000 of end-item value); by 1980 the rate was 3 percent/$1,000 and it is now .3 percent/$1,000 due to continued emphasis to find and analyze failures and correct problems so they don't recur. They allow that this quality metric is not perfect, but feel it has some strong merits. First, it is simple and relevant to overall product quality. Therefore, they feel improvement on this metric is easily understood and will have a collateral benefit of improving quality on all fronts, not just specific areas being measured.

Second, the metric is rooted in history. Hewlett Packard has been tracking this metric for many years and has a data base from which to make meaningful comparisons, and the metric was developed by founder, Bill Hewlett. To their credit, HP has resisted attempts to change this single most important measure of quality.

h. Hewlett Packard has a vendor rating/evaluation system called TQRDC. The elements of that system include evaluation and rating of: technology, quality, responsiveness, dependability, and cost, seemingly in that order.

i. Mr. Wolf's final point was that technology is changing so fast that a paper-based quality system cannot define all important factors before there are fundamental changes that invalidate the system.

3. **Interview with Mr. Bodway, CBO Director of Product Development.**

a. **Subject:** *Product Development Process for HP Information Systems.*

The presentation and discussion describes the standard "phase review process" composed of seven serial phases and the responsibilities involved with new product development. The typical project completes all phases in from 6 months to 3 years with an overall 70 percent likelihood of successful completion.

b. A new product is composed of computer hardware, basic operating systems, and/or operating system overlay software in combinations necessary to enhance existing product lines or create new ones, plus if applicable, customer system solutions and interface to customer IS networks. Their PM is called System Manager though this report will term this individual the PM.

c. The process has been in use since 1986 to permit management of 20-30 new projects at any point in time; it is composed of 7 phases (0-6) as follows:

—*Requirements/Plan.* Identifies opportunities, defines life-cycle resource requirements and commits resources for next phase. Links project to business planning. About 50 percent of all projects proceed to next phase.

—*Study/Define.* Selects the competitive alternative that satisfies corporate expected return. Establishes functional planning and commits

resources for next phase. About 80 percent of all projects completing this phase are ultimately completed and marketed.

—*Specify/Design*. Confirms total project baseline (cost, schedule, performance and payoff) and commits resources for all follow-on phases.

—*Develop/Test*. Authorizes publication of specifications of price, performance and availability and may authorize limited customer access.

—*User Test/Ramp Up*. Authorizes unrestricted trade shipment to customers.

—*Entrance/Support*. Complete R&D enhancements and system management activities.

—*Maturity*. Implements discontinuance plan (like transition plan) and removes from phase review process.

d. At each phase review, the phase review committee decides if the project will proceed immediately (with or without conditions), will be delayed or cancelled. The committee is composed of the highest corporate functional managers: marketing, R&D, quality, manufacturing, customer support, and finance. The phase reviews are often conducted with the Chief Operating Officer, Mr. Morton, in attendance. They are scheduled for exactly 30 minutes. They are not design reviews or problem-solving sessions. The primary purpose is to discipline the product development system to work on schedule, and to ensure all issues are resolved before the review. There is no formal preparatory review with the committee; rather, the PM is expected to identify all problems well before the review and resolve them via direct action with the necessary functional groups.

e. The critical factor for successful projects is the business plan; if it is well thought-out and integrated, the corporate system will successfully execute accordingly. The PM conducts weekly reviews with all functional participants who are accountable to the corporation for support. The PM is an orchestrator, with no decision or directive authority other than to coordinate all actions and ensure full compliance with corporate systems; he also has no direct control of project funding;.

f. The typical PM is two levels below the assigned divisional general manager (GM). The divisional GM reviews all reports to the phase review committee but does not "vote." Should the project require more than the previously approved project funding, the Computer Business Executive Council must decide (composition of the CBEC is the COO and corporate executive vice presidents).

5. Interview with Mr. Snyder, CBO Director of Program Management.

a. **Subject:** *Strategic Direction of the New Product (Phase Review) Development System*. The discussion included specific reference to the major new product line, "Spectrum," in which the HP 3000-series computer hardware and software architecture was changed; the project required 4.5 years, completion in 1985, and was conducted via a different process than described for current new products.

b. The "Spectrum" project was managed by a hand-picked, dedicated team of 200 experienced personnel organized under a system program manager (SPM), as distinct from a system manager, due to scope. The SPM and other senior participants had "assured round trips" back to previous positions should they have to "bail out" from "Spectrum." Spectrum was clearly a project in which HP "bet the company." The SPM set the schedule and controlled funding; he had direct communications with the CEO and regularly used them to resolve issues among functional participants. Schedule was the critical criteria of success; funds were overrun somewhat and performance objectives adjusted as necessary to achieve on-time market introduction.

c. Mr. Snyder indicated that the success of Spectrum laid in a stable baseline for the whole information system product line for about 16 years; that is, another project of similar scope should not be needed for another approximately 8 years.

d. The SPM reported monthly to the COO and CEO to inform, explain and, if needed, get assistance. Financial management support was provided by the matrix.

e. For the projects managed under the phase review system, Mr. Snyder explained his office decides which projects will proceed past Phase 2 and when. He stated that the intent is to choose the projects which will offer maximum market

penetration first; but nearly all projects, once approved for Phase 4, will be completed. The process provides a set of "technology platforms" which can be selected from for earliest introduction of satisfactory capability; the result is that very few projects require pushing the state-of-the-art.

f. He explained that the primary problem for industry is failure to complete a major development; the HP system facilitates rapid, tailored introduction of solutions for customer use. He stated that a precept of HP's system is to ensure against "surprise." If anyone lies, or hides behind legal interpretations, that person is fired. If suppliers fail to live up to agreements, they are eliminated from the industry.

6. Interview with Mr. Morton, CBO Chief Operating Officer, and Mr. Walker, CBO Office of Chief of Financial Management.

a. **Subject:** *Strategic Planning and Decisions.*

b. Mr. Morton described HP as being good at disseminating corporate objectives so all personnel know the priorities. He explained that he attended most phase reviews in order to keep abreast of progress and to ensure the system was working.

c. He described the business planning process as one that builds consensus and ensures good short-term performance without sacrificing long-term R&D programs.

d. He described the PM as a facilitator to the standard structure and when he was unable to resolve all problems, the group and sector managers would step in to assist.

e. Mr. Morton mentioned that a divisional realignment had been accomplished in November 1988 to better facilitate integrated program planning and execution.

f. He further explained that the Computer Business Executive Council was empowered to make strategic decisions, review selected businesses and integrate planning across businesses.

g. Mr. Walker described the process of attributing financial data to projects as fairly relaxed, giving the line managers flexibility to adjust funding to accomplish priority objectives.

RESULTS ACHIEVED

No specific project was tracked at HP, either at the Microwave and Communications Group or the Computer Business Organization; therefore, achievement of specific cost, schedule or performance goals was not assessed. It appeared that, as a general observation, emphasis was on timely achievement of strategic goals. Major programs (e.g., "Spectrum" and the surface mount technology facility) were controlled at the PM level with frequent PM to CEO-surrogate status updates. Success of these major programs was measured in terms of timeliness first. Technical performance was next in importance, the product/plant must be fully sufficient when introduced, but could, and would be improved through planned enhancements over its life cycle. Investment cost was not over-controlled, funds were the tool to achieve strategic breakthroughs. The smaller, product enhancement and application projects were tightly administered by the phase review process. In this latter process, PMs had little authority, acting as coordinators for normal operational managers. Timing, performance and cost for these projects appeared to be orchestrated through a committee management process. Project achievement versus original project baselines was not assessed.

APPENDIX C
DOW CHEMICAL CASE

PROJECTS: Capital Plant and Equipment

COMPANY: Dow Chemical Company, Michigan Division

DATE OF VISIT/INTERVIEWS: 23 March 89

PERSONS INTERVIEWED:

Dr. Robert Pangborn, Laboratory Director
Mr. Frank Aerstin, Section Manager, Process Engineering
Mr. Larry Meir, Division Engineering
Mr. Norm Hozak, Division Engineering
Mr. Stan Nelson, Dow Purchasing
Mr. Mike Wood, Dow Purchasing

DESCRIPTION OF SYSTEMS:

This case documents the Dow Chemical Company, Michigan Division process for managing implementation of major capital/equipment systems. Four to five of these systems are in process at any point in time. Recent examples include an aspirin production facility, a special purpose plastics plant, etc. Such plants include a structure; a process-flow line composed of incoming materials storage, handling and processing; in-process and final product storage; process monitoring and control systems, safety and waste disposal systems, etc.

SCOPE OF PROJECTS

1. **Timeframe.** Typically, 18 months from Board of Director approval for detail engineering through operational start-up.

2. **Funding.** Investment funding of $2M to $500M; the typical new plant costs about $100M.

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

1. **Program Management and Process Engineering**

a. Dow manages all capital projects in phases, as follows:

Phase	Effort
1	*Scope.* An outline proposal from any element
2	*Preliminary Engineering.* At this stage authorization[1] is given to proceed from the appropriate level dependent on projected cost. Program Manager is assigned.* Long lead Items are placed on order.
3	*Plan for Engineering.* The operational requirements for equipment and buildings are established.

The steps above (which result in a detailed cost estimate and business plan, as well as, engineering descriptions) are the responsibility of the Process Engineering Department. It is handed over to Division Engineering upon completion of Phase 3. The lead Process Engineer normally reverts to a consulting role with the lead Project Engineer taking over. There is a formal review at the end of Phase 3; the Head of Process Engineering has the authority to move the program into Phase 4. The PM has the authority to bypass this review if he feels it is essential to meet program objectives.

Phase	Effort
4	*Detail Engineering.* Contract requirements are documented, sources solicited and evaluated.
5	*Construction.* Contractor accomplishes building and installs vendor provided equipment.

6 *Prestart-up*. Cleaning and testing of facility. This is a joint PM and gaining Plant Manager run test with the PM retaining decision authority.

Start-up. The facility is turned over to operations.

b. The mortality rate of projects is nearly 50 percent before Phase 4. This cancellation does not necessarily represent a bad program but may be in response to a change in the market or business plan. Dow Purchasing (worldwide) has approximately $2B capital expenditure budget annually.

c. The size of the typical program management core staff is 5-10 with the remainder matrix assigned as required. The entire program staff with its matrix support is moved near the construction site, usually in a set of trailers. This gives the PM significant effective authority over all project team members.

d. Nearly all PMs come from manufacturing because the result will be a manufacturing plant. They are experienced in manufacturing operations. Characteristics looked for in a PM are:

—Good leadership

—Plant operation experience.

