AD-A090 146 DEFENSE SYSTEMS MANAGEMENT COLL FORT BELVOIR VA F/G 5/1
DEFENSE SYSTEMS MANAGEMENT REVIEW, VOLUME 3, NUMBER 3, SUMMER 1--ETC(U)
1980

UNCLASSIFIED NL

1 OF 2
AD
A090146

[illegible] III

AD A090146

SUMMER 1980
VOLUME 3
NUMBER 3

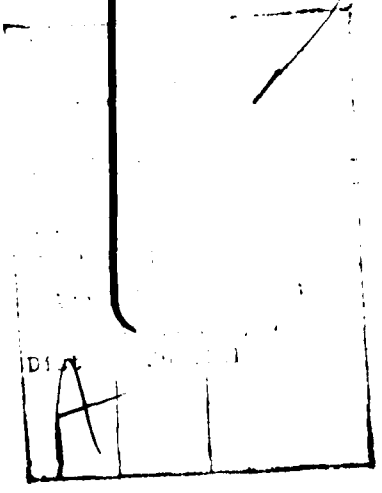
DEFENSE SYSTEMS MANAGEMENT REVIEW

(b)

Vol ... Numbers ...
Su... ... Tuning of
th... D... A...quisiti...
...

(11) 1981

(12) ...



SUMMER 1980
VOLUME 3
NUMBER 3

DEFENSE SYSTEMS MANAGEMENT REVIEW

Maturing of the DOD Acquisition Process

from the editor...

Each year, the Defense Systems Management College graduates more than 300 students from its Program Management Course. This is the longest and most demanding course offered by the College, and its students represent a cross section of the acquisition community. They come here to learn, obviously, using the resources of the College. But, just as important to the College and to everyone in the acquisition business, they are, in themselves, an educational resource. Collectively, the students in the Program Management Course represent years of hard-earned experience in various aspects of acquisition management. The College administration does everything possible to tap that experience and use it to further the College mission of acquisition management education.

What does this have to do with the Defense Systems Management Review*? Plenty. The Autumn 1980* Review *will contain a number of short papers prepared by students of Program Management Course Class 80-1 dealing with program funds management. The Winter 1981 issue, which will be heavily weighted toward cost estimating and cost analysis, will have a number of student papers on that topic. If it works, we anticipate continuing this kind of student involvement in the DSMC publications program indefinitely. This will give the students the opportunity to really think about and analyze an issue or problem, and it will give the* Review *readership the opportunity to benefit from the results of that thought and analysis.*

In the meantime, we still welcome papers from any of you out there with something useful to say about this business of systems development and acquisition. You can call us to talk about it, or just submit your paper without prior contact. Either way, we'd like to hear from you.

7 The Maturing of the DOD Acquisition Process

David D. Acker

The United States is approaching a crossroads. As a nation, we have a choice to make. We can choose to continue our role of responsible leadership in the community of nations in the free world, or we can choose to abdicate that role. Our survival will depend in large measure upon maintenance of a credible military and economic posture and—perhaps even more importantly—our ability to marshall defense resources in a timely manner to meet any enemy threat. Secretary of Defense Harold Brown recently said, "We must decide now whether we intend to remain the strongest nation in the world. The alternative is to let ourselves slip into inferiority, into a position of weakness . . . and to become a nation with more of a past than a future."

History has graphically and repeatedly taught us that it is folly to depend solely upon treaties and arms limitations for our security. We must continue to have well-trained and disciplined troops, adequately armed and supported, positioned at strategic locations throughout the free world. To ensure these troops are provided with first-class defense (weapon) systems, we must continue the effective government and industry working relationship in the environment of mutual respect and trust that has prevailed since World War II.

Author's note: I want to express my appreciation to the many people both within and outside the government who reviewed and commented on this paper during its early stages of preparation. Many of their comments and recommendations are reflected in the final version. My special thanks go to Mr. John H. Richardson, President of Hughes Aircraft Company, who reviewed this work and pointed up a significant problem in acquisition. He said: "Your draft on the defense acquisition process over the last 30 years is indeed a monumental effort. It is especially interesting to look back over this time period that represents the working period for many of us since World War II. In retrospect, we have produced a great number of highly effective weapon systems with varying degrees of efficiency. However, the bureaucracy has grown at such a rate, it is not surprising that costs are increasing and the time to deploy effective military hardware has increased by a factor of two or three. I am concerned that our approach has been to institutionalize to solve the problems rather than to give the industry and military program managers the responsibility and authority to carry out their assigned tasks as efficiently as possible. I think your paper highlights this problem and provides the visibility necessary if it is ever to be resolved."

David D. Acker is Professor of Management and Senior Advisor at the Defense Systems Management College. Prior to joining DSMC, he was assigned for 3 years to the Office of the Director, Defense Research and Engineering, where one of his responsibilities was the development, coordination, and communication of policy associated with major defense systems acquisition. Mr. Acker spent 23 years in industry in design engineering, project engineering, and program management associated with Air Force, Navy, and Army contracts. He has taught engineering and management courses at Rutgers University, VPI, and UCLA, and is the author of numerous articles on management, design, and communications. Mr. Acker holds B.S. and M.S. degrees in mechanical engineering from Rutgers University.

Introduction

The basic objective of our defense spending is preparedness, not the prosecution of hostilities. In this environment, the maintenance and upgrading of current defense systems, as well as procurement of major new defense systems, represent a significant activity of, and cost to, the Department of Defense (DOD). Threats stemming from different political philosophies in the international arena, and the constant pressure to contain costs, have resulted in increased attention being placed on the defense systems acquisition process—a process that depends upon a close working relationship between DOD and industry.

During World War II, the government-industry teamwork enabled this nation to become the "arsenal of democracy." We fulfilled our requirements for defense systems in a profit-motivated, free-enterprise environment. We must continue to do so in the decade of the 1980s.

President Dwight D. Eisenhower, in his farewell address to the nation in January 1961, pointed out that the United States was facing a hostile ideology; therefore, our military establishment provides a "vital element in keeping the peace. . . . Our arms must be mighty, ready for instant action, so that no potential aggressor may be tempted to risk his own destruction." We are still facing a hostile environment. Therefore, in the 1980s we cannot risk emergency improvisations for national defense.

The United States didn't really have "an armament (defense) industry" until after the Korean conflict, Eisenhower explained. In previous wars this country had been able to convert from the production of "plowshares" to "swords" in time to meet any national emergency. At the start of the 1960s, Eisenhower found this approach to be no longer viable. A return to the plowshares to swords approach would have been unwise because of the growing technical complexity of our defense systems and equipment; the long lead times required for design, development, production, and testing; and the attendant increased costs of defense systems. If the United States had returned to the *in extremis* approach to national defense, it would have left our country vulnerable to would-be aggressors.

Eisenhower also conveyed another concern when he said that "in the councils of government we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex." The concern that Eisenhower expressed was shared by citizens both in and out of government. It was the concern of these people that a community of interests might be developing that could influence the magnitude and direction of our domestic and foreign policies. Included in this community—the military-industrial complex—were corporation executives, military officers, civilian bureaucrats, congressmen, and others. At the center of the community was the unique relation-

ship between DOD—the customer—and the companies within defense industry—the contractors. Some patriotic citizens went so far as to say that we had progressed from an arsenal of democracy to a military-industrial complex composed of a group of people concerned only with their own interests and welfare.

The question that required an answer in the early 1960s was this: Are the government and industry keeping each other in check, or are they acting in concert to reinforce one another? In other words, would the DOD-industry teams coalesce to the point that they would be free to operate without constraint? Were this to happen, the traditional balance normally maintained by our political system would be jeopardized. The answer, of course, was—and still is—that the traditional checks and balances will remain intact.

The Concept of Program Management

During the 1950s and 1960s, the concept of program management—the business and technical management of selected tasks using a centralized management authority—evolved from the need for an organized approach to managing the defense systems acquisition process. This process consists of a complex cycle that commences with identification of a need and the conception of a system to satisfy the need. The cycle ends—following deployment (and possible modification) of the system—with the retirement of the system from the inventory, or the expenditure of the system in service, as in the case of an air-to-air missile. A program—for purposes of this article—may be considered as an aggregation of controlled, time-phased events designed to accomplish a definite objective. Often a program involves a pyramid of contractually interrelated government, contractor, subcontractor, and supplier organizations for long periods of time. In this complex environment, the performance of any one organization can affect the others. Procurement methods and practices present a formidable challenge to the government-industry teams established to manage programs. Experience gained since the Korean conflict indicates that successful completion of a defense system program depends not only on the contractual environment, but also upon an understanding and proper application of a number of management systems developed by both DOD and industry.

Beginning in the late 1950s, the framework for program management—as we know it today— was established by the Air Force Systems Command in a series of regulations popularly referred to as the "375 series." These regulations and the accompanying manuals originated in missile/space programs, where failure could not be tolerated, and went into detail as to how systems acquisition should be managed from formulation of a system concept until "phase-out."

As program offices for managing the systems acquisition process were organized through the services, the nature of the offices took a variety of forms.

Some offices were highly integrated and self-supporting; some were of a matrix type; others were highly staffed and dependent upon a permanent functional staff for their support. The concept of a program office to manage the development and production of a system has been proved sound; however, some offices have been hampered in their activities by management layers, either by the service involved, or by their own functional and/or supporting staffs, or by both.

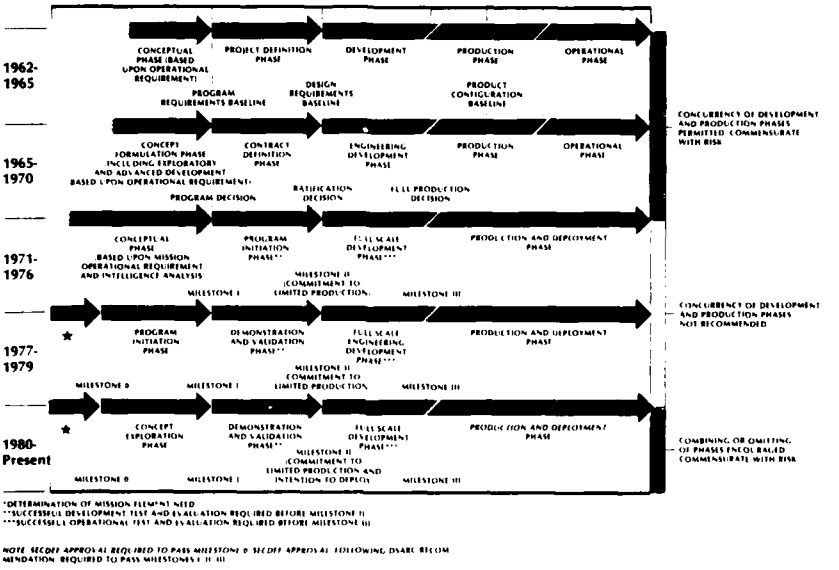
Every program, regardless of its size or the nature of the defense system involved, exhibits certain features in common with other programs. For example, a program generally contains five[1] distinct phases in its life cycle: (a) exploration and development of alternative defense system concepts based upon a recognized mission element need; (b) demonstration and validation of selected alternative concepts; (c) design, development, limited production, test, and evaluation; (d) production; and (e) service deployment, operation, and operational support of the defense system. The fifth phase may also include product improvements, both planned and unplanned. Within each phase there are discrete and specific events that must occur before the program advances to the next phase. The program life cycle represents a meaningful and understandable framework into which virtually every action, event, document, responsibility, and authority bearing upon the management of the program can be fitted. Figure 1 depicts the evolution of the major defense system acquisition life cycle over the years.

When the contract for a program is negotiated and signed, it represents—in an implied sense—a partnership agreement between the customer and the contractor. By awarding the contract, the customer does not relinquish responsibility for program performance; therefore, the customer must know how the contractor is managing the program. For example, the contractor's organization is of concern to the customer, but to a lesser degree than the operation of his system for planning, scheduling, and controlling of the program effort. The contractor's system for allocating resources, authorizing work, and evaluating its own and subcontractor performance are vital customer concerns.

National security objectives provide the guidelines for initiation of new defense systems programs and the continuation or deletion of existing programs. These objectives are derived from many sources: presidential statements; National Security Council deliberations; intelligence reports and estimates; and national and international political, economic, military, and social factors. Table I provides a framework and a point of reference for the discussion that follows. The table identifies the Presidents, Secretaries of State, and the DOD principals (the Secretaries and Deputy Secretaries of Defense, the Directors of Defense

1. The production and deployment phases are often combined into a single phase.

FIGURE 1
Evolution of the Major Defense Systems Life Cycle



Research and Engineering, and the Secretaries of the Army, Navy, and Air Force) who, over the past three decades, have influenced the national security policy and the defense (weapon) system acquisition process.

In the interest of brevity, the table does not include the members of several other groups who have had an impact on, and made contributions to, the plans, programs, and budgets of the DOD. Within DOD, these groups include those distinguished individuals who have served as the Chairmen of the Joint Chiefs of Staff; the Assistant Secretaries of Defense (Program Analysis and Evaluation), (Comptroller), (Installations and Logistics), (Manpower), (Command, Control, Communications, and Intelligence); the Assistant Secretaries of the services; and the Joint Logistics Commanders. Outside DOD, there are many dedicated leaders who have served as Directors of the Office of Management and Budget (OMB)—formerly the Bureau of the Budget—chairmen of congressional committees interfacing with DOD, and defense industry executives.

Now, let's examine how the process of defense systems acquisition has matured and how it has been affected by the changing management philosophies for conducting the business of DOD throughout the past three decades.

TABLE I
Presidents, Secretaries of State, and DOD Principals (1949–1980)

	PRESIDENT	SECRETARY OF STATE	SECRETARY OF DEFENSE	DEPUTY SECRETARY OF DEFENSE
1949	HARRY S TRUMAN	GEORGE C MARSHALL DEAN C ACHESON	JAMES V FORRESTAL LOUIS A JOHNSON	STEPHEN T EARLY
1950	↓	↓	LOUIS A JOHNSON GEORGE C MARSHALL	STEPHEN T EARLY ROBERT A LOVETT
1951	↓	↓	GEORGE C MARSHALL ROBERT A LOVETT	ROBERT A LOVETT WILLIAM C FOSTER
1952	HARRY S TRUMAN	DEAN C ACHESON	ROBERT A LOVETT	WILLIAM C FOSTER
1953	DWIGHT D EISENHOWER	JOHN F DULLES	CHARLES E WILSON	ROGER M KYES
1954	↓	↓	↓	ROGER M KYES ROBERT B ANDERSON
1955	↓	↓	↓	ROBERT B ANDERSON R B ROBERTSON JR
1956	↓	↓	↓	↓
1957	↓	↓	CHARLES E WILSON NEIL H McELROY	R B ROBERTSON JR DONALD A QUARLES
1958	↓	↓	↓	↓
1959	↓	JOHN F DULLES CHRISTIAN A HERTER	NEIL H McELROY THOMAS S GATES JR	DONALD A QUARLES THOMAS S GATES JR JAMES H DOUGLAS JR
1960	DWIGHT D EISENHOWER	CHRISTIAN A HERTER	THOMAS S GATES JR	JAMES H DOUGLAS JR
1961	JOHN F KENNEDY	DEAN RUSK	ROBT S McNAMARA	ROSWELL L GILPATRIC
1962	↓	↓	↓	↓
1963	JOHN F KENNEDY LYNDON B JOHNSON	↓	↓	↓
1964	↓	↓	↓	ROSWELL L GILPATRIC CYRUS R VANCE
1965	↓	↓	↓	↓
1966	↓	↓	↓	↓
1967	↓	↓	↓	CYRUS R VANCE PAUL H NITZE
1968	LYNDON B JOHNSON	DEAN RUSK	ROBT S McNAMARA CLARK M CLIFFORD	PAUL H NITZE
1969	RICHARD M NIXON	WM P ROGERS	MELVIN R LAIRD	DAVID PACKARD
1970	↓	↓	↓	↓
1971	↓	↓	↓	DAVID PACKARD
1972	↓	↓	↓	KENNETH RUSH
1973	↓	WM P ROGERS HENRY A KISSINGER	MELVIN R LAIRD ELLIOT L RICHARDSON J R SCHLESINGER	KENNETH RUSH WM P CLEMENTS
1974	RICHARD M NIXON GERALD R FORD	↓	↓	↓
1975	GERALD R FORD	↓	J R SCHLESINGER DONALD H RUMSFELD	↓
1976	↓	HENRY A KISSINGER	DONALD H RUMSFELD	WM P CLEMENTS
1977	JAMES E CARTER	CYRUS R VANCE	HAROLD BROWN	CHAS W DUNCAN JR
1978	↓	↓	↓	↓
1979	↓	↓	↓	CHAS W DUNCAN JR W G CLAYTOR JR
1980	JAMES E CARTER	CYRUS R VANCE EDMUND S MUSKIE	HAROLD BROWN	W G CLAYTOR JR

* POSITION REDESIGNATED UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING (21 OCT ''

DIRECTOR * DEFENSE RESEARCH AND ENGINEERING	SECRETARY OF THE ARMY	SECRETARY OF THE NAVY	SECRETARY OF THE AIR FORCE	
THIS POSITION WAS NOT ESTABLISHED UNTIL PASSAGE OF THE DOD *REORGANIZATION ACT* OF 1958 6 AUG 58	KENNETH C ROYALL GORDON GRAY	JOHN L SULLIVAN FRANCIS P MATTHEWS	W STUART SYMINGTON	1949
	GORDON GRAY FRANK PACE JR	↓	W STUART SYMINGTON THOMAS K FINLETTER	1950
	↓	FRANCIS P MATTHEWS DAN A KIMBALL	↓	1951
	FRANK PACE JR	DAN A KIMBALL	THOMAS K FINLETTER	1952
	ROBT T STEVENS	ROBT B ANDERSON	HAROLD E TALBOTT	1953
	↓	ROBT B ANDERSON CHARLES S THOMAS	↓	1954
	WILBER M BRUCKER	↓	HAROLD E TALBOTT DONALD A QUARLES	1955
	↓	↓	↓	1956
	↓	CHARLES S THOMAS THOMAS S GATES JR	DONALD A QUARLES JAMES H DOUGLAS JR	1957
HERBERT F YORK	↓	↓	↓	1958
↓	↓	THOMAS S GATES JR *WM B FRANKE*	JAMES H DOUGLAS JR *DUDLEY C SHARP*	1959
↓	WILBER M BRUCKER	WM B FRANKE	DUDLEY C SHARP	1960
HAROLD BROWN	ELVIS J STAHR JR	JOHN B CONNALLY	EUGENE M ZUCKERT	1961
↓	ELVIS J STAHR JR CYRUS R VANCE	FRED H KORTH	↓	1962
↓	↓	FRED H KORTH PAUL H NITZE	↓	1963
↓	CYRUS R VANCE STEPHEN AILES	↓	↓	1964
HAROLD BROWN JOHN S FOSTER JR	STEPHEN AILES STANLEY R RESOR	↓	EUGENE M ZUCKERT HAROLD BROWN	1965
↓	↓	↓	↓	1966
↓	↓	PAUL H NITZE PAUL R IGNATIUS	↓	1967
↓	↓	PAUL R IGNATIUS	HAROLD BROWN	1968
↓	↓	JOHN H CHAFEE	ROBT C SEAMANS JR	1969
↓	↓	↓	↓	1970
↓	STANLEY R RESOR ROBT F FROEHLKE	↓	↓	1971
↓	↓	JOHN H CHAFEE JOHN W WARNER	↓	1972
JOHN S FOSTER JR MALCOLM R CURRIE	ROBT F FROEHLKE *HOWARD H CALLAWAY*	↓	ROBT C SEAMANS JR JOHN L McLUCAS	1973
↓	↓	JOHN W WARNER J W MIDDENDORF II	↓	1974
↓	HOWARD H CALLAWAY MARTIN R HOFFMANN	↓	JOHN L McLUCAS	1975
MALCOLM R CURRIE	MARTIN R HOFFMANN	J W MIDDENDORF II	THOMAS C REED	1976
WM J PERRY	CLIFFORD L ALEXANDER JR	W G CLAYTOR JR	JOHN C STETSON	1977
↓	↓	↓	↓	1978
↓	↓	W G CLAYTOR JR EDWARD HIDALGO	JOHN C STETSON HANS M MARK	1979
WM J PERRY	CLIFFORD L ALEXANDER JR	EDWARD HIDALGO	HANS M MARK	1980

The Decade of the Fifties

Following a low volume of major defense systems business after World War II (the late 1940s), the Korean conflict and the general deterioration in the international situation led to an expansion in the development and production of defense systems. During the latter half of the 1950s, defense systems sales were stable. Then, toward the close of the decade, a gradual transition from long production runs to more research, development, test, and evaluation began to take place.