Most PMs do two or less projects in a career. They are high-risk operations, that is they can terminate advancement but will not terminate employment.

e. Previously, most Dow projects took 3 years from scope to turnover, now the emphasis is on a shorter start period. There is a move toward concurrency and away from a strict sequence as described above.

f. Detailed financial control is maintained. A detailed cost estimate is established at Phase three and locked in at Phase 4. It clearly identifies cost to the equipment level.

g. Program managers have authority to pick a supplier, with price not the only factor.

2. **Detail Engineering Management.**

a. Volume of business has driven Dow to institutionalized "fast track (12-18 months cycle) programs where emphasis has been on budget and timing. There is recognition that cost and time are related and the firm is emphasizing schedule within budget limits. Time is a competitive advantage. Once the Board of Directors funded a program, total control of these funds goes to the program manager. He must obtain approval from the Board of Directors prior to commitment if he expects to exceed his budget by over 10 percent.

b. Dow Purchasing is normally its own prime systems integrator. Contract administration is in the engineering division. They visit plants and inspect processes. Program management employs detailed control using Pert and basic cost accounting information, updated weekly. In construction programs, one division utilizes MAC computers with MAC Project II software. Several of the local construction firms use the same information data bases to track schedule. There is a great deal of attention paid to the detailed master plan; the PM reports monthly to upper management (normally one level above the PM). Program managers and plant managers are generally five levels below the Chief Executive Officer of Dow; intervening layers are (from the top) President, Dow, USA; VP Manufacturing; GM, Michigan Division: and Major Manager, Product XYZ.

c The firm is using a financial management system which would probably pass CSCS audit. They look at it in detail as they manage their work but only report up aggregated data. They can, however, focus on a particular cost or schedule variance as required.

3. **Purchasing Capital Equipment Items and Construction Services.**

a. Dow has only a few major purchase items or commodities centrally purchased. Otherwise each operating location (e.g., Michigan Division) controls its own purchases.

b. In purchasing, most of the professionals are degreed engineers from the technical field supported. Emphasis is on the buyer's professional knowledge to understand acquired technology.

c. Specifications are general in nature. Dow expects the vendor to produce specific solutions for operational requirements. A great deal of emphasis is on technical evaluation. If the engineer and the project buyer disagree, the program manager is the tiebreaker.

d. When making a source selection, cost is only one factor. It must be integrated with schedule and quality.

e. The company concentrates on maintaining a stable vendor base. The basis for this base

is the experience of the professionals in the company. The company spends a good deal of time on prequalification.

f. Dow uses competition when it is appropriate. There is no corporate goal or policy mandating its use. Guidance is based on common sense. Supplier relationships are developed to emphasize schedule and put less emphasis on cost. We were provided copies of their supplier evaluation system which was quite similar in use in other cases. It is a supplier audit system which evaluates the supplier's processes. The goal is to screen out poor suppliers with the collateral benefit of reducing the supplier base. They have not used the system as a weighted factor in making contract awards, but are considering this later.

g. Procurement administrative lead time is rarely longer than a month. It can be done in 1-2 days when necessary. Because most projects are on a fast track, with considerable concurrency, this dictates making purchase decisions as late as possible in the process, giving the greatest flexibility in making engineering decisions.

RESULTS ACHIEVED

No specific project was tracked at Dow Chemical; therefore, no specific cost/schedule/performance goals were set. In general, schedules appeared to be met as a first priority; performance objectives were met though detailed requirements were traded-off with the exception of safety features which were never compromised; cost objectives, plus-or-minus the 10 percent management reserve to the PM were met.

Endnote

1. Authorization - The company's Business Management Team can authorize the scoping of a project. If it is more than $2M, it must be approved by the Board of Directors. This decision is reviewed at the end of Phase 3 when the Board gives its final approval. Approved program funding is allocated to the program manager.

APPENDIX D
GENERAL ELECTRIC AIRCRAFT ENGINE CASE

PROJECT NAME: "Factory of the Future"

COMPANY: General Electric Aircraft Engines (GEAE), Lynn, Mass.

DATE(s) OF VISIT/INTERVIEW(s): 14-15 Feb 89

PERSONS INTERVIEWED:

A non-attribution request was made by interviewees. Personnel were interviewed at several management levels including general management, project management, and functional department management.

DESCRIPTION OF SYSTEM

The General Electric (GE) Aircraft Engine Group "Factory of the Future" is a fully automated machining facility for processing rotating components of high performance jet engines. It is one of several new manufacturing plants planned and implemented from the mid-1970s to present to modernize GE's worldwide competitiveness across many commercial and military product lines. All such plant projects shared many of the same guiding principles such as automation and team management. The factory system includes a modern process area which houses approximately 25 numerically controlled (NC) machines for turning, milling and drilling vendor-delivered raw materials. Numerically controlled machines are linked to a mainframe computer controller which directs interaction of machines between process runs with automated materials handling and other support systems (e.g., incoming inventory staging and delivery system, tools staging and delivery system, and the system for finished product cleaning and preparation for shipping). Production control and status is automatically provided to the production control room. In operation, a part undergoing processing in the plant is never touched by human hands from the time raw materials are unpackaged until the finished part is packaged for shipment. About 22 rotating parts for various jet engines are currently being processed in the plant with growth to about 30 parts during the next 2 years. The plant facility is run by 120 union personnel supported by about 60 management personnel, 24 hours/day, 362 days/year. Management personnel are production planners, systems and maintenance engineers; union personnel are of two skills—parts receiving and shipping handler and automated factory mechanics. There are no direct machine operators in the plant.

SCOPE OF PROJECT

1. **Timeframe.** Conceived: 1982.

   Planned: 1983-1984.

   Implemented: 1985 ground breaking; 1986 initial production startup

   Full Operation: 1987 24-hr. operation; 1990 full capacity loading.

2. **Funding.** A $52 million internal venture capitalization of which about $6 million is for the building and $46 million for the automated machines and materials handling systems.

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

1. **Program/Project/Plant Management**

   a. Matrix managed; aspects are as follows:

   —The PM has a staff of about 60 dedicated personnel, hired via the standard company personnel system for the implementation and production phases; about 120 additional people were provided by functional directorates, as negotiated between the company and the union.

   —Staffing appears to be very stable over the implementation and production phases to

date. The PM has a strong position reference personnel retention due largely to strength of personality and knowledge of the personnel system.

—In production, the PM is not responsible for the business plan; that is the responsibility of the PMs of customer engine programs.

—The plant PM is responsible for quality, cost and delivery of machined parts to the plant responsible for the follow-on process.

—The PM has no authority to operate outside of normal G.E. aircraft engine procedures; for example, purchasing exercised strict autonomy in source solicitation and selection procedures.

b. Project was baselined via a plant appropriation request (PAR), a projected business plan, resource allocation, schedule, and technical description. The baseline PAR plan is developed by operational management, approved by the Chief Executive Officer, and presented to the implementation PM for execution. Changes to the PAR must be approved by the Department General Manager (PM's immediate superior) unless significant changes to budget, schedule or ultimate capability are to be made. The PAR is not a detailed document but an objective-orientated one.

c. Progress/status reports were made quarterly to the GEAE Vice President (two levels above PM). The reports were detailed and provided for information. The GEAE has eliminated all VP positions at Lynn, Mass.; thus division general managers directly report to the GEAE VP. The "Factory of the Future" PM reports to the Manufacturing Department General Manager.

d. Plant organization in the production phase is based on management/worker teams rather than traditional line and staff elements. Only two worker skill categories exist—part handlers and machine maintainers. This permits great flexibility in employing teams in that they are motivated to work cooperatively to optimize productivity and quality.

e. The PM selection criteria is different for the PM designated to plan and gain corporate approval for the project from the PM charged with implementing the plan and running the plant. The "Factory of the Future" has had three PMs. The first managed concept development and planning through approval of the PAR by the CEO.

The second PM implemented the plan and continued as the plant manager for 1 year following initial production start-up.

The current PM is principally responsible for production, but also is seeing to the evolutionary nature of application software development and implementation, and initial processing of the remaining ten parts planned for full capacity operation in 1-2 years.

2. **System Engineering Management.**

a. Specification of systems to be acquired from vendors was done iteratively and cooperatively with system vendors. The requirement, solicited competitively, was a capabilities definition; vendor proposals established what would be provided; these proposals were negotiated to ensure full understanding and the capability to be provided. The GEAE did not initially specify subsystem requirements but did spell out all critical interfaces to other systems, including control system. Vendors were selected based on their technical proposals; solicitations were open, though the design team did suggest probable sources. A somewhat unique aspect of vendor contracts was since there was significant risk there would be problems integrating various systems which must operate automatically together, vendors were obligated to perform until all systems were operating successfully. Fixed-price contracting applied to most vendor efforts.

b. It was noted that, though GEAE uses CAD/CAM and has acquired a CAD/CAM company, it can not automatically transfer CAD documentation to the CAM system due to the detailed and time-consuming process of review and approval of design results. Should this process be improved, there appears to be substantial promise of directly translating design criteria into numerically controlled machine instructions.

3. **Purchasing and Quality.** (Subparagraphs apply to all elements of GEAE, not just the subject plant.)

a. It was observed by GEAE managers that the attitude concerning ethics has evolved during the past few years to one of total compliance with the letter of government regulations and guidelines. This strongly subordinates project performance, cost and schedule objectives to that of

compliance. This situation is driven by findings of unethical behavior in the 1984 timeframe and the tremendous emphasis government agencies have made to define and enforce ethical practices for industry. Therefore, for consistency, DOD requirements are implemented across the board, to include their application to commercial products and processes.

b. The corporation uses MIL-Q quality requirements on all aircraft engines, commercial and military. GEAE touts quality as the first element in successful engine products due to implications of failure of aircraft safety and company reputation. A supplier quality rating system is in place for a few component commodities; a classic quality control approach is employed involving the following:

—Audit of suppliers' QC system to ensure sufficiency

—On-site visits to ensure systems are being used according to plan.