The process of procuring major defense systems in the 1950s was complex. The programs lasted many years and consumed large amounts of money. Nevertheless, the basic process for procurement of defense systems included all of the functions that normally pertain to the acquisition of goods or services:

—Preparation of a description of the requirement (need).
—Solicitation and selection of sources.
—Negotiation and award of a contract.
—All of the activities involved in contract administration.

The key steps in the procurement process during the 1950s—and through the 1960s and 1970s—are illustrated in Figure 2. In a specific procurement, the variables such as (1) statutes and regulations that apply and (2) the urgency of satisfying the requirement, may impact the actions to be taken in each step and/or the sequencing of the steps.

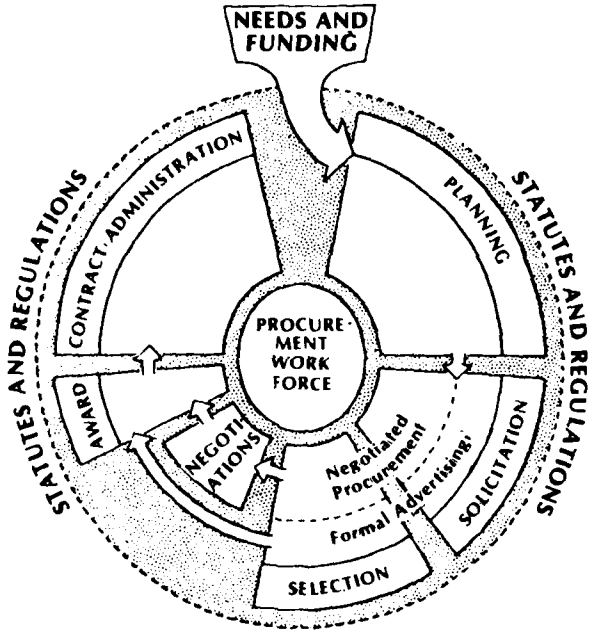
During the 1950s, defense business was characterized by rapidly advancing technology; concurrency in design, development, and testing; and cost-plus-fixed-fee contracting. Emphasis was on the development and production of defense systems that incorporated the most advanced technological innovations. This, of course, led to a high risk of failure.

Money was authorized to develop almost any new defense system that appeared capable of giving the United States a performance advantage over any potential adversary. Such considerations as "should-cost," "design-to-cost," and "life-cycle cost" were not uppermost in the minds of the defense systems planners until the late 1950s. Both development and production were carried out under cost-reimbursement contracts. In this environment, production costs did not pose a major constraint on engineering design. When a design was discovered to be impractical in production—or to be inoperative in field use—it was modified in accord with government-funded engineering changes.

Toward the close of the 1950s, a new trend began to appear. The government began to look over the shoulders of the defense contractors. It was at the time when the United States accelerated its pioneering program in ballistic missile development and production. The high risks and costs of these programs, which employed concurrency of development and production, could not be borne by industry alone. Heavy reliance had to be placed on sole-source procurement,

because competitive capabilities had not been developed. By 1960, for instance, a majority of the contract awards made by the Air Force were non-competitive, and over 40 percent of the awards were cost-plus-fixed-fee contracts.

FIGURE 2
The Basic Procurement Process



Source: Report of the Commission on Government Procurement, Volume 1, December 1972.

The DOD did not have an orderly, integrated planning, programming, and budgeting system during this decade. Although James V. Forrestal, the first Secretary of Defense (SECDEF), took steps to create a uniform budget structure for use by the military departments, the planning and budgeting by each department was carried out in relative isolation from the others. Consequently, the plans prepared by each military department were based upon (1) the kind of war

that department envisioned, and (2) reliance of that department on its own resources. This led to overlapping of functions, duplication of missions, and occasional capability omissions.

The military planning was hardware-oriented and looked ahead 5 years. On the other hand, the military budgets were separated into appropriation categories (input oriented) and unconstrained by the Office of the Secretary of Defense (OSD). As a result, the military departments tended to submit budgets that were higher than either the SECDEF or the Congress could accept. The OSD budget, prepared by the Comptroller, did consider fiscal realities, but only projected requirements for 1 year ahead. The Director of the Budget in the Bureau of the Budget established the final defense budget. Several changes were needed to correct the problems and bring about an integrated process:

—An orderly, coordinated system had to be developed.
—The OSD had to provide fiscal guidance to the military departments.
—Planning had to be guided by OSD, and communications between the military departments had to take place.
—Planning, programming, and budgeting had to be focused on national security objectives over a specific number of years.
—Better communication with the Bureau of the Budget (now the Office of Management and Budget) had to take place.

The lack of a well-organized and integrated DOD financial management system, along with the practice of "piecemeal" procurement, led to unstable employment in defense industry and the emergence of a transient work force. Many of the contractors being challenged to develop and produce defense systems on the outer fringes of technology found it difficult to create and maintain smoothly functioning program management teams.

During World War II, defense industry had become a significant factor in the economy of the United States. The DOD budget had grown to about 50 percent of the federal budget. It continued to be a major part of the federal budget while the defense systems acquisition programs were being conducted to support the Korean conflict and a limited number of military assistance/grant aid agreements with allied countries. The military assistance program (MAP) continued throughout the 1960s and 1970s, but at a much lower level. Today there is some sentiment in the Congress to phase out the MAP altogether. From 1950 through 1980, the foreign military sales (FMS) program, involving the sale of U.S. military goods and services—as well as training—to U.S. allies, has continued. According to the Foreign Military Sales Act, as amended in 1968 (Public Law 90-629), the United States was to be reimbursed for not less than the value of the goods and services being transferred. Further, all costs, including a reasonable contribution to sunk investment costs, were to be recouped. In the amended act, FMS became the responsibility of the International Security Agency (ISA)—an

agency geared more to meeting demands by selling from the inventory than to procuring major defense systems for allies through the defense systems acquisition process.

As the transition from military aid to military trade was taking place between the United States and its allies, European members of the North Atlantic Treaty Organization (NATO) began to see the need to develop and protect their industrial bases—particularly those members capable of developing and producing defense systems. With this as a backdrop, and because of the high cost of developing, producing, and fielding new defense systems, the tendency to form multinational corporations grew.

The Decade of the Sixties

The defense systems acquisition environment began to undergo marked changes in the early 1960s. After a decade of experience with the acquisition of high-technology defense systems, DOD attention began to shift toward integrated planning and programming, and to using available resources more efficiently throughout the defense systems acquisition process.

On January 21, 1961, Robert S. McNamara, a former corporate executive, became Secretary of Defense. During his first year in office, he decided to centralize the authority and planning for the defense establishment at the level of the Office of Secretary of Defense and to decentralize operations. While centralization of the planning and operational decisions came about, decentralization of operations was not realized during his term of office.

THE FIVE YEAR DEFENSE PROGRAM

Among the beneficial changes introduced by McNamara was the Five Year Force Structure and Financial Plan, now known as the Five Year Defense Program (FYDP). The FYDP is a register of all currently approved programs, along with their funding and manpower levels. Serving as the pivot of the entire defense programming system, it groups all military forces and all defense systems according to their principal missions, without regard for service affiliations. In the FYDP, resources (inputs)—manpower, defense systems, and installations—are related to the military functions (outputs).

The 10 major programs of the FYDP are listed in Figure 3. Programs 1 through 6 and program 0 have a force-mission or combat-mission orientation. Programs 7, 8, and 9 have a support orientation. Because program resources overlap various management areas as well as functional responsibilities, no one program remains the exclusive responsibility of a single Assistant Secretary of Defense.

The major force programs of the FYDP are composed of program elements. These elements are the smallest units of military output controlled at the OSD level. Each element constitutes an identifiable military capability that contributes

FIGURE 3
The Ten Major Programs of the FYDP

Program 1	**STRATEGIC FORCES** Strategic offense forces; strategic defense forces; civil defense; the command organizations associated with the strategic forces.
Program 2	**GENERAL PURPOSE FORCES** All of the force elements not assigned to Program 1; the command organizations associated with these force elements; logistic and support units.
Program 3	**INTELLIGENCE AND COMMUNICATIONS** Resources for intelligence and security; communications systems; specialized missions such as aerospace rescue/recovery, oceanography, weather service.
Program 4	**AIRLIFT AND SEALIFT** Industrially funded and non-industrially funded transportation organizations; water terminals; traffic management.
Program 5	**GUARD AND RESERVE FORCES**
Program 6	**RESEARCH AND DEVELOPMENT** Research, exploratory development, advanced development, engineering development, management and support, operational systems development.
Program 7	**CENTRAL SUPPLY AND MAINTENANCE** Activities are not organic to elements of the other programs.
Program 8	**TRAINING, MEDICAL, AND OTHER GENERAL PERSONNEL ACTIVITIES** Training not identified with elements of other programs.
Program 9	**ADMINISTRATION AND ASSOCIATED ACTIVITIES** Major administrative headquarters, field commands, construction support, the Defense Contract Audit Agency.
Program 10	**SUPPORT OF OTHER NATIONS** Support of Allies, the Military Assistance Program (MAP), the Agency for International Development (AID), similar activities.

to the mission of a major program. Costs are measured in terms of the amount required to finance the program element in a given year. Today, there are about 1,100 program elements serving as basic building blocks in the programming process.