—Performance is assessed based on the following:

--Delivered quality; reported quarterly; value-40 percent; measured using an exception reporting system

--Definition of the quality system and conformance; value-60 percent.

c. The goal of the supplier qualification system is to narrow their supplier base while encouraging suppliers to become more self-sufficient and responsive to a greater line of component requirements. The system is not used as a "bid factor" for government orders but is in use for commercial orders.

d. Numerically controlled machine self-checking accuracy, coupled with off-line but integrated testing capability, all linked to the control system minimizes the need for off-line testing to verify quality of machining. This capability can be of use in two important ways: 1) Normal accuracy of the numerically controlled machines, backed up by automatic calibration may permit component specifications to be detailed knowing the inherent NC accuracy/quality; 2) When quality reporting is required, the reports requirement can be adjusted to use computer output from NC machines directly, versus using off-line tests and differently formatted reports.

4. **Production.**

The "Factory of the Future" has potential for significantly reducing WIP inventories due to predictability of process time. The JIT and TQM reality in the plant forms a cornerstone for expanding these capabilities out into the integration/assembly plants.

RESULTS ACHIEVED

The "Factory of the Future" is clearly a technical, cost and schedule success. However, due to reduced orders for the principle parts to be processed in it, the plant has yet to achieve the financial success upon which it was approved. The shortfall of business is being made up by pulling processing of other production parts from older plants. This requires more application software development and integration and should be achieved in 1-2 years.

APPENDIX E
TEKTRONIX CASE

PROJECT NAME: World Class Manufacturing Plants

COMPANY: Tektronix, Beaverton, Ore.

TriQuint, Beaverton, Ore.

DATE of VISIT/INTERVIEWS: 30 March 89

PERSONS INTERVIEWED:

Mr. John Ristow, Director, Corporate Quality Assurance
Mr. Soren Vestergaard, General Manager, Portable Test Instruments Division
Mr. Robert Dueltgen, Marketing Manager, Portable Test Instruments Division
Mrs. Bonnie Sullivan, Director, Corporate Procurement
Mr. Don Tucker, Manager, Operations Group, Federal Systems Division
Mr. Neil Shiller, Army Account Manager
Mr. Richard Allen, Director, Quality and Reliability Assurance, TriQuint
Mr. Alan Patz, President, TriQuint and former Director, Finance and Operations, Tektronix Technology Group
Mr. Richard Anderson, Financial Manager, Multi-Comp and former Financial Manager, Tektronix Capital Projects

DESCRIPTION OF PROGRAM

Six capital programs, planned and implemented from the late-1970s to mid-1980s, were investigated. They were efforts by Tektronix to position itself as a world class manufacturer and supplier of electronic test and measurement equipment and communications systems. Corporate strategy was to ensure and improve their market share in the face of the mounting Japanese invasion of worldwide markets for electronic test and measurement equipment. Centerpiece of the strategy was a new 2400-series portable oscilloscope product line. The new scopes required much higher performance, smaller and less power-demanding components than previous instruments as well as improved availability of thousands of vendor supplied components. In addition, a purchasing program originally termed the "Supplier Reduction Program" was investigated; it was implemented over the period 1987-1988. The four capital projects were:

- *Building 59, Integrated Circuit Manufacturing Plant.* A 185,000 sq. ft. production facility designed specifically for integrated circuit (IC) production. The building project involved a production area:

  —Isolated from vibrations of corridors and elevators and with work areas isolated from each other (conceptually like a Beautyrest mattress)

  —With overpressure atmosphere which, with air cleaning filters, provides atmosphere cleaner than 10 parts (1 micron or larger) per cubic foot (this is 1000 times cleaner than a hospital operating room)

  —With extremely tight temperature and humidity control, compressed air and special production gases (including poisonous and explosive) distribution systems, and with five separate contaminated waste material disposal systems.

  The plant currently produces silicon bipolar ICs, charge-coupled devices and gallium arsenide (GaAs) ICs. The GaAs capability was a business spin-off in 1985 to TriQuint, a totally owned subsidiary, to produce and market GaAs technology to Tektronix and other customers (including competitors); it is the subject of a separate caselette below.

2. *GaAs IC Plant*. This plant occupies 35,000 sq. ft., of Building 59 (above) and is operated by TriQuint. The plant was planned and implemented as a part of Tektronix as part of a long-range design to ultimately spin it off. Tektronix foresaw its needs would be far less than plant capacity. The plant produces GaAs ICs to customer order and a number of standard components for Tektronix and other customers. At this time Tektronix represents 10 percent of TriQuint's sales while direct sales to the government (mostly research and advanced development efforts) are about 20 percent and sales to industry (including primes on government contracts) are another 70 percent. The project involved designing, providing, installing and testing automated equipment for IC production (e.g., ion implanting devices) and all utilities (e.g., gases, air, waste, etc.) which would augment or adapt to the Building 59 facility. The GaAs is the most demanding IC technology currently in production in Building 59.

3. *Building 78, Automated Warehouse*. Building 78 was designed to be the central incoming parts receiving, storage and retrieval facility. The building was designed around an automated system for storing and retrieving parts and a high-bay storage area for oversized items; this storage area utilizes special 50 vertical foot fork-type lifts (these lifts are manned). The objective of the facility was to integrate and reduce all parts inventories and to improve cycle-time in finding and moving needed parts to appropriate manufacturing plants.

4. *Cathode Ray Tube (CRT), Hybrid Circuit, and Circuit Board (CB) Manufacturing Plants*. These projects were referred to during interviews about the above projects and were similar in scope, timing, and overall corporate objective. They are included to round out the application of project management approaches used in Tektronix.

SCOPE of PROJECTS

1. *Building 59 (IC facility)*. Cost: $53.4M; Approved by Board of Directors (BOD) in 1979; required 21 months to implement.

2. *GaAs Plant (in Building 59)*. Cost: $1.7M; Approved by BOD February 1984; completed and spun off as TriQuint in April 1985.

3. *Building 78 (automated warehouse)*. Cost: $23M; Approved by BOD in 1977; completed in 1979.

4. *CRT, Hybrid Circuit and CB Plants*. Cost: $20-50M each; approved and implemented between the late-1970s and mid-1980s.

5. The Supplier Reduction Program reduced manufacturing material suppliers from more than 2,900 to approximately 200 in 1½ years. These suppliers represent more than $380M annually in Tektronix purchases.

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

Tektronix went through a major reorganization in the late 1970s from central control to decentralized. It is composed of three fairly autonomous business groups (managed by vice presidents), each with several product divisions and/or component manufacturing plants. These divisions and plants are managed by general managers and are profit-and-loss centers. Each of the above capital projects was conceived during a period of central management and most were executed during decentralized operations. In all cases, Tektronix was the integrating organization, hiring consultants and system/subsystem contractors as required.

1. **Building 59 (IC facility).**

a. *Program/Project Management (including functional management)*. The vice president for manufacturing was initially the responsible senior manager for the project (later the project was reassigned to the VP of Tektronix Technology Group); the former chose to assign a project coordinator (PC) to share the coordination function with a PC assigned by the corporate Director of Facilities. This VP retained all project decision-making authority. The project team consisted of several industrial engineers who, among other duties, managed various building and subsystems contractual efforts, and who reported to the VP through channels; representatives of four pre-existing semiconductor manufacturing facilities (these were users) who reported through their channels to the same VP; and a consulting contractor. Procurement was, at the time, a central corporate function. The project team was reorganized about 12 months into the 21 month im-

plementation due to corporate reorganization then underway. At about the same time several key participants (including the VP and engineering PC) were changed due partially to a significant unauthorized cost overrun condition. The facilities PC function was assumed under the new Director of Finance and Operations who reported to the new VP of Tektronix Technology Group. The PCs conducted weekly status reviews with all team members except the VP who was briefed as necessary.

b. *Technical Requirements Management*. Environmental requirements for the facility varied among the user group representatives due to the different IC technologies to be resident in the building. Originally each technology would get an area tailored to its needs, each isolated from the other. However, space to be allocated to each technology was difficult to determine, due to differing forecasts of future business for each. The result was the entire facility was built to the most stringent requirement (that of GaAs ICs). Because a change would cost more, there was some effort, during implementation, to hold down costs by trading off some construction materials choices (e.g., use Copper pipes instead of stainless steel for various gas pipes). Facilities specifications were developed by industrial engineers in coordination with the facilities PC; some users felt left out of the process until too late.

c. *Financial Management*. The function was originally centralized at corporate headquarters, then moved to the new Director of Finance and Operations when that position was created. The original BOD approval authorized $42M for the project with up to a 10 percent reserve allocated to the VP. Corporate financial management did not track commitments of funds for the project, the project team did. When corporate financial management discovered actual expenditures exceeded authorization plus reserve, commitments for the project were even larger. It is interesting to note that Tektronix continues to leave project financial management to the responsible VP and has not imposed more stringent rules for authorizing and tracking project funds. Rather, they rely on accountability of assigned management.

d. *Result*. The project was completed on time and to full specification, total cost to implement was about 150 percent of that initially authorized. The 2400-series oscilloscopes which depended upon the facility were introduced on-target and have become the highly successful, main product line at Tektronix. Over-design of Building 59 has facilitated technological expansion and will continue to do so for up to 20 more years; any significantly lesser facility would be approaching technological obsolescence by the early 1990s. It appears that if overruns had been reported in a timely manner to the BOD, they might have been approved without need to replace those responsible. In any case, Tektronix has not implemented severe procedures which would preclude any possible recurrence, rather they continue to rely on appointed managers to operate according to good business practice.

2. The GaAs Facility in Building 59

a. *Program/Project Management*. The project was approved to be internally implemented then spun off as a separate business enterprize following completion. The former Director of Finance and Operations, Tektronix Technology Group, was appointed General Manager (GM) of the prospective new business and had full authority to commit up to the approved $1.9M plus 10 percent reserve without reporting back to corporate headquarters; he was not required to report progress to the laboratory VP. This GM appointed a full time Project Manager, who, following completion, became Vice President of Manufacturing in the new business, TriQuint; the GM became President of TriQuint.

b. *Results*. The project was completed on original schedule despite a delay in BOD approval of 4 months. It came in 10 percent under approved cost and in full compliance with technical requirements. TriQuint is now a $10M/year business. Its GaAs technology is commercially sold to industry at large and is one of the critical technologies provided to space programs.