In addition to the major programs of the FYDP, both OSD and the services use functional programs—such as the Telecommunications and Command and Control Program; the Communications Security Resources Program; or the General Defense Intelligence Program—to manage certain resources that cut across program element or appropriations boundaries.

The FYDP is updated three times a year. The most important update occurs in January when the document is revised to reflect the President's budget. This edition of the FYDP serves as the DOD planning and programming baseline for the ensuing year. In May or June, each service secretary approves the program objectives memorandum (POM) prepared by his organization for the next budget cycle, and OSD issues an update to the FYDP to reflect the service POM inputs. In September, the SECDEF concludes his review of the service POMs and revises the service programs as necessary. OSD then issues another update to the FYDP reflecting the SECDEF program decisions with respect to the POMs. This issue of the FYDP (1) is used in negotiations with the Office of Management and Budget prior to the first of January, and (2) serves as the basis for the creation of the service budgets to be forwarded to the Congress the first of January. In January, the cycle begins again.

In October 1965, McKinsey and Company initiated a study to determine how to improve the programming process in DOD. Based on the results of this study, the SECDEF began the annual programming cycle by publishing a list of major force-oriented issues that would have major impact on our armed forces. To prepare this list, the SECDEF used the military guidance provided by the Joint Chiefs of Staff (JCS) in the joint strategic objectives plan (JSOP) and the advice of the OSD systems analysis organization (discussed later).

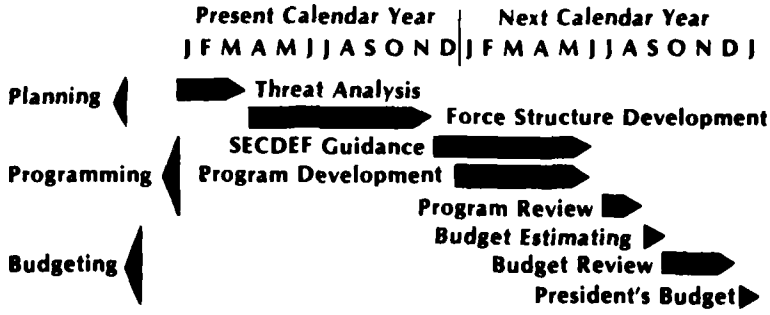
In addition to the listing of issues, the SECDEF initiated the draft presidential memorandum. This document, treated as a privileged communication from the SECDEF to the President, covered the tentative programming events being considered by DOD during the next fiscal year.

In 1968, the SECDEF began the annual issue of logistics guidance and 18 other guidance memoranda. Soon after, the SECDEF issued the first development concept papers (DCP), which will be discussed in more detail later.

THE PLANNING, PROGRAMMING, BUDGETING SYSTEM

To make the Five Year Defense Program work, McNamara introduced another management tool—the planning, programming, budgeting system (PPBS). (See Figure 4.) The SECDEF recognized that realistic force planning must

FIGURE 4
The Planning, Programming, Budgeting System



be based on the military strategy that the United States wishes to follow in accomplishing national security objectives. In the development of a suitable force structure, fiscal, manpower, research and development, and production constraints must be applied. Also, adequate consideration must be given to the risks that are imposed by resource contraints. The PPBS takes these factors into account, and serves as an integrated system for establishment of the annual DOD budget and the periodic revisions to the FYDP.

An examination of the PPBS reveals that it is a cyclic process containing five distinct, but interrelated, phases, namely: (1) planning, (2) programming, (3) budgeting, (4) executing the programs approved by the Congress, and (5) maintaining accountability and reporting results. The fifth phase also includes preparing future plans, programs, and budgets, as well as supplying financial status information to DOD managers.

The broad categories of major programs—upon which the planning was based when the PPBS was introduced—were sometimes referred to as the "Hitch Program of Packages" after Charles J. Hitch,[2] then Assistant Secretary of Defense (Comptroller).

From 1961 to 1969, the PPBS was a centralized decision-making activity with McNamara, Hitch, and Dr. Alain C. Enthoven (see systems analysis section) acting as principals. As in the 1950s, the programs submitted by the military departments contained no fiscal constraints. Thus, the budgets were unrealistic and, in

2. Charles J. Hitch developed the PPBS at the Rand Corporation in the early 1960s on an Air Force-sponsored study.

most cases, had to be severely slashed at the OSD level. With time serving as a critical factor, OSD management had to make significant program decisions without giving the military departments an adequate opportunity to defend their plans, programs, or budgets.

In 1969, the PPBS was modified by the new SECDEF, Melvin R. Laird, to permit some decentralization of the decision-making process. The SECDEF requested that the program and budget submissions made by the military departments fall within the explicit fiscal contraints that he would establish annually. From that time on, fiscal guidance became the principal constraint on the military departments during the development of their plans and budgets. The departments recommended the total program objectives—in a program objectives memorandum—for the forthcoming budget year and the 4 subsequent years within explicit fiscal constraints. This change to the PPBS shifted competition for financial resources from OSD to the military departments and into the programming phase of the PPBS.

The program objectives memorandum is a document prepared by each military department and defense agency in a prescribed format for submittal to the SECDEF. The document contains a recommendation covering the total resources required by the department or agency within the parameters set forth in the SECDEF's fiscal guidance. To develop the POM, each military department and defense agency must determine how it proposes to allocate and prioritize limited resources in a multimission environment among competing needs to maximize combat capability. Included in each POM is an assessment of the risk associated with current and proposed forces and support programs.

SYSTEMS ANALYSIS

During his 8-year term, McNamara introduced to DOD another management process—systems analysis. This process, which was to become an integral part of the PPBS, had been known in the industrial world as "cost-effectiveness study." An OSD office was created and given responsibility for conducting studies and analysis of the resources required, in terms of cost, to accomplish specific defense objectives.

Dr. Enthoven, who was appointed to head a small systems analysis section in the Defense Comptroller's office in 1961, became the Deputy Assistant Secretary of Defense (Systems Analysis) in the fall of 1962, and the Assistant Secretary of Defense (Systems Analysis) in September 1965. Throughout this period, Dr. Enthoven's office was the primary action office for the major force-oriented issues. The Office of the Joint Chiefs of Staff served as the office for collateral action. The military departments and defense agencies were given responsibility for reviewing and commenting on proposed plans and programs for dealing with critical issues affecting the security of the United States.

Hitch encouraged industry to conduct independent studies and analyses to determine what contributions it might be able to offer to improve existing defense systems and to provide suggestions for new ones. By such efforts, Hitch believed that industry would be able to anticipate some of the DOD decisions regarding the future content of the FYDP.

The systems analysis approach advocated by McNamara had worked well in the industrial world where its success or failure could be determined by profits. In the DOD environment, however, it was difficult to determine the effectiveness of each decision. While difficult to determine, cost-effectiveness had to be measured to deal with the problem of limited resources. Unknowns, such as how much "security" additional quantities of a specific defense system will provide, limit management's ability to determine precisely the correctness of a decision. There is no known way to assign a price to such a decision. The big question to be answered by defense planners and decision-makers will always be: "What types and quantities of defense systems are required to meet the national security objectives within available resources?"

At the close of McNamara's term in 1969, the FYDP and the PPBS were firmly established. The FYDP and the PPBS not only brought some order to the annual budget cycle, but—with the adoption of systems analysis techniques—improved the process of allocating scarce resources. Although some participants were not completely satisfied with the effectiveness of the McNamara approach, it did help to bring the DOD mission into conformity with overall national security objectives.

CONTRACT ADMINISTRATION ORGANIZATION

In the early 1960s, each military department had its own contract administration service organization composed of a headquarters office and several field offices. The field offices were organized by function, commodity, or geographical area. Because this appeared to be a cumbersome arrangement, the ASD (Installations and Logistics) launched Project 60. The purpose of this project was to develop a plan for an effective DOD-wide contract management organization. The project was completed in 1963 and the present DOD contract administration structure is an outgrowth of the recommendations made in the final report. Today, central contract management is provided by Defense Contract Administration Services (DCAS). Through offices in 11 operating regions, DCAS administers all of the defense contracts except those specifically excluded by the SECDEF.

Excluded from DCAS management are a few plants still controlled by the military departments through their plant representatives. The tasks performed by the DCAS field offices and the plant representatives are important to the success of defense systems acquisition programs. However, not all of the tasks performed

by the contract administration personnel are of daily concern to the government program managers.

HARVARD STUDY

In 1962, the Harvard Weapons Acquisition Research Project report covering 12 major defense systems showed that, on the average, the quality of the defense systems being produced tended to exceed their original specifications. This quality was being achieved at the expense of development time (development time was averaging 36 percent longer than predicted), and costs (costs were averaging as much as seven times more than originally estimated). To rectify this situation, OSD management issued the following directions:

—Make defense system costs equal in importance to both performance and scheduled delivery to the inventory.
—Eliminate "gold plating."
—Increase competition at the start of a new program.
—Reduce the number of cost-type contracts, particularly cost-plus-fixed-fee contracts.

This report was favorably received by OSD. Corrective actions were taken. A dramatic reduction in the number of cost-plus-fixed-fee contracts took place. Incentive and fixed-price contracts became the vogue to facilitate competition. The contracts took into consideration the technical risks the contractors had to assume, as well as the resources (men, machines, money, and facilities) required.

LIFE-CYCLE COST

Life-cycle cost (LCC)—the total cost of acquisition and ownership—became a consideration in defense systems acquisition in the early 1960s when the Logistics Management Institute, under the sponsorship of the ASD (Installations and Logistics), conducted an investigation and recommended that the concept be applied to defense programs. At the outset, it was applied on procurements at the equipment level. Following issuance of DOD Directive 4100.35[3]—which was devoted to planning for integrated logistic support—and a tightening of the defense budget, application of LCC at the systems level became a requirement to support planning. Several major defense systems programs, such as the Navy LHA, the Air Force F-15, and the Army SAM-D, employed some type of life-cycle costing technique on a trial basis. Then, issuance of the following directives accelerated the adoption of life-cycle costing on all major programs:

---

3. U.S. Department of Defense Directive 4100.35, *Development of Integrated Logistic Support for Systems and Equipment*, 19 June 1965.