3. Building 78 Automated Warehouse

a. *Program/Project Management*. The vice president responsible for this project hired a professional project manager. This PM was empowered to task Tektronix staff and commit resources authorized for the project. Mr. Anderson, then the project's financial manager, attributed ultimate success of the project to three things:

—Hiring a professional PM

—Detailed business and technical planning prior to BOD approval, including soliciting and evaluating bids for all building and subsystems contracts on a range-bid basis. This required bidding firm, fixed prices with contingency values should bidders encounter bad weather, unexpected soil conditions, software interfacing problems, etc.). The project team then analyzed potential costs, established a best estimate with range contingencies and obtained approval for the best estimate plus a 10 percent reserve.

- The requirement was not changed during implementation. Increased requirements were implemented as follow-on "block upgrades."

b. *Technical Requirements Management.* The project was planned for evolutionary implementation. The baseline effort was implemented to facilitate future upgrades (e.g., initial ground preparation was beyond the minimum needed to take advantage of low costs if done all at once; it was used later during an upgrade). This approach permitted low cost expansion once such was defined and approved without complicating initial implementation.

c. *Results.* The project was completed on time, within 1 percent of authorized $23M cost and achieved total required performance. This facility ultimately provides more capacity than Tektronix requires, due to later decisions to implement JIT with selected vendors delivering directly to manufacturing divisions. This was, in part, due to decentralization of corporate functions. Tektronix has acted to use the extra capacity to sell inventory capability to outside firms. It took about 6 months to complete training of existing warehousing personnel to use the automated capability. Salary incentives were used to motivate these warehousers to assume more complex aspects of computer use.

4. Other plants (CRT, hybrid circuit and CB manufacturing) were successful and employed different project management techniques at the discretion of top corporate officers responsible (vice presidents). One plant was implemented using a contract project manager who was given authority to draw and control corporate resources needed for implementation.

5. **Purchasing and Quality.** In April 1987, Tektronix chartered a project manager, responsible to Director of Corporate Procurement, to reduce the number of suppliers of manufacturing materials from the estimated number of 1,500 to 350 by October 1988. Objectives were to reduce purchasing overhead and improve delivered quality of component items and materials. Later, this project was renamed the Preferred Supplier Program (PSP). It was planned following examples of Xerox and General Electric who provided some early guidance. The goal (350 suppliers) was approved by the Executive Vice President for Operations. The concept evolved from their Manufacturing Excellence Program (MEP), an adapted form of Total Quality Management. The MEP consisted of four integrated programs:

—**JIT**: just-in-time

—**TQC**: total quality commitment

—**MRP**: manufacturing resource planning

—**PI**: people involvement.

a. The PSP foresaw a need to continue using some suppliers who may never become "preferred" but support mature product lines. These have been termed "strategic suppliers" and are expected to be phased out.

b. The project was managed as follows:

—A Procurement Council (Council), headed by the Director of corporate procurement. Each division has its own procurement function; corporate procurement is now a staff agency. The Council established criteria and approved plans for the project to ensure fairness and consistency. The Council also selected members of:

—The Management Review Team (MRT), including cross-functional managers who were peers of the PM. The MRT provided interdivisional and staff coordination and selected members of:

--The Supplier Reduction Teams (SRT), one per commodity of material, totaling 18 SRTs. Each SRT was chaired by applicable procurement commodity managers from corporate. Membership included engineers and other user representatives from each interested manufacturing division. These divisional members were

responsible to communicate progress and findings to their divisions. Now that the project is in the sustaining mode, SRTs are employed to develop corporate contracts where appropriate, periodically review supplier performance (e.g., delivery statistics or performance exception reports) and adjust any commodity supplier decisions, as needed. These teams are now called "stakeholder teams."

c. The project is effectively constrained by government requirements to maintain a minimum percentage of small, disadvantaged, and minority owned businesses. To date this has not been too limiting due to the fact that few such firms supply high-technology manufacturing components; rather, they typically provide local value added services which are sufficient to cover government requirements when applied across the business.

d. Tektronix employs a "closed loop corrective action process" whereby corporate contract supplier problems are solicited periodically, or on-event basis, to corporate procurement. (Problems with division-unique suppliers are handled at the division level.) These are analyzed by stakeholder teams with feedback provided to suppliers in quarterly or annual meetings. These meetings typically consider in-process price adjustments based on market trends; Tektronix does not wait until the end of contract performance periods to adjust prices. Typically, no incoming inspection tests are done at Tektronix. In the past such tests were done; over time the need has declined due to practice of developing strong partnerships with the best suppliers. Rather, testing done at board and assembly levels during manufacture at Tektronix finds any failures which are then aggregated and fed back to procurement via the above closed loop process. It was found that conversion to JIT has supported corporate test philosophy since any lot problems are likely to be noted early and little inventory will be on hand or incorporated into final products.

e. In addition to periodically polling divisions for supplier data, Tektronix periodically polls suppliers to assess their opinion of Tektronix as a customer. Questionnaires and follow-up meetings attempt to identify highlights and shortcomings in any Tektronix division procurement practices or policies.

f. *Results*. By October 1988 the number of preferred suppliers had been reduced to 207 (i.e., suppliers to be used in new product development); during the project a total of 2,898 suppliers were noted to have been in use (almost twice the original estimate). These 207 suppliers provide component material in 276 component technologies and covering an estimated 100,000 part numbers (number not available during the interview). Tektronix also utilized another 200[5] "strategic" suppliers to support existing product requirements. Tektronix has an objective of one supplier only for most parts. Often several other suppliers are noted as capable of meeting needs in a crisis, but no special effort is underway to keep multiple suppliers available. Tektronix actively encourages suppliers to consider long-term strategic alliances in cooperative development of new products; an example mentioned was an alliance with Motorola where both companies announced that a Tektronix computer work station would be the first user of a new Motorola microprocessor. Tektronix also solicits for strategic alliance partners in Japan.

APPENDIX F
PACIFIC BELL CASE

PROJECT NAME: Advanced Digital Network (ADN)

COMPANY: Pacific Bell, San Ramon, Calif.

DATE OF INTERVIEWS: 17 Mar 89

PERSONS INTERVIEWED:

Mrs. Judy Bradford Director, Digital Product Introduction, Product Management
Mr. Lawrence Kunke, Director, Human Resource Management; former Director, Marketing and New Product Development

DESCRIPTION OF SYSTEM

Pacific Bell's Advanced Digital Network (ADN) is a digital line service for subscribers which provides full duplex, point-to-point or multipoint service with customer-selectable data rates of 1.2, 2.4, 4.8, 9.6, 19.2, 32, 38.4 and 64 Kbps. The system provides interconnectivity to other network services such as public packet switching, Pacific Bell's local area network and others. Unique features of ADN are customer network control and diagnostic capabilities, speed selectivity, and network reconfigurability. The system is composed of equipment and software added to existing Pacific Bell digital transmission network central office plants to provide the host capability; subscribers order service from Pacific Bell and acquire terminal data sets from independent vendors.

SCOPE OF PROJECT

1. **Timeframe.** -Conceived by Bell Labs prior to Bell System divestiture in 1984

   -Concept development by Bellcore, 1984-85

   -System development by Pacific Bell, start May 1985

   -Project redirected, November 1986

   -System deployment February 1989; currently orders are being taken and service initiated for customers.

2. **Funding.** Since November 1986, Pacific Bell has invested $2.5M for planning, design, development, testing and analysis, prior to approval for implementation; significantly greater funding was approved for system-wide implementation (actual amount is not releasable according to Pacific Bell sources).

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

Pacific Bell was created out of the Bell System divestiture in 1984. Prior to that time, it had no in-house acquisition system or activity except their role to implement Bell system enhancements conceived and managed at corporate level. Therefore, Pacific Bell was described as a start-up company with a $9B revenue stream when created in 1984. It took several years to formalize an acquisition process within Pacific Bell; it also took several years for new product development to become a priority business at Pacific Bell. These factors may have been principal contributors to the decision in 1986 to redirect and restart the development of ADN. Though schedule was determined the first priority in achieving project success according to the PM, lack of top-level management linking strategic objectives to project goals delayed the process of trading-off system technical requirements for cost advantages that customers ultimately demanded. The following discussion focuses on the systems development process in Pacific Bell as observed through the ADN case.

1. **Program Project Management**

a. *Matrix Managed.* The designated PM was provided a dedicated team of five functional managers who report directly, and are totally responsible to the PM to coordinate their functional tasks through their departments' organic functional directorates. One of these subordinate managers chaired an interdepartmental project team of 13 persons. The PM was directly responsible to the corporate Market Planning Board (MPB) consisting of corporate officers. The PM chaired a district directorate manager-level Steering Committee composed of peers. There are approximately 150 such PMs in new product or capital development at Pacific Bell; new product development is organized under the Vice President of Marketing. There are approximately 60 active new product development projects underway at this time. At peak activity periods, about 300 people were working ADN in dedicated or time-shared tasks. Mrs. Bradford described her authority as informal; most project personnel worked for other peer or senior management, so she felt that open and frequent communications with those peers and senior managers was the only practical way to sustain effective and integrated involvement of all participants. The six-person project team organized itself to establish sets of primary functional interfaces with the following matrixed functions:

—Marketing (several elements)	—Network Engineering
—Finance	—Information Systems
—Customer Billing	—Operations
—Regulatory	—Strategic Planning
—Legal	—External Affairs
—Procurement	—Advertising

b. The new product development process is as follows.

—*Idea Processing and Feasibility Analysis* by a standing study team. This team culls through all suggested ideas for those appearing most promising, feasible, and consistent with corporation strategy. For selected ideas, an approximately 30-page mini-business plan is prepared for submission to the MPB which selects the best, prioritizes among them, allocates necessary development funds and directs that development commence. At this time the PM is assigned; PMs were normally four levels beneath the vice presidential level. Beginning with ADN, Pacific Bell began appointing PMs for priority systems from district manager (director) ranks (one level higher).

—*Design, Test and Trials, and Development Analysis.* Design consists of detailed project planning to include business planning, specification and standards development, establishment of vendor sources and development of support systems. Development tests are done in-house and arrangements made for selected customers to participate in operational testing. Permission to conduct customer tests must be obtained from the California Public Utilities Commission. Following conclusion of operational tests, the business case is submitted to the MPB for approval to implement and to allocate necessary resources. A tariff is prepared for filing upon MPB approval. The ADN proceeded through this design, test and development phase twice (only one tariff was filed); however, the first time was followed by an aborted attempt to implement via project team "hand-off" to the matrix for implementation. As a result the project was restarted in 1986 from the design stage. The first developmental effort was attempted too quickly resulting in the PM's decision to conduct an intensive customer survey to find out what digital transmission services the market really wanted, and at what price. The result was a significant modification to the specification. Mrs. Bradford described this as the salvation of the project which, up to that point focused more on technology than customer need.

—Following approval for full-scale implementation, the process involves deployment planning and technical implementation to prepare communications backbone and control facilities for the new public offering. At this time, the tariff is filed. Once the network is prepared and tariff approved, customer orders can be solicited and satisfied. The ADN completed this phase and would be finished but the PM insists she be allowed to carry the project for several additional weeks to manage issues that may arise as customer service is cut over and field service fully institutionalizes the provisioning and activation process. As of late March 1989, 120 customer orders are in and 25 operational. Another unique aspect of

this phase is the PM's decision to prepare an audit and evaluation of the process as experienced by ADN.

—Once the project is completed it is turned over to the life-cycle management and product portfolio fulfillment process as a standard service offering. It is interesting to note there is no formal vice-presidential level decision required to activate the new service. Effectively, it is a PM decision made in coordination with operational management. The ADN required 27 months of intensive management to complete development and implementation once redirected in 1986.

c. Top management (i.e., President and Executive VPs) are not involved with new product development business except to approve major implementation budgets (ADN was approved by the President).

d. The PM noted the development process was perhaps unnecessarily long for ADN due to the "heel-to-toe" nature of process guidelines and could be improved by tailoring and parallel activities.

e. The reporting requirements for ADN were quarterly presentations (15 minutes) to the Marketing Planning Board. She felt that was inadequate to sustain interest by the functional matrix in order to continue on schedule. Therefore, she unilaterally decided to provide monthly status reports to the planning group and to functional district managers upon whom she depended for personnel resources and funds status.

f. The PM feels that ADN was quite successful but could have been much more so if it was conceived as an evolutionary project composed of several phased implementations. The drawback is that there may have been substantially less high-level support for ADN if it was not perceived as "significant" under those circumstances.

g. Mrs. Bradford described her qualifications for program manager as significant multifunctional experience during her 22-year career with the telephone company. She developed insight into many aspects of the company. She has no business degree or engineering background. She felt this did not inordinately hamper her, because she feels people management and communications skills are most conclusive to project success. She had 5 days of PM training during development of ADN, none before. She did feel inadequately prepared to understand the financial aspects of project management and felt somewhat compromised due to lack of budget management authority; only $1M of the total allocated for implementation was under her control. The biggest drawback in finances was difficulty in tracking funding resources within the matrix to whom most funds were released. Matrix functional managers had a tendency to unilaterally decide how and when to commit or expend project funds. The PM had a 10 percent reserve in the implementation phase; if that buffer were exceeded, a revised business case would have been submitted to the MPB for project go/no-go decision. This was not an issue with ADN which completed successfully within budget.

2. **Purchasing**

a. The ADN acquired the basic design technology from an outside source during the design and test phase. The design source was and is a small business. However, Pacific Bell has acquired ownership of the technology.

b. Due to regulation of the public communications business, Pacific Bell is precluded from manufacturing or marketing any customer premises equipment beyond an interface point (e.g., a line jack). This poses several technical and procurement issues. The ADN project's ultimate business success is tied to the capacity and well-being of vendors who offer the customer premises adapters which control data line access at terminal locations. Mrs. Bradford indicated that Pacific Bell is trying to encourage other vendors to license the technology so access to the necessary hardware for system proliferation is not limited. She said it is difficult for a company as large as Pacific Bell to appreciate the severe limitations of small companies once a large-scale product line goes into full-scale production and deployment. The ADN is now limited in the sales effort due to lack of vendor participation marketing customer adapters. During the development phase, frequent visits of Pacific Bell engineers and managers to the vendor facility often overwhelmed its capacity to host visits and continue development work.

RESULTS ACHIEVED

The Advanced Digital Network is one of the first significant new products to successfully transition to market at Pacific Bell. Success seems to have been attributable to a determined professional core project team, moreso than the management process. The dual oversight of the Market Planning Board (within Pacific Bell) and various regulatory agencies (FCC, California Public Service Commission, and the Department of Justice) results in a confusing and uncooperative environment for new products. The ADN completed on time and under budget for the final development and implementation phases. It is selling well and promises to be a major contributor to Pacific Bell's profits in the future.

APPENDIX G

BECTON DICKINSON CASE

PROJECT NAME: FACStar

COMPANY: Becton Dickinson Immunocytometry Systems (BDIS) Division, San Jose, Calif.

DATE OF VISIT/INTERVIEWS: March 16, 1989

PERSONS INTERVIEWED:
Division President
Director, Product Development Programs
Engineering Project Manager; former FACStar PM
Vice President, Product Development and Technology Management
Purchasing Manager

DESCRIPTION OF SYSTEMS

Becton Dickinson Immunocytometry Systems (BDIS) designs, develops, manufactures and markets high technology cell analysis systems. The BDIS is the market leader in the United States and worldwide for this type of system, with 55 percent of sales outside of the United States. Fluorescence-Activated Cell Sorters (FACS) are automated systems identifying blood and tissue cells in a flow stream, separating them, and collecting them from samples for further analysis and culturing. The systems were invented in the early 1970s and were primarily for laboratory use. During the 1980's, BDIS was organized to bring the technology to the clinical market with a redesigned, lower cost, user-friendly FACS-type system. The BDIS has also developed and marketed the FACScan, a cell analyzer, and other advanced cell processing systems. Most of these systems are integrated and are composed of an instrument, a commercial computer controller, applications software, and a variety of reagents which are chemical compounds used in processing samples. Primary applications for the systems are patient monitoring and diagnosis and treatment of cancer, immune system disorders, rheumatoid arthritis and multiple sclerosis, etc.

SCOPE OF PROJECTS

The FACStar concept was approved for development in April 19[illegible] division president staked the future o[illegible] ompany on it. The FACStar is the rebi[illegible] o[illegible] vailable laboratory FACS technology into a marketable system for clinical research use. To be marketable it had to be easy to use and affordable; neither feature applied to earlier FACS systems. And, it had to be available for an April 1985 industry show for biologists and first customer unit shipped in September 1985, 18 months later. The $10M company bet more than $1M in research and development (R&D) on FACStar. Following FACStar, BDIS developed FACScan and FACStar-plus (an enhanced laboratory, high-end version of FACStar) over a 3-year period. The decision to develop FACStar was not supported by detailed cost-benefit analysis at the time; rather, the president explained he felt strongly that the clinical market was ripe if Becton Dickinson could provide an affordable and user-friendly aid to clinical diagnosticians.

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

1. **Program/Project Management.** (Subsequent to introduction of FACStar, FACScan and FACStar-plus, BDIS began to formalize the new product development process. This was thought necessary due to company growth and the need to manage more developmental projects in

parallel. The new process is summarized at the attachment.

a. **Matrix Management.** The FACStar was developed by a project team of four key middle management persons (a lead engineer, a marketing manager, a manufacturing manager and a financial business manager). The lead engineer performed the traditional PM activities in an *ad hoc* manner and formally led the technical element, also dedicated to the project for its duration.

b. The FACStar was described as a "skunk works" project for the design phase in which participants had full authority to do what was necessary to make it work; performance tradeoffs were encouraged to meet the design-to-unit-price bogie and the schedule; cost overruns were allowed, though not encouraged. The project had total support of the president, who regularly exhorted the company to fully support the project even if it impacted other ongoing efforts. The importance of FACStar was not lost on any employees. The president explained that he placed maximum trust in his people and could do that due to the care he used in selecting those managers. In exchange for the total trust atmosphere, he demanded there be no "surprises." The Director of Product Development Programs described the president's management style as visionary; he used consensus to establish organization commitment prior to approving the program for development (which he confirmed by saying that his top-management personnel expected him to be able to express clearly the merits of any decision he communicated).

c. Coordination was accomplished via weekly project team meetings when status and action plans were reviewed and problems solved. Quarterly, the president reviewed the project with top divisional management. Corporate Headquarters was not formally involved but was advised of status by the president as he felt appropriate.

d. The project budget was allocated to participating department chiefs (typically VP level); the project leader requested commitment of funds, as required. The VP's used broad discretion moving available funds around to ensure their functions were fully supportive of the project. For FACStar and other early development programs, funding expenditures were tracked closely due to the requirement to provide quarterly status to Limited Partners (source of capital improvement funds arranged by the parent corporation). Subsequent to completion of the approved main projects that required detailed financial accounting to the partners, the system of detailed financial tracking by project has been discontinued; it is being reconsidered for the future as the new product development system is implemented.

e. The president explained that in his competitive market he feels that on-time completion is more important than development cost, since early entry into the market will more than make up extra R&D costs. This attitude is well understood by all personnel interviewed. It was felt that 30-40 percent overruns in development cost would result in a 4 percent decrease in life-cycle profits compared to a 50 percent developmental schedule stretch-out which would result in 30-40 percent reduction in life-cycle payoff. Despite the philosophy of pushing schedule accomplishment first, it was clear that resource constraints at the division level force management to intentionally prioritize some projects at the expense of others. It seems that such decisions are fully announced, with likely impact, to the company, so participants of lower priority projects do not get disillusioned.

f. The Vice President for Product Development and Technology Management explained the VP role as providing resources to projects, not managing new projects. The result is that VPs are involved with strategy formulation to select the most promising projects for full support; they do not review projects for content or status once launched (approved for development). He went on to explain that following project approval, program management shifts to "change control and problem-solving" done best by the PM. The appointed PM is his own boss unless he seeks help.

2. **Requirements and Technical Management.**

a. Evolutionary product line development is the preferred method at BDIS over total new systems. When new systems are needed, the division uses the research department to provide "technology platforms" to prove-out new technology; this minimizes technical risk.

b. Limited design specifications are used; emphasis is on functional operational specifications and detailed planning by all functional representatives on project teams.