—DOD Directive 5000.1[4] (discussed later), which changed the mode of defense systems acquisition.
—DOD Directive 4105.62,[5] which made life-cycle costs one of the principal considerations in the selection of contractual sources for major defense sysems.
—DOD Directive 5000.28[6] (discussed later), which made design-to-cost a major acquisition policy.

According to DOD Directive 5000.28, "The LCC of a system is the total cost to the government of acquisition and ownership of that system over its full life. It includes the cost of development, acquisition, operation, support, and where applicable, disposal." LCC objectives are separated into cost elements. These cost elements are firmed into cost goals to which the system will be designed, and its cost controlled. Practical trade-offs between system capability, cost, and schedule are made throughout the life cycle to ensure that the system developed will have the lowest life-cycle cost consistent with performance and schedule requirements.

The influence of time on a program manager's ability to curb costs is dramatically illustrated in Figure 5.

CONCEPT FORMULATION AND CONTRACT DEFINITION

In July 1965, OSD issued a directive requiring that concept formulation and *contract definition phases* precede the engineering development phase of each major program.[7] Concept formulation phase activities were to include accomplishment of comprehensive system studies and development of experimental hardware; contract definition (formerly referred to as the project definition phase in the previous issue of this directive[8]) was that period during which preliminary design and engineering were to be verified or accomplished and firm contract and management planning were to be performed on a program. Before proceeding with the engineering development phase of a new program, the program had to be accepted as a part of the FYDP.

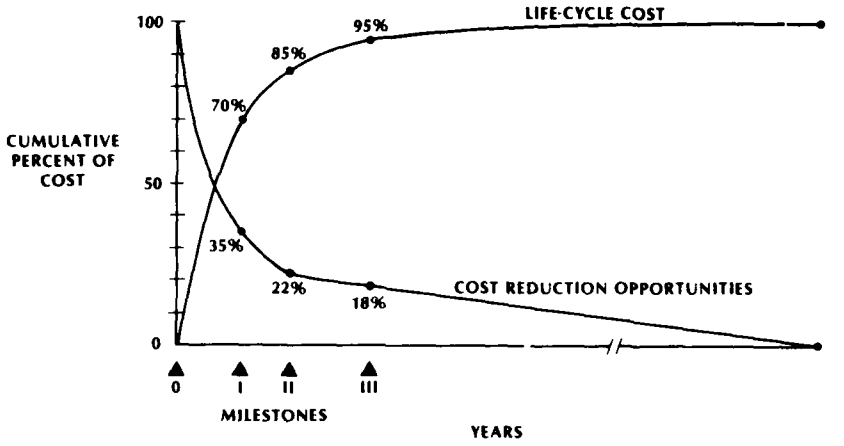
TOTAL PACKAGE PROCUREMENT

In the mid-1960s, successful development contracts were generally followed

---

4. U.S. Department of Defense Directive 5000.1, *Acquisition of Major Defense Systems*, 13 July 1971.
5. U.S. Department of Defense Directive 4105.62, *Proposal Evaluation and Source Selection*, 6 April 1965.
6. U.S. Department of Defense Directive 5000.28, *Design to Cost*, 23 May 1975.
7. U.S. Department of Defense Directive 3200.9, *Initiation of Engineering and Operational Systems Development*, 1 July 1965.
8. U.S. Department of Defense Directive 3200.9, *Project Definition Phase*, 26 February 1964.

FIGURE 5
Influence of Time on a Program Manager's Ability to Curb Costs



by production contracts with little or no likelihood that the developer would have to face competition. To ensure this, contracts based upon the initial competitions started to include, along with the development effort, requirements for substantial production quantities. Observing this trend, Robert H. Charles, ASD (Installations and Logistics), conceived the total package procurement (TPP) concept. The objectives of this concept were as follows:

—Limit or eliminate "buy-in" considerations.

—Motivate contractors to design for economical production, and minimize any tendency for production redesign.

—Encourage subcontracts with, and obtain components from, the most efficient supply sources.

—Encourage contractor efficiency through competition, and thereby reduce costs.

According to Charles, TPP would allow the government, like any buyer in the commercial world, ". . . to make a choice between competing products on the basis, not of estimates, but of binding commitments concerning performance and price of operational equipment."[9] It established these commitments com-

9. Robert H. Charles, presentation before the Defense Industry Advisory Council, "Total Package Procurement Concept," 18 February 1966.

petitively for as much of a program as practicable, and then permitted the winning contractor's profit ultimately to be determined under an incentive arrangement that related opportunity to risk. Profit was targeted initially in competition and was finally determined by the quality of the product and the efficiency of the winning contractor.

The TPP concept fell far short of its goal. Cost overruns continued, new defense systems failed to meet technical performance requirements, and schedules slipped on many programs. The reasons for the failure of the TPP concept are many. The "heating-up" of the economy and the onset of inflationary pressure—both unrelated to a specific program—may have been partially responsible for the failure of the TPP concept. More importantly, the concept did not provide contractors with sufficient management flexibility to cope with all of the problems as they became known. Contractors had to make substantial production commitments to meet delivery schedules before completion of design and verification by testing. Costly redesign and rework followed. Continued trade-off analysis was stifled because of the rigidity of the contracts.

Although the Air Force Maverick air-to-surface missile program was successful using the TPP concept, serious problems were encountered on many other programs. Among those running into trouble were the Air Force Galaxy transport (C-5A) and short-range attack missile (SRAM); the Army Cheyenne helicopter (AH-56A); and the Navy destroyer (DD-963). As a result of the problems encountered, DOD recognized the need to place stringent limitations on the application of TPP. Perhaps the most important limitation was ensuring that the estimates of future service demands, military threats, and technology were sufficiently accurate to allow pricing options on proposed defense systems acquisition programs to be evaluated adequately before program initiation.

PLEA FOR DISENGAGEMENT

Early in 1965, industry made a plea for disengagement from a number of government-imposed management systems. Contractors, through the industry associations (see Appendix) voiced concern about the proliferation of management systems imposed on defense systems programs, and the growing number of reporting requirements. Industry deemed this trend to be inconsistent with fixed-price or incentive contracting. It questioned how the customer (government) could review and approve contractor actions without seriously weakening either the contract incentives or the warranties. Industry made the case that, when the customer chose to exercise detailed management of a program, the customer should share the success or failure of the contractor's performance with respect to incentives and fixed-price limits.

New tools had to be found that would provide the customer with "visibility," while not interfering with contractor prerogatives. The Aerospace Industries

Association formed a Systems Management Analysis Group (SMAG) to investigate the problem. Highlighted in the resulting report of this group, issued in May 1966, were the conflicts between existing DOD management systems; the need to match appropriate management systems with the type of contract selected for a given defense system program; and the need to tailor the degree of management to the complexity of the program involved. The report urged that steps be taken to ensure any new management system was worthwhile in light of the expense involved in its application; consistent with those management systems already adopted for use by DOD; and in consonance with overall DOD policy.[10]

The force of the industry pleas led to the release of DOD Directive 7000.1 in August 1966, concerning resource management systems of the DOD.[11]

RESOURCE MANAGEMENT SYSTEMS

In September 1965, Dr. Robert N. Anthony of Harvard succeeded Hitch as ASD (Comptroller). Upon the appointment of Anthony, the SECDEF assigned to him the task of bringing an accountability feature into the PPBS and providing some government "disengagement." This was accomplished by development and implementation of resource management systems (RMS). The RMS minimizes requirements for information while obtaining the data that are essential for program management purposes. Where possible, RMS makes use of contractors' internal systems and reporting procedures, thus avoiding the imposition on contractors of unnecessary reporting burdens.

The principal resource management systems are as follows:

—Programming and budgeting system—the process of establishing goals and determining the resources needed to reach the goals;

—Managing the acquisition, use, and disposition of capital assets;

—Managing the acquisition and disposition of inventory and similar assets;

—Managing the resources for operating activities, i.e., the combat forces and their associated support.

The resource management systems were not only oriented to the needs of management, but they provided information required by the Bureau of the Budget (now the Office of Management and Budget), the Treasury Department, and the Congress.

The ASD (Comptroller) was made custodian of all resource management systems. Those systems related directly to financial control or reporting were

10. *Report of the Systems Management Analysis Group*, Aerospace Industries Association of America, 12 May 1966.

11. U.S. Department of Defense Directive 7000.1, *Resource Management Systems of the Department of Defense*, 22 August 1966.

made his direct responsibility; the other management systems were made subject to his approval. Additional DOD directives and instructions in the 7000-series, relating to management and control systems, were issued in the late 1960s and early 1970s.

SELECTED ACQUISITIONS INFORMATION AND MANAGEMENT SYSTEM

In 1965, Anthony recognized the need to develop an integrated approach to financial management for major defense systems acquisitions. The problems rampant at that time were proliferation of systems and reports; the costs of operating the systems; lack of capability to make adequate cost estimates; the lack of adequate contract status information; and the lack of cost control.

Industry, through the representation of major industrial associations in the Council of Defense and Space Industry Associations (CODSIA), collaborated with DOD in the development of a selected acquisitions information and management system (SAIMS). SAIMS—a subsystem of the resource management systems—was born in December 1965. This new system followed the approach of getting information from the contractors' management control systems in a form DOD managers could use to support planning and to evaluate contractor progress. SAIMS, which continued to evolve over the next 3 years, provided both DOD and industry program management with economic impact analysis. Also, it provided information for estimating costs of new programs, follow-on procurement and major program changes, pricing and negotiating, funds management, and performance measurement. The relationship of SAIMS to RMS is illustrated in Figure 6.