3. **Purchasing and Vendor Quality.**

a. The purchasing manager described the current stage of BDIS' relationship to vendors as "contractual," meaning BDIS sends "Requests for Quotes" to prequalified suppliers (only) and following evaluation, contracts for 1-2 years of requirements. He wants to keep at least two viable sources for each commodity required but tends to have only one source on line at a time for any specific part. He distinguishes this "contractual" approach from purely open bidding and does not see BDIS reverting to classical and transitory open competitive bids; it would be too expensive from an overhead standpoint, as well as unnecessary for accomplishment of objectives. His ultimate goal is to have a minimum number of multi-item quality suppliers with long-term partnership arrangements.

b. The BDIS buys piece parts, kits parts according to assembly and either contracts out assembly efforts or performs assembly organically, depending on the item. All testing is done internally, normally as part of the product integration process. Purchasing also acquires computers which are used as system controllers from DEC and HP depending on customer applications. For the $120M (1989 estimated sales) business, purchasing expends about $28M annually at present rate.

c. The purchasing manager described the tracking system implemented to attribute delivery performance and quality performance to vendor on a monthly basis. The system has been in effect only about 6 months, to date, but is already used in vendor source selection to ensure low bidders, who have not performed well, do not get more business. Purchasing provides feedback to vendors and trend charts show dramatic improvements over 1-2 month periods once these vendors realized they were being tracked. This feedback has revealed instances where BDIS procedures contributed to schedule and performance problems that were then corrected in-house. In-house requisition handling, order processing and rejected materials processing are also regularly tracked. This SPC is beginning to squeeze major problems out of the BDIS vendor purchasing system.

4. **Manufacturing and Field Service.** These functions were not directly investigated, but it was noted that FACStar was not well prepared for manufacture or field support when introduced. It was explained that neither the FACStar project team, nor anyone in the company had much manufacturing or field support know-how due to the very small product line in place prior to FACStar. These deficiencies appear to be drivers for the new formal product development system.

RESULTS ACHIEVED

The FACStar completed development and was introduced on schedule; performance trades were made to meet the desired unit price bogie; and development costs were the buffer variable to ensure other criteria were met. As of 1984, the company (BDIS) was in trouble with a very narrow product line and flat sales. Several years of research in the FACS-type systems resulted in advanced technology with a small market in medical research. The FACStar did directly result in turning the company around, which grew over 10 times (X10) in sales over a 5-year period from its introduction. The project has been a commercial success in its own right (average sales of about 100 units/year compared to 15-25 units/year of the earlier type FACS systems). It has a good margin and the reagents it uses have a significant margin, so it has had multiplied profit effects. Also, the following two major new projects, FACScan and FACStar-plus, were major successes. These successes have resulted in sufficient growth so management decided to formalize the system of project/program management. Though most aspects of the "new" system have been used during recent years, and the system has evolved, it appears it may take time for project personnel to adjust to the more formalized process. As envisioned, it does not appear that senior functional management (the VPs) will second-guess their designated participants on project teams once they participate in project go-ahead decision-making.

NEW BDIS PRODUCT DEVELOPMENT SYSTEM

The BDIS organization and staffing have grown to manage the now highly-successful business. Organizational features are:

a. The division now has four vice presidents (Customer Service, Research, Product Development and Technology Management, and Operations) plus directors for Finance and Administration, Medical and Regulatory Matters, Human Resources, Marketing and Sales, and Business Development.

b. Product development engineers are program managers. This is due to the company philosophy of technical market leadership. The hardware system PMs report through a director of new projects to the vice president, thence to the president; software PMs report directly to the vice president; the Director of Product Development Programs reports separately and directly to the vice president; her responsibilities are resource planning, priority setting, conflict resolution and overall implementation strategies. Also, she performs directly as program manager on several "crisis projects"; these projects are driven by tight schedules.

The engineering PM explained that committee management, implemented as the company progresses, could, but should not be allowed to, degrade the decisiveness of past new product decisions. The BDIS approach involves assigning one top manager to run the New Product Committee and ensure top management control.

The following are extracts from the BDIS' draft, "Program Management of Product Development Process, SOP #5152.0":

1. The new process is documented in an SOP of about 50 pages.

2. The purpose is threefold:

a. "To accelerate introduction of new products to the marketplace...."

b. "...to 'ensure' their (new products') proper operation and ability to be produced...."

c. "To provide guidelines for management of new product development, from Concept and Feasibility through Development into Manufacturing."

3. The process is conducted in three phases:

a. **Concept and Feasibility.** A product or technology idea is proposed by the champion to the New Product Committee. With minimum investment, risks and benefits are assessed and a minibusiness plan is presented to the Operating Committee for resource commitment and prioritization. The objective for the mini-business plan is that it be done quickly and without great detail; "...if the 'quick and dirty' looks attractive, detail (on cost targets, etc.) will be worth pursuing during the Development Phase." Once the operating committee decides (composition is the president, vice presidents, directors and other direct reports) the program manager is appointed. He/she has total program authority to implement development and pilot manufacture without operating committee approvals unless the business plan schedule or performance is likely to be breached.

b. **Development.** The concept is developed via the process of creating a program specification, initial design and breadboarding, construction and testing of several prototypes and refinement of prototypes. The product development specification defines as many externally measurable performance parameters as possible --those that are of key importance to the customers and for testing but not to "...describe engineering details of how that performance will be achieved." This specification, which appears to be an enhanced business plan, describes interface requirements among functional disciplines involved, plus a detailed schedule.

c. **Manufacturing.** Pilot systems are built by a joint team from development and manufacturing organizations followed by product release once the product team agrees the product is ready for production; this is done in a final design review. Manufacturing engineers complete transition to full production; field service teams develop procedures to provide support and a training and education group prepares to provide continuing education.

4. Program Manager Authority, Responsibility and Accountability: The program manager is selected from the product development organization and serves as the product authority following program approval by the Operating Committee. He/she authorizes the product specification, is the business manager and generally responsible for overall management and support of the process. He/she is assisted by the Director of Product Development Programs who operates as

an alter ego to ensure all process requirements are fully considered by the project team participants. These functional project team participants are designated project managers and they are accountable to the program manager, but have authority in their functional organization to obtain support for the project objectives.

APPENDIX H

MOBILE SUBSCRIBER EQUIPMENT CASE

PROJECT NAME: Mobile Subscriber System (MSE)

COMPANY: U.S. Army Communications Electronics Command and GTE Government Systems Division

PERSONS INTERVIEWED AND DATES:

1. Army PM and key staff members interviewed, Jan. 18, 1989:
   COL John Power, Project Manager
   Mr. Al Madnick, Deputy Project Manager
   Mr. John Waldman, Procurement Contracting Officer
   LTC Ed Wicke, Assistant Project Manager, Production
   Mr. Dave Fermaglich, Chief Program Management Division
   Mr. Dave Keatley, Deputy Project Manager, Systems and Engineering
   Mr. Cary Fishman, Chief Transmission Technical Management Division
2. The GTE and government on site representatives interviewed, Feb. 16, 1989:
   Mr. Mike O'Donnell, MSE PMO on-site representative
   MAJ Rich Allen, MSE PMO on site representative
   MAJ Turbane and staff, on site DCAS representatives
   Mr. John Betts, GTE Deputy Program Manager
   Mr. Tom Muldoon, GTE Director of Acquired Systems
   Mr. Al Dettbarn, GTE Director of Operations
   Mr. Cliff Wilson and staff, GTE Cost Accounting
   Mr. John VanDolman, GTE Engineering Manager

DESCRIPTION OF SYSTEM

The Mobile Subscriber System (MSE) project evolved from several earlier attempts to acquire a system for mobile field radio, telephone and record traffic for the U.S. Army and other Services. The MSE system provides total radio-telephone, wire telephone, and facsimile service to each U.S. Army corps and separate tactical unit. The concept for signal battalion employment is changed considerably due to use of the network elements for area coverage verses higher-to-lower headquarters connectivity. The MSE is an automatically controlled system and, as such, is simpler to operate and involves different operator and employment management skills than the systems it replaces. The MSE interfaces to, and supports a multitude of, new wire command and control systems in being and to be deployed within the corps and division areas. Also, it interfaces to combat net radio, echelons above-corps (EAC) and national communications systems.

SCOPE OF PROJECT

The MSE is a turnkey system for Army tactical communications. Once fully deployed, it will be the first time in the history of the Army that all its units, active and reserve, will have fully interoperable, encrypted, jam-resistant, mobile tactical communications equipment. The MSE is being acquired via the competed non-developmental acquisition of all signal battalion mission equipment (area coverage and system control), plus subscriber (user) access and terminal equipment (e.g., telephone, facsimile and mobile radio-telephone) for five U.S. Army corps, each with five divisions, plus separate brigades and support units. The total system is to be fielded to all Army units (active and reserve) by 1993, 8 years from the award of the production contract. The MSE

acquisition includes acquisition, integration, training, fielding, and support of the communications, shelter, prime mover, electrical power and ancillary equipment necessary for total system operation and support. The equipment requirement includes:

- --270-plus node center switches
- —50-plus large extension switches
- --1300-plus small extension switches
- —2800-plus line of sight radios
- —580-plus radio access units
- —40-plus system control centers
- —9800-plus mobile radio-telephones
- —32300-plus telephones
- --6300-plus facsimiles
- --6500-plus HMMWV trucks (more than 10 percent of the total Army fleet of HMMWV)
- --5500-plus power generators.

The FFP production contract, with all options which must be exercised to achieve the above deployment, has a baseline price of $4.3B and will be effective for 7 years (including a last year to provide for additional quantities should the force structure change). A time and materials contract exists for follow-on replenishment spares, contractor maintenance support, contractor training, installation kits, and technical assistance for up to 22 years (15 years following last production deliveries). An FFP time and materials contract exists for post-deployment software support for the life of the system (15 years following last production delivery). All three contracts were competed, evaluated and priced together.

In 1982, Mr. James Ambrose, the U.S. Army Acquisition Executive (AAE) and Under Secretary of the Army (USA) directed that CECOM acquire MSE as a total package using commercial practices and to acquire an available off-the-shelf system versus development of a full-MIL system. The CECOM solicited industry in 1984 and obtained two proposals; evaluation was completed in 1985 and production contract awarded in 1QFY86. The Army submitted the MSE project to the Congress as one of the Defense Enterprise Programs (DEP) in 1987 IAW Title 10 US Code Sections 2436 and 2437. The DEP designation carried with it the milestoning mechanism to ensure program funding would be as planned if cost, schedule and performance requirements were met. Also, the DEP designation would provide the PM with required manning and support and freedom from counterproductive regulations, policy, directives, etc. The GTE Government Systems Division built a new plant at Taunton, Mass., dedicated to the assembling, integrating and testing MSE shelterized equipment; it is in full operation. The MSE subsystems are assembled, tested and delivered to the Army at field locations in "division slice" increments of about 80 shelters; no full system testing (i.e., division complement) was done prior to follow-on test and evaluation (FOTE) at Fort Hood, Texas (the IOC unit).