During the defense systems acquisition process, only three kinds of financial information are required by DOD management from industry, namely:

—Funding information for budget preparation and update;

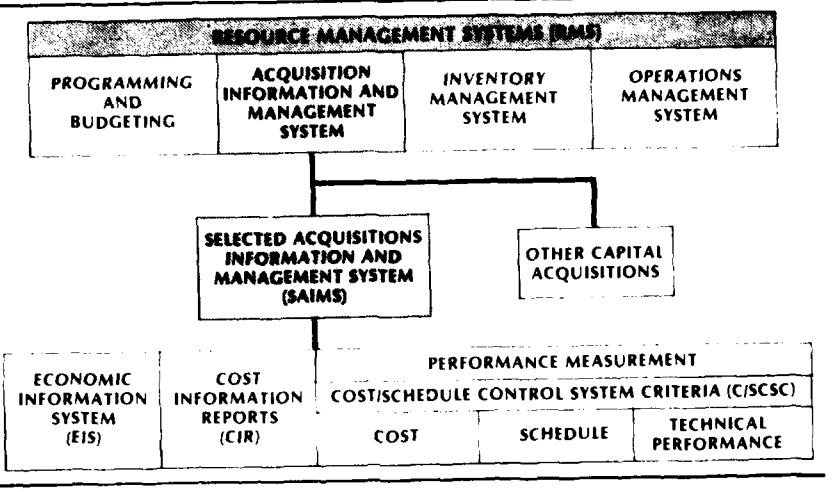
—Historical cost data for use in estimating costs on new defense systems programs, or extensions of existing programs;

—Contract performance information to assess contract status, evaluate performance trends, and provide early visibility of cost and schedule problems.

All contractually related financial management reporting emanates from a contractor's internal system; therefore, it is necessary to ensure that the contractor's system is sound and that it provides reliable data. For example, to ensure that the internal cost/schedule control systems of selected contracts within major programs are sound and that the systems will produce valid and timely progress information, the criteria set forth in DOD Instruction 7000.2 have been established as standards of acceptability.[12]

12. U.S. Department of Defense Instruction 7000.2, *Performance Measurement for Selected Acquisitions*, 22 December 1967.

FIGURE 6
The Relationship of SAIMS to RMS



Application of cost/schedule control systems criteria on a defense system acquisition program provides the program manager with better visibility and controls for achieving cost, schedule, and performance objectives. It also provides the government program manager with the following:

—A means for recognizing previously unidentified problems on the program;
—An ability to trace the problems to their source;
—A method for determining the cost impact that will be created by the problems;
—An objective, as opposed to subjective, assessment of program status on a periodic basis.

From the viewpoint of the contractor, there are two benefits to be gained from application of a cost/schedule control system to a program. These benefits are an improved overall system discipline, and a more detailed planning and budgeting process. Although DOD requires that the control system be applied to all major defense system programs, it is being applied selectively to others that fall below the "major" category. This is occurring because its application provides a better basis for (1) controlling contract performance, and (2) responsible decision-making.

SELECTED ACQUISITION REPORTING SYSTEM

In 1967, a system involving the preparation and presentation of reports on selected defense systems programs was conceived by Anthony. The objective of

this internal DOD reporting system—released as DOD Instruction 7000.3 early in 1968—was to summarize technical performance, schedule, and cost information on "selected" major defense system programs.[13] Submitted quarterly, each selected acquisition report (SAR) provides the SECDEF with program visibility and progress, and identifies specific problems relating to meeting designated performance, schedule, and cost targets. Management attention is focused primarily on exceptions to the program plan and breaches of program thresholds established in the development concept paper (DCP), now known as the decision coordinating paper. The SAR system closes the feedback loop on major defense systems programs by comparing actual with planned accomplishments.

In April 1969, the SAR became the vehicle for providing Congress with the status of major defense systems programs. Then, in 1975, through passage of Public Law 94-106, the SAR became the legal document for providing standard, comprehensive summaries of the status of selected defense systems programs to Congress at the end of each quarter of the fiscal year.

SHOULD-COST ANALYSIS AND PRICING

In the late 1960s, defense officials began to express their concern about the adequacy of the pricing techniques used in sole-source procurements. They recognized that when there were no competitive forces at work, there was a tendency for contractors to be liberal in their cost estimates. This tendency appeared to be especially prevalent when costs were being estimated beyond 1 year. Defense officials reached general agreement that contract prices must reflect economical and efficient performance practices, as well as realistic costs. To bring this about, government contract negotiators had to learn how to recognize a realistic contract price—a figure based upon what the program should cost when the contractor is performing with reasonable economy and efficiency.

To meet the problem head-on, Anthony sponsored the development of a new pricing technique. This technique, identified as "should-cost analysis," consists of an in-depth analysis of a contractor's management, cost-estimating, and production practices. In addition, the effects of poor performance are identified and measured using standard industrial engineering techniques. The findings are used to develop a baseline for pricing. The price excludes the costs resulting from inefficient practices. The should-cost analysis and pricing technique, based upon the coordinated efforts of a team of government engineering, pricing, procurement, auditor, and management specialists, has proven to be effective in fostering long-range improvements in industrial practices and in setting more realistic contract prices.

---

13. U.S. Department of Defense Instruction 7000.3, *Selected Acquisition Report (SAR)*, 28 February 1968.

OTHER MAJOR DOD DIRECTIVES

In the mid- to late 1960s, several additional major policies/directives were issued by DOD that relate to the defense systems acquisition process. Although they will not be discussed in detail in this article, the subjects covered are worthy of note:

—Development of integrated logistic support plans for systems/equipment, i.e., the integration of logistics considerations and logistics planning into the systems engineering and design process;

—Proposal evaluation and source selection;

—Defense standardization program, i.e., a program to control item proliferation;

—Quality assurance, i.e., the enforcement of technical criteria and requirements governing all material, data, supplies, and services developed, procured, produced, stored, operated, maintained, overhauled, or disposed of by or for DOD.

—Selection and application of management control systems in the acquisition process;

—Value engineering program, i.e., a program to eliminate or modify unessential characteristics and minimize cost through the organized use of value engineering;

—Technical data management, i.e., the standard way of doing business when contractor-prepared data are required by functional managers in various functional areas. Data requirements result from, and are subservient to, related tasks in the statement of work;

—Configuration management, i.e., a discipline applying technical and administrative direction and surveillance to (1) identify and document functional and physical characteristics of a configuration item, (2) control changes to those characteristics, and (3) record and report change processing and implementation status;

—Work breakdown structure (WBS), i.e., a product-oriented family tree which completely defines the program. It is composed of hardware, software, services, and other work tasks that result from engineering efforts during development and production of defense systems or equipment. The WBS displays and defines the products to be developed/produced and relates the elements of work to be accomplished to each other and to the end product.

LESSONS LEARNED

During the 1960s, several lessons were learned beyond those cited, namely:

—The acquisition process lacks timeliness and flexibility in responding to world threats.

—Paper studies cannot adequately establish that the technology needed for a new defense system is at hand. Breadboards, brassboards, or other hardware demonstrations of feasibility reduce the margin for error. When resources are scarce, hardware demonstrations may have to be limited.

—Trade-offs between performance, cost, and schedule, with the objective of achieving the right balance between performance and cost, should be made prior to the engineering development phase of a program's life cycle.
—Planning for integrated logistic support—the composite of all the support considerations necessary to assure the effective and economical support of a defense system throughout its life cycle—should begin prior to the engineering development phase.
—The period in which design takes place is not the right one for discovering and implementing untried technology; rather, it is the time for integrating known technology.
—Specification requirements should be simplified and limited throughout the acquisition process, and use of applicable existing industrial standards, specifications, and hardware should be increased to minimize costs.
—Independent parametric or comparative pricing techniques should be used to achieve more realistic costing.
—Both parties to a contract should have a reasonable time to examine the technical package and discuss it before any commitments are made.
—There is no substitute for competent and objective surveillance of critical program elements on a continuing basis.

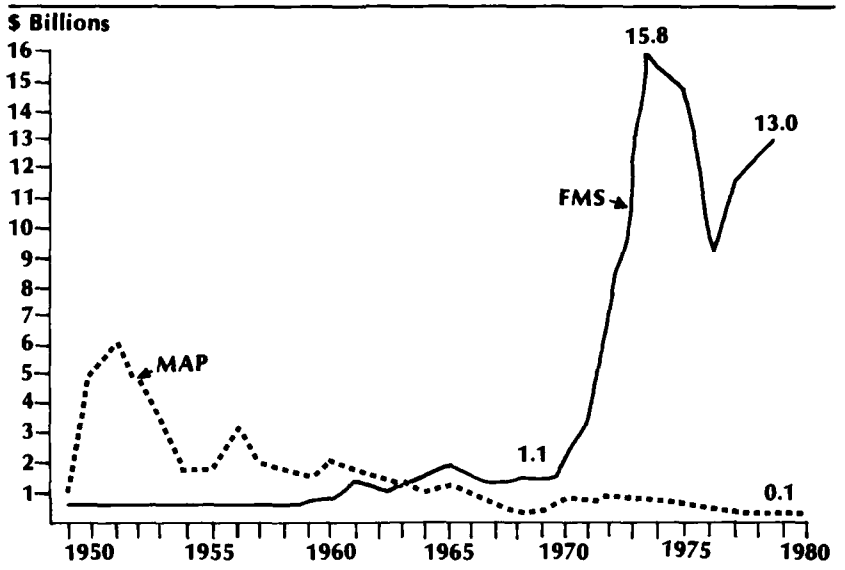
THE INTERNATIONAL ENVIRONMENT IN THE 1960s

In the early 1960s, the U.S. foreign policy, *vis-à-vis* Europe, shifted from military aid to military trade. As the decade advanced, European countries became more self-reliant as their prosperity increased. Europe redeveloped a portion of its technology base, located and developed markets in the Third World, and began to compete with the United States in specific facets of the defense business.

Growth of European defense industry created a number of problems—military, economic, and political.
—Militarily, the growth of European industry led to destandardization. This resulted in some major problems. For example, when U.S.-built systems and equipment were replaced with European-built items, logistical problems developed.
—Economically, growth of European industry—in a collective sense—enabled our allies to compete with the United States in Third World markets.
—Politically, as European defense industrial bases became institutionalized, both nationally and transnationally, the United States began to feel a challenge from its allies.

Since 1964, foreign military sales (FMS) have exceeded the military assistance program (MAP) authorization levels (see Figure 7). Beginning in 1966, MAP started to taper off. However, FMS agreements, after remaining relatively con-

FIGURE 7
Comparison of MAP and FMS for Fiscal Years 1950-1979



stant through the last half of the 1960s, grew from $1.1 billion in 1970 to a high of $15.8 billion by 1975. Today it stands at about $13.0 billion, while MAP stands at $0.1 billion. At the start of the 1980s, more than 70 foreign countries and international organizations are participating in FMS agreements.

The growth of FMS has impacted U.S. defense systems acquisition programs by placing extraordinary demands on U.S. program managers. For example, it has not been uncommon for a foreign customer to request an item that is not identical to that purchased for the U.S. Armed Forces. Also, it has not been uncommon to have the technical requirements for an item vary among the foreign countries.

When foreign customers procure major defense systems still in development or production, fixed (non-recurring) costs can be spread over a large base, thus reducing both the U.S. unit costs and the total costs of ownership. However, several less obvious factors, such as the creation of a need for excessive overtime when U.S. negotiators settled for over-ambitious delivery schedules, have impacted the U.S. programs. In order to cope with the FMS problems, the workload

of U.S. program managers has increased many-fold, but few program offices have been authorized additional personnel. Without sufficient program office personnel, resolutions of FMS problems have suffered long delays.

Problems in financial management practices associated with FMS have been discovered:

—The goods shipped to FMS customers are not always completely accounted for.
—The military departments have used different billing procedures.
—The collection procedures have been inadequate.

In June 1975, DOD issued an instruction setting forth a system intended to standardize the accounting, billing, and collection procedures on FMS programs.

RECOMMENDATION FOR LEGISLATIVE ACTION

In the late 1960s, industry believed that major changes were needed in both the Armed Services Procurement Act of 1947 and the Armed Services Procurement Regulation. It was the prevailing viewpoint in industry that the attention and emphasis needed to improve the process could only be achieved through congressional hearings, followed by appropriate legislation. John P. Elliott of the Western Electronic Manufacturers Association—now the American Electronic Association (see Appendix)—in an appearance before Representative Chet Holifield's Military Operations Subcommittee of the House Committee on Government Operations in June 1969, called for establishment of a Commission on Government Procurement.

Appearing before the same subcommittee of the House of Representatives shortly thereafter, Karl G. Harr, then president of the Aerospace Industries Association, urged support of the proposed bill to establish a Commission on Government Procurement. During his appearance, Harr took the opportunity to place the relationship of government to industry in perspective. He said:

> . . . in the government-industry interface there are fundamental differences in emphasis. The system requires that this be so. Two basic principles underlie that interface. Both sides subscribe to both of these principles but each side of the interface bears a different primary mandate. The government procuring agency has as its primary responsibility the acquisition, in the most efficient manner, of the best possible goods and services in support of national programs. Industry supports this principle. Industry on the other hand bears the primary mandate of doing the best job of which it is capable, again in the most efficient manner. The government subscribes to this principle.
>
> Despite the apparent compatibility of these two points of view . . . these principles are not necessarily . . . wholly reconcilable in the tens of thousands of applications which today's large government/industry interface requires. . . . Threading one's way

> through today's complicated and complex procurement environment in such a way as will at all times preserve our basic principles and objectives in optimum fashion, and give full vent to the collateral factors which must be considered, is about as sophisticated a challenge as any among us has to face.[14]

Congress was receptive to the industry recommendation, and a commission was created in November 1969. The commission was given a charter to study the government procurement policies and practices and to recommend to the Congress any changes to them that would promote efficiency, economy, and effectiveness in the procurement process. The findings and recommendations of the commission presented to the Congress in 1972 are reported later in this article.

The Period of Transition

In 1969, Congress displayed some preoccupation with the economy, the environment, and energy. This preoccupation, along with the growing sentiment to fund social programs, the disenchantment with the conflict in Vietnam, and the escalating costs of defense systems programs, led Congress to make the defense effort the primary target for budget cuts.

To respond to this situation, Secretary of Defense Melvin R. Laird and Deputy Secretary of Defense David Packard initiated a number of actions aimed at improving the management of the defense systems acquisition process and gaining control of systems acquisition costs.

PROCESS IMPROVEMENT

Packard established a Defense Systems Acquisition Review Council (DSARC) within OSD to advise him of the status and readiness of each major defense system to proceed from one program phase to the next phase in its life cycle.[15] The DSARC functions were to be separate from and not a part of the management reviews assigned to the Director of Defense Research and Engineering (DDR&E). The DSARC reviews were made to permit coordinated evaluations and deliberations among senior managers prior to a decision to proceed to the next phase in the acquisition program.

In addition to the DSARC actions, Packard requested that the DDR&E conduct a management review at least once on each major acquisition program. Such reviews would prove helpful in determining what OSD actions might be taken to improve management of the defense systems acquisition process.

---

14. U.S., Congress, House, *Government Procurement and Contracting*, pt. 9, p. 2488, 1969.

15. David Packard, memorandum to the Secretaries of the military departments, Director of Defense Research and Engineering, Assistant Secretaries of Defense, subject: "Establishment of a Defense Systems Acquisition Review Council," 30 May 1969.

About the same time, Packard took a number of other important steps. He requested that increased dependence be placed on hardware competition—using prototypes—and demonstration, and that decreased dependence be placed on paper competition. Critics of this process claimed that it added substantially to development time and, as a consequence, to cost. Advocates said that costs should be examined over the entire life cycle of a defense system and the system benefits from the early discovery of problems or defects. Prototyping appears to be most advantageous when the defense system: (1) entails substantial innovation, (2) is to be produced in quantity, and (3) is characterized by a low ratio of development to total acquisition costs.

Relative to test and evaluation (T&E), he requested that it begin as early as possible and be conducted throughout the acquisition process to assess and reduce risks and to estimate the operational effectiveness and suitability of the system being developed. Before the start of testing, issues critical to the system mission, test objectives, and evaluation criteria were to be determined. Successful accomplishment of the T&E objectives were to be the criteria for approving the commitment of significant additional resources to a program, or for advancing a program to the next phase in its life cycle.

In May 1970, Packard issued a memorandum citing other ways by which the acquisition of major defense systems could be improved.[16] The essential features of this memorandum served as the basis for DOD Directive 5000.1, "Acquisition of Major Defense Systems," the first of a number of directives and associated instructions in the "5000 series." The memorandum and directive stated Packard's ideas that "successful development, production, and deployment of major defense systems are primarily dependent upon competent people, rational priorities, and clearly defined responsibilities." Decentralization—which still did not exist—of responsibility and authority for the acquisition of major defense systems was to be fostered to the greatest extent possible, consistent with the urgency and importance of a particular program. Program managers were to be given adequate authority to make major decisions, rewards for good work, and more recognition toward career advancement. OSD was to assume responsibility for establishment of acquisition policy and assure the major programs were being pursued in response to specific needs. The military departments were to be given responsibility for identifying needs and defining, developing, and producing systems to satisfy these needs. OSD and the military departments were to be given joint responsibility for monitoring the progress of each major program. The

16. David Packard, memorandum to the Secretaries of the military departments, Director of Defense Research and Engineering, Assistant Secretaries of Defense, and others, subject: "Policy Guidance on Major Weapon Systems Acquisition," 28 May 1970.

Defense Systems Acquisition Review Council, established previously, was formally recognized as the group that would support SECDEF decision-making at each program milestone.

Under Packard, OSD disengaged from the detailed direction of the defense systems acquisition process and assumed the role of monitor and decision-maker at milestones associated with major systems only. The monitoring process required that a "contract" be established between OSD and the procuring military department. The contract was the development concept paper—the DCP—and it was administered by the DDR&E. The DCP described the technical requirements to be achieved; the thresholds which, if exceeded, would be the basis for a review of the entire program; the quantity; the cost; and the schedule. At each program decision point, the program was reviewed by the DSARC. If the DSARC determined that the program was ready to advance to the next phase, such a recommendation was made to the SECDEF, who had the decision authority. The SECDEF decisions at Milestones I, II, and III were reflected in the DCP and incorporated in the FYDP documentation at the next program objectives memorandum (POM) submission.

The DCP became known as a decision coordinating paper in 1971. Today, it is still known by that title, but its usage has changed. Limited to 10 pages, it provides program information essential to the decision-making process. It contains a statement of the direction needed from the SECDEF, a description of the overall program, the need for the program, the design alternatives, the program schedule and acquisition strategy, and the issues affecting the SECDEF's milestone decision. The DCP annexes include program goals and thresholds, resources required, and projected life-cycle costs.

Before the close of the 1970s, the SECDEF decision memorandum (SDDM), rather than the DCP, began to serve as the "contract" between OSD and the procuring service. The SDDM records the SECDEF decisions and directions following: receipt of DSARC recommendations; breaches of program thresholds; PPBS changes that affect program execution; and congressional actions that affect program execution.

The integrated program summary (IPS)—a document developed in the late 1970s—includes, like the SDDM, some of the information that was formerly presented as part of the DCP. This 60-page (or less) document summarizes the acquisition plan to allow informed analysis by interested OSD staff members. The mandatory annexes include a cost track summary, a funding profile, a summary of system acquisition costs, manpower requirements, and logistics data.

DEFENSE SYSTEMS ACQUISITION EDUCATION

To provide professional education in program management and defense systems acquisition management, Packard established the Defense Systems

Management School—now College—on 1 July 1971. This institution was given three missions as follows:

—To prepare selected military officers and civilian personnel for assignments in program management career fields;

—To conduct research and special studies in program management and defense systems acquisition management;

—To assemble and disseminate information relative to program management and defense systems acquisition management.

CONCURRENCY VS. NON-CONCURRENCY

The concept of concurrency, which evolved in the late 1950s on the Air Force Ballistic Missile Program, involved the initiation of some of the production activities on a program prior to completion of the full-scale development effort. During the 1960s, the concurrency approach was used on the major systems acquisition programs, commensurate with the risk.