ACQUISITION MANAGEMENT TECHNIQUES EMPLOYED

Attachment 1 outlines the most significant elements of the unique MSE acquisition strategy. Attachment 2 provides the unique elements of the solicitation for production and support offers.

1. **Program/Project Management.**

a. The Army and GTE program offices are organized similarly, that is, as a matrix where the organic program offices are small and the bulk of assigned personnel are matrixed from other functional directorates or external organizations. The head of the project at GTE is a division vice president, four levels removed from the corporate chairman; the Army PM is four levels removed from the SECDEF. Following production contract award, the Army management structure changed to the PEO approach as implemented by the Army. Before the change, the PM reported to Commander, CECOM, then to Commander AMC, then to the Secretary of the Army. Following the change, the PM reported to the PEO, Communications Systems, then to the Under Secretary of the Army, then to the Secretary of the Army. One of the key strengths of the management effort was the independent assessment of the program, conducted from the time of the production award through 1987, by retired LTG Robert Berquist, for the AMC Commander. This ongoing assessment, with quarterly updates to the four star level, highlighted critical problems, posed solutions and helped keep the project on track.

b. *No MS1, MS2, or MS3 ASARC/DSARC.* An ASARC was held in 1979 which approved

entry into FSED. Following program redirection, MS1 and MS3 were documented as a result of Secretary of the Army decisions made during decision briefs; MS2 is not applicable to NDI projects. The type classification action (finding of suitability for Service use) was made as part of the evaluation/source selection.

c. Waivers to acquisition policy and regulations. Mr. Ambrose signed a letter to the PM waiving all but statutory FAR provisions. The waiver to FAR and other policy provisions desired were:

1) To eliminate progress payments

2) To allow the production contract to extend over 7-years of new obligations

3) To obtain a warranty of design and performance

4) To allow for economic price adjustments

5) To provide special economic acquisition provision which required the contractor to spend at least a specified percentage of the contract price in the United States

6) To allow the government to breakout selected spare parts if in the government's best interest

7) A currency fluctuation protection provision

8) To allow assembly and acceptance testing of full configurations at field staging/delivery sites.

No subsequent DA, AMC or CECOM documentation was generated to establish which policy or regulations were to be waived. The PM has established, however, that the intent of all such policy/regs is required of MSE and MSE must complete the requirements even though some occur later in the project than may be typical in standard acquisition strategies.

d. Despite DEP designation, the PM asserted that no special authority has been granted to him. He is still involved with justifying matrix personnel retention, travel funding, etc., and the decision-making authority for cost, schedule and performance trades is at Secretary of the Army level. The PM's job remains to ensure delivery of a fully acceptable system, on schedule and within budget. With respect to funding, the DEP program designation was subsequent to the MSE production award and first 2 years of performance. Funding has been stable subce FY87, due to the unique nature of the scope of the program and the production contract provisions for stable funding and timely option awards. Relevant aspects of early funding for production are:

1) The Congress cut the required FY85 funding by 50 percent and threatened to do the same for FY86. Strong top-level Army support via congressional testimony kept the FY86 program fully funded.

2) The Congress required they be provided the details of the specific equipment to be included in the program, the associated testing results of that equipment, and the proposed funding schedule prior to the obligation of any production funding.

3) Key elements of the MSE acquisition strategy which appeared to support full funding with the Congress were:

—Recognition that MSE must be fully deployed before Army units could fully interoperate and before they could integrate the benefits of many follow-on user command and control systems

—The production contract provided for automatic termination should year 2-7 options not be exercised within 90 days of funds availability to the PCO

—Funding by contract year must cover 100 percent of previously negotiated quantities.

4) Congressional negotiations were critical due to the lack of schedule flexibility in single-year appropriations to otherwise plan for efficient production runs and the lack of schedule slack in the follow-on test and evaluation (FOTE) program upon which obligation of FY88-and-beyond funds were tied. Due to the relatively small funding in the first year (FY85), a waiver to FAR was approved allowing the contractor to proceed even though second-year funding had not yet been provided. This second-year funding was essential to create the minimum set of equipment and software and support needed to conduct FOTE in FY88. Mr. Ambrose concisely summed up the situation in justifying the waiver to the full funding policy to the ASD(C) as follows:

"This is an exceptional case...because the program only makes sense if we and the Congress agree to buy the whole program. I think we should recognize, therefore, that we shouldn't get caught up in rules and procedures that are designed for completely different acquisition methods."

5) In 1987, the Congress put a cap of $4.3B on the total MSE production program and effectively fully funded the program through 1990 contingent on continued proper execution.

e. The Army PM's relationship with the Prime Contractor's PM (GTE, Taunton, Mass.) is considered cooperative and frequently informal. This is due to the absence of many of the CDRL requirements for status reports normally associated with Army procurements. The contract formalized only two management tracking requirements:

--Semiannual cost expenditure reports

—Agendas and minutes of formal program reviews (quarterly).

The Army PM describes the relationship as one in which his staff assists the contractor to anticipate problems and to propose appropriate actions to preclude or minimize the impact of such problems. He indicated that the strategy was quite effective and, in fact, has been essential in keeping the project within the milestone constraints of his DEP contract with the Congress.

f. The GTE conducts interdivisional coordination meetings weekly; the Army on-site representatives attend; this is one of two informal status oversight means for the Army PM. The other is Army PMO direct access to the GTE management data base system. In addition, there are monthly status reviews between the Army PM and GTE's MSE Division VP. Quarterly, GTE submits and briefs a project status laydown to the PM thence to the Program Executive Officer and Army Under Secretary. There has been concern by GTE that the government is micromanaging the project but the current (Feb 89) atmosphere is good.

g. The AMC commander observed in December 1986 (1 year after initial contract award) "MSE has always been touted as a program that was not to be conducted in the business as usual mode." His comment punctuated the direction to CECOM to ensure the program got all the personnel it required and quickly. The CECOM was at the time beginning to evolve a "core/matrix" staffing plan which reduced the PM core to about 27 personnel and CECOM functional directorates were to provide other matrix personnel, as negotiated between the PM and the functional Directors in CECOM. This was about a year before the Army PEO concept was implemented.

2. System Engineering Management

a. Priorities for the MSE acquisition were satisfactory performance at absolutely least cost and absolutely on time. The system engineering effort was to define and integrate the operational requirement and the supporting "ilities." Clear direction was made at the top (AAE) that the system would be acquired off the shelf with no development. Major "user" and "developer" cooperation was mandated to get the "nice to haves" out of the minimum requirement and to ensure against requirements creep. Such direction and thorough execution protected the fixed-price bottom line; in addition, all ECPs/VECPs, in order to be considered, must be implementable within the original contract price. There were substantial modifications required to the demonstration system to become the negotiated MSE system; these included integration of demonstration software into the baseline; repackaging components into smaller, lighter vehicles; and modifications to the radio frequency bands required. Many unique acquisition strategy elements resulted in difficult negotiations with the functional experts in the special interest agencies of the government (e.g., OTEA, NSA, and U.S. Army Signal Center); virtually all of these had to be resolved at the Major General level even after the rather clear direction of the U.S. Army.

b. The MSE project involves no GFE; All equipment and data required to support the MSE configurations are the prime contractor's responsibility to acquire and deliver (e.g., HMMWV, power units, air conditioners, shelters).

c. No military specifications were used in the RFP; the system requirement is defined in the MSE Operational Capabilities Document, an eight-page narrative of mandatory capabilities and desired

(not essential) capabilities which defined the technical and interface requirements for the competed solicitation and against which the proposals were evaluated subjectively. Evaluators compared offered systems against minimum operational requirements, highly desirable features, and "nice to haves," then established any modifications which might be required to the off-the-shelf systems offered. The MSE production contract fully satisfies all five minimum required operational capabilities, all mandatory enhancements in the form of priced technical options, and 55 of 69 desired features. The selected offeror's product specifications are now part of the production contract; some of these are military specifications. A P3I program is envisioned to selectively add features once the basic system is fully deployed.

d. Systems testing was done substantially different from normal Army procedure due to the NDI nature of the project. There was considerable concern about the test program in that the required system was never tested as a full corps or division system prior to FOTE. The risk was that the system, as modified for the Army, would not satisfy operational requirements and too much equipment would have been produced by the time a full operational test was possible to correct any deficiencies. Integration and testing was similar in approach to a commercial MIS system, which is not usually totally integrated and tested prior to delivery to the customer location. The MSE test program was described as "continuous evaluation" and was composed of four phases:

1) Prior to production award—consisted of offerors submitting test plans and procedures; operational demonstrations of each proposed system in Europe in the field; and evaluation by the Evaluation Board augmented by OTEA, Signal Center and Army Communications Command personnel.

2) During production lead time—consisted of initial production tests at each subcontractor and prime contractor location witnessed by the government; as equipment and subsystems were built-up and integrated, contractor reliability tests and government product assurance tests.

3) Initial acceptance and fielding—consisted of destination final acceptance tests; unit training and a field training exercise to prepare the gaining units for follow-on testing.

4) Follow-on test and evaluation(FOTE); system reviews and sample data collections. The FOTE was directed by OTEA and involved a full division field training exercise using a complete division set of MSE. Only Army soldiers employed, operated and maintained (unit level) the system. Corps level testing features were simulated by loading the division system with external traffic requirements

e. The goal of the test program was to reduce formal testing time without losing comprehensive data required for a valid assessment of the system's operational effectiveness. A major innovation used to plan and execute the test program was the establishment of dedicated "MSE Test Platoon" composed of 32 senior NCOs and 3 officers. This platoon gathered lessons learned from the French and British experience in testing RITA and Ptarmigan (similar systems to MSE); they were also responsible for monitoring preproduction item testing at GTE and the subcontractors; monitoring the 33 OTEA test items (issues) during source selection/evaluation and planning FOTE.

f. Two major complications for the testing were:

—There was no standard Army corps communications system of similar capability against which MSE could be comparatively evaluated

—The MSE was the first of a set of Army Tactical Command and Control Systems so there was no capability to operationally test the interoperability with those systems.

g. Configuration management has been of critical importance due to the presence of four technical baselines from soon after contract award. There was a requirement baseline in the solicitation; a demonstrated baseline; a contract baseline; and a modified demonstrated baseline, all of which had to be driven toward one baseline as specific definition was developed after award. It was noted that, in 1986, GTE decided to implement several ECPs "at risk" pending government approval. This potential problem was corrected during 1987 and appears to remain under control.

3. **Logistics**

a. The maintenance concept calls for military maintenance at the operator/organizational and forward direct support (divisional) levels and contractor support at the theater (in-country and depot levels. Following last production deliveries, about 1993, GTE will be responsible for 15 years to provide the GS/depot support.

1) The GTE provides depot level maintenance and spares for the operational life of MSE. The program negotiated firm fixed prices for the entire 22-year projected life of the system. However, some of the FF prices reflect a large margin for contingency (e.g., items potentially going out of production). The PCO and GTE plan to renegotiate some of the out-year prices to reduce uncertainty by reflecting one price for items still in production and another should they be out of production. This latter effort is complicated by the lack of audited cost data as a result of the method of source selection used (see Procurement section below).

2) Many MSE components are standard military items of supply which will derive support through standard Army channels. The divergence of support channels and sustaining engineering/production for the standard items versus the MSE peculiar items may be a problem area as time goes on.

b. The contract does not provide much of the CDRL data normally required; rather, data in contractor format or in contractor data bases is made available to government logistics managers. This requires a more flexible attitude by the government team than normal, much more in-depth knowledge of requirements and the MSE system, and considerable travel.

c. The principle issues coming out of FOTE are logistics. Specifically, new equipment training was found to be insufficient; the biggest issues in training were focused at the first- and second-line leadership levels and network control. A second training related issue was the trade-off between use of off-the-shelf applications software which was not particularly user-friendly and the need for greater sustainment training for network controllers. Increased on-board spares and user aids also appeared necessary. Many of these issues are being corrected within the existing contract scope and some will be handled through future enhancements; e.g., the P3I process.

d. Logistics implementation required a Herculean effort by government and contractor personnel. This was due to the significant departure of MSE from the traditional logistics approach wherein LSAR is provided and the development process can be employed to provide time to develop logistics at a more leisurely pace. The need to totally revamp the personnel skills, recruitment and training for the tactical Signal Corps was a principle complicating factor.

4. **Procurement**

a. The source selection process shaped the MSE system (e.g., equipment configurations, testing, acceptance, support and training) in ways beyond the traditional purpose for evaluations; as a result, the PM had to have considerable influence in the evaluation board proceedings. For the prime contract, simultaneous negotiations, with demonstrations, permitted direct government involvement with each offeror to ensure each provided a "best operational system" to be priced. The procurement plan established that only total systems which had been designed, developed and tested could be offered (and principle components had to have completed development; special modifications were permitted). It went on to require a subjective evaluation of offered systems that satisfy the operational baseline but might have different characteristics, to determine which offered the "best value" to the government. It was possible that no system would provide all required and all desired features. Virtually everything was open to negotiation including all terms and conditions. This led to the evaluation board assuming additional effort, in that it created detailed unique model contracts for each offeror before requesting best and final offers; this required the evaluation board to understand each system offered to an uncommon degree.

1) There was significant opportunity for technical leveling due to the negotiation method used; however, that did not appear to be a significant problem due to the control and coordination exercised by the PCO.

2) The PCO required cost and pricing data to be submitted with the initial proposals; however, they were later determined unnecessary.

Thus cost and pricing data were not updated for best and final offers. This is unique for such a large contracted effort and has caused some problems in evaluating ECPs/VECPs, due to lack of visibility into GTE's cost structure. The impact, to date, has been that the source selection process was about 3-6 months shorter than it would have been otherwise. Offerors' budgetary cost estimates were used to perform a preliminary evaluation, a "commercial practice" approved by the Army General Counsel. The final evaluation was based on each offeror's best and final firm fixed price offer; as well it was decided that no audit of price proposals was to be accomplished.

b. The GTE has a separate directorate to manage subcontracts (there are 29 major subcontracts plus many vendor components in the MSE contract). The GTE uses a mini-project team to manage each subcontractor; a separate directorate administered contracts. A just in time (JIT) approach to subcontractor and vendor deliveries is in place for some components and is expanding. It is GTE policy to maximize competition where it can exist but reserve critical components to be made in-house; a second source is retained where practical to maintain competitive pressure. Buys are split annually and GTE will pay a higher price to keep the second source "warm."

c. The MSE program may be the largest ever bought primarily from foreign sources; it involved a "shoot-off" between the United Kingdom and France and, due to the outcome, there was direct pressure at the head-of-state level to influence the outcome after the selection had been made. As a result of agreements outside the scope of the MSE program, the evaluation board results and the Army selection were supported by the Administration.

5. **Financial Planning and Execution**

a. The system enjoyed the highest of budget priority in the Army which has permitted a rational execution plan to be developed and implemented. If there is continued support from the Congress through sustained funding, the program should be successful. The contracts are structured to discourage reduced funding/stretchout as costs would increase significantly and system utility would be jeopardized should full fielding not take place on a firm schedule.

b. The GTE has limited financial reporting requirements under the MSE contract. They do comply with CAS, but it wasn't clear if that was a corporate requirement or due to the desire to be able to qualify easily for future government business. Also they felt it was important to have consistent cost accounting throughout the corporation.

6. **Production Management**

The production management effort appears similar to other government programs. However, the subcontracted effort is high (65-70 percent) and may provide some unique lessons for other such cases. The in-house production effort is predominantly that of assembly and test of components through the integration and preacceptance testing of 17 different type shelter configurations making up the signal corps assets (to distinguish from the user terminals which are integrated into existing user vehicles following delivery). The GTE designed, approved and built a dedicated production facility in Taunton, Mass., to optimize the program. The facility produces four shelters per day, one division's worth (80) per month. A production team is assigned to integrate and test all of a subset of the 17 different shelters. This approach results in a high degree of worker accountability and ownership which is not customary with production line techniques. The GTE would not have invested in the new facility had not the Army provided top-level assurance that the full production quantity would be bought. The plant will be paid for before the 7-year production program ends.

7. **Quality Program.** The GTE works to MIL-Q quality standards with DCAS monitoring despite no existing formally required MIL-Q program. This appears to have been decided by GTE because of the strength of the system in ensuring all tasks are done properly and documented. However, shelters leaving the Taunton plant do not have DD250 final acceptance; rather they are checked by DCAS and so documented, sent to the field delivery site where they are assembled to the vehicles and ancillary equipment and sent through final test and acceptance.

RESULTS ACHIEVED

To date, the project execution remains within DEP

milestone constraints, fully funded, and has successfully completed fielding and follow-on test and evaluation (FOTE) by the 1st Cavalry Division at Ft. Hood, Texas. The FY85 basic contract and options for years FY86-88 have been awarded on schedule. This is even more significant in view of the reduction in real procurement funding for the Army during the past 3 years and the ramp-up of MSE program funding required over the same period. Savings to the Doa are estimated as:

—$500M RDTE, due to NDI basic system

—$1.5B RDTE, plus PA due to acquisition approach and scope of competed effort

—$8B total life-cycle costs, due to up-front competition for life-cycle support

—5000-7000 military personnel, due to simplicity of employment, operation and maintenance.

Operational benefits anticipated as deployment continues are summed up by the evaluation French Signal Officers made of the RITA system (heart of the MSE system) and which is fully deployed by the French Army: "Communications were no longer a limiting factor for the combat arms." The Commander of U.S. Army TROSCOM summed up the impact of the schedule objectives of MSE on the acquisition process to make it succeed:

> "Given the short time, there was no way business as usual would get the job done."

The MSE Acquisition Strategy Elements

The following were outlined by the CECOM Commander in October 1983, following Mr. Ambrose's direction that the system would be acquired without development, using off-the-shelf equipment and software, and as a total turnkey system. "*" indicates those elements which were later changed. The change process was a steady analysis and negotiational effort by all elements of any large acquisition team. The U.S. Army's interest and involvement were instrumental in limiting substantial change to the initial NDI strategy.

*1. No restriction to manufacture outside the United States. (This was changed via requirement to negotiate a minimum percent of contract funds to be spent in the United States.)

2. Industry was required to demonstrate a production system to qualify for the competition.

3. No competitive reprocurement data to be acquired.

4. No proprietary data to be purchased.

5. Contractor to perform life-cycle depot and in-theater special repair maintenance.

6. No built-in-test requirement.

7. No optimal repair level analysis (ORLA) requirement.

8. No government maintenance equipment or test software requirement.

*9. Commercial manuals are acceptable for operator and organizational level maintenance. (Now military format manuals.)

10. Contractor to provide post deployment software support for life of system.

*11. No frequency spectrum limitations. (Critical modification to of-the-shelf equipment accomplished.)

12. No low-level nuclear detonation protection required.

13. Foreign shelters, vehicles, and power units allowed. [GTE bid the full use of standard U.S. Army shelters, vehicles, and power units.]

*14. No interface requirements (NATO, TRI-TAC, existing Army systems). (These are to be provided via priced options beyond the interfaces provided with the GTE/RITA system as demonstrated.)

15. No parts control program.

16. Mixed contractor/government configuration control based on impact to maintenance significant spare parts.

17. No TEMPEST requirements.

18. No producibility engineering analysis program required.

19. No change to contractor software language or documentation required.

20. No formal safety program required; though some safety analysis was.

21. The C-130 transportability not required. [GTE system provides for C-130 transportability.]

22. No independent government testing prior to production.

23. No validation/verification of security penetrability of software.

24. Contractor to provide initial training of operators and organizational maintenance personnel.

The MSE Production Solicitation Features

The following unique features are key to executing the acquisition strategy negotiated within the U.S. Army. The offeror was to provide:

1. Description of test plans and criteria for government acceptance of systems, equipment, and spare parts.

2. Description of method of providing maintenance and supply support at all echelons above unit level.

3. Description of means of assuring availability of spare parts "of satisfactory quality and at a reasonable cost" during the 15 years following the last production delivery.

4. Description of method for providing operator and maintainer training during the lifetime of the system.

5. Description of means to accomplish fielding, new equipment training to active and reserve personnel and in the Army schools.

6. Description of joint Army/GTE configuration management approach to support logistics requirements.

7. Post-deployment software support for the system lifetime.

8. Strategy to ensure that more than 50 percent of the total contract cost was spent in the United States.

9. Mandatory priced options for the following performance features not necessarily available in the as-is equipment demonstrated: interfaces to satellite, digital systems, TRI-TAC system (system for above Corps level communications), net radio and commercial or national communications systems.