In 1969, Packard conducted a review of many defense systems acquisition programs and discovered that the programs in trouble at that time were using the concept of concurrency. A detailed study of the use of the concurrency concept on successful programs was not made. As a result of Packard's discovery, a blue ribbon defense panel report (discussed later) in 1970, and a RAND report completed in the spring of 1971, Packard cautioned against unnecessary overlapping of program phases (concurrency) on future systems acquisition programs.

In the late 1970s, a Defense Science Board (DSB) study concluded that cancellation of some of the programs in the late 1960s could not be attributed to the application of the concurrency concept. In many cases, the programs had been cancelled for political or technical reasons, or because of a change in threat. Further, the DSB found that (1) an early production commitment did not necessarily cause a program schedule to slip, even though a development problem had to be corrected, (2) the addition of more formalized test and evaluation procedures during the 1970s was ensuring earlier discovery and correction of development problems, and (3) concurrency had been a normal practice in commercial business for many years. Therefore, the DSB took the position that overlap of program phases was desirable, provided that a competent program manager was available to make it work, and the risks involved were not too large.

COST GROWTH

During the late 1960s and early 1970s, Congress was becoming increasingly concerned about (1) the cost growth on major design systems programs and (2) the tendency of DOD to become "locked into" development and production of major systems regardless of any increase in cost. The dramatic growth in unit

costs can be seen in the following example. The P-47 fighter built during World War II cost $100,000 per unit; the F-105 fighter built between 1954 and 1963 cost about $2.5 million per unit; and (in 1973) it appeared that the F-15 fighter would cost about $10 million per unit. The same trend was evident in other defense systems being acquired for the armed forces. If the cost growth could not be curtailed, both DOD and Congress believed that the ability of the United States to field sufficient forces and carry out its international commitments would be seriously jeopardized.

Packard learned in discussions with the Industry Advisory Council—a forum composed of representatives from a cross-section of U.S. industry established by the SECDEF for presenting suggestions and constructive criticisms—that the basic causes of cost growth in defense systems acquisition programs, beyond the unpredictable inflation rate, included the following:

—Overoptimism in cost estimating;

—Program changes made during the development and production phases of a program;

—Failure to adequately identify risks. During that time period, this kind of failure was caused frequently by not completing the contract definition phase of a program before committing the program to full-scale development.

To correct the problems, Packard directed the service secretaries to:

—Propose methods to improve cost estimating;

—Establish requirements that would ensure completion of the contract definition effort on a program before SECDEF approval to proceed with full-scale development effort;

—Place increased emphasis on the application of configuration management and ensure sufficient knowledge of the impact of a proposed change on program costs before authorizing that the change be made;

—Ensure areas of high technical risk were identified and fully considered before starting full-scale development of a defense system.[17]

COST ANALYSIS IMPROVEMENT GROUP

Cost analysis involves the following:

—Estimating and evaluating program resource requirements;

—Estimating costs to be incurred throughout the program life cycle;

—Determining cost data needs;

—Developing cost information systems.

17. David Packard, memorandum to the Secretaries of the military departments, subject: "Improvement in Weapon Systems Acquisition," 31 July 1969.

Packard recognized the need for an independent cost analysis group at the OSD level in 1969; however, such a group was not formally established until January 1972 when the SECDEF issued a memorandum establishing an OSD Cost Analysis Improvement Group (CAIG).[18] The group was given a charter to provide the DSARC with an independent evaluation of the cost of each major defense system program and to establish uniform criteria, standards, and procedures for use by all DOD units making cost estimates.

In DOD Directive 5000.4, which provided a permanent charter, the CAIG became "an advisory body to the DSARC on matters related to (program) cost" and the focal point for cost analysis activities involving OSD staffs and all DOD components. Other duties of the CAIG included: (1) providing policy for the collection, storage, and exchange of information on improved cost estimating procedures, estimating methods, and historical cost data, and (2) revising existing or developing new techniques for projecting costs.[19]

TOTAL PACKAGE PROCUREMENT DISCONTINUED

Use of the total package procurement concept was discontinued by Packard. He believed that contracts should be tailored to the risks involved. Cost-plus-incentive-fee contracts were preferred for both advanced and full-scale development of major defense systems. When technical risks permitted, such contracts were to include provisions for competitive fixed-price subcontracts for subsystems, components, and materials. This enabled major portions of the program to benefit from competition. When risks were reduced to such an extent that realistic pricing could take place, fixed-price contracts were to be used. Packard requested that consideration be given to the use of negotiated fixed-price contracts after the production design could be specified realistically. To the extent possible, contracts negotiated under these circumstances were to encourage competition for subsystems, components, and materials.

The Decade of the Seventies

Since the issuance of the basic DOD Directive 5000.1, focusing on the acquisition of major systems, several DOD policy issuances elaborating upon, or augmenting, the original policy were forthcoming in the 1970s. This article cannot cover each of the policy documents in detail. However, many of them are worthy of mention before reviewing the principal events surrounding those which this article does address. The principal policy documents not discussed are identifed below:

---

18. Melvin R. Laird, memorandum to the Secretaries of the military departments, subject: "Cost Estimating for Major Defense Systems," 25 January 1972.

19. U.S. Department of Defense Directive 5000.4, *OSD Cost Analysis Improvement Group*, 13 June 1973.

—*Defense Acquisition Regulation* (formerly the Armed Services Procurement Regulation).
—*Administration—General.* DODD 5000.23 Systems Acquisition Management Careers, Nov 74; DODD 5000.29 Management of Computer Resources in Major Defense Systems, Apr 76; DODD 5160.55 Defense Systems Management College, Jan 77.
—*Technical Management.* DODD 4120.3 Defense Standardization and Specification Program, Feb 79; DODD 4120.21 Specifications and Standards Application, Apr 77; DODD 4151.1 Use of Contractor and Government Resources for Maintenance of Material, Jun 70; DODD 4151.9 Technical Manual Management, Jan 75; DODD 5010.19 Configuration Management (supporting DODI 5010.21 was cancelled), May 79; DODI 5000.36 System Safety Engineering and Management, Nov 78; DODI 5000.37 Acquisition and Distribution of Commercial Products, Sep 78.
—*Integrated Logistics.* DODD 4100.35 Development of Integrated Logistic Support for Systems/Equipments (replaced by DODD 5000.39, Jan 80), Oct 70; DODD 4140.40 Basic Objectives and Policies on Provisioning of End Items of Material, Feb 73.
—*Production, Quality Assurance, Test and Evaluation.* DODD 4155.1 Quality Program, Aug 78; DODD 5000.3 Test and Evaluation, Dec 79; DODD 5000.34 Defense Production Management, Oct 77; DODD 5000.38 Production Readiness Reviews, Jan 79.
—*Resource Management.* DODI 7000.2 Performance Measurement for Selected Acquisitions, Jun 77; DODI 7000.3 Selected Acquisition Reports, Apr 79.
—*Contract Management.* DODD 5010.8 DOD Value Engineering Program, May 76.
—*Information/Data Management.* DODD 5000.19 Policies for the Management and Control of Information Requirements, Mar 76; DODI 5000.32 DOD Acquisition Management Systems and Data Requirements Control Program, Mar 77.
—*International Cooperation.* DODD 2000.9 International Coproduction Projects and Agreements Between the U.S. and Other Countries or International Organizations, Jan 74; DODD 5530.3 International Agreements, Dec 79.

COMMISSION ON GOVERNMENT PROCUREMENT REPORT

In December 1972, the Commission on Government Procurement, chaired by E. Perkins McGuire, a consultant and corporation director, and co-chaired by Representative Chet Holifield from California, presented its report to Congress.[20] The commission—the first ever to concentrate exclusively on procurement—made 149 recommendations. Eighty-two recommendations required

20. *Report of the Commission on Government Procurement* to the Congress, 31 December 1972.

executive branch action and 67 required legislative action.

Among the principal findings of the commission were the following:

—Government procurement policies and procedures were needlessly diverse.

—Congress was ill-equipped to evaluate performance, costs, and schedules for new defense systems programs in the context of national security objectives and priorities.

—Contractors were frequently bewildered by a variety of requirements from different government agencies, but lacked an effective route in the executive branch through which to appeal for more realistic treatment.

—There was no systematic government-wide effort for studying ways to improve the procurement process.

Relative to the systems acquisition process, the commission found that "the kind of data used to choose a preferred system (from available alternatives), the timing of the choice, and the subsequent design latitude have a predictable effect on the outcome of a major system program." The commission also found a need to realign ". . . the acquisition structure to correct the *de facto* abdication of responsibilities in Government and industry that has come about for want of a clear understanding of the decisions and actions that actually control system acquisition programs."

The commission findings led to a major recommendation that an Office of Federal Procurement Policy be organized in the executive branch to formulate government-wide acquisition policies and regulations, and to monitor government-agency acquisition practices. Such an office has been formed. The commission also recommended that the acquisition work force be upgraded by establishment of an institution that could provide necessary education and services. This has been accomplished by the formation of the Federal Acquisition Institute (FAI) under Public Law 93-400.

Among the commission recommendations directly applicable to the major systems acquisition process were the following:

—Emphasize competition on alternative systems approaches at the "front-end" of the acquisition process in order to minimize the occurrence of performance and cost problems downstream.

—Increase competition for major system acquisition contract awards by encouraging small and medium-sized companies to propose alternate design concepts—provided they have contingency plans for the purchase or lease of production facilities in the event they win the competitions.

—Simplify the decision-making process—but keep it flexible—and place greater reliance on sound judgment and less on regulations and complicated contracts and clauses.

—Develop legal and administrative remedies to speed resolution of contract disputes.

—Reduce management and administrative layering between policy-makers and program offices.
—Require more government reliance on the private sector, rather than in-house facilities, for procurement.
—Study means to increase awareness of the costs associated with the implementation of social and economic goals through procurement.
—Give visibility to Congress to exercise its responsibilities, i.e., provide congressmen with the information needed to make key program decisions and commitments.

The general industry reaction to the report was favorable. One industry spokesman said increased competition was the most innovative portion of the commission's four-volume report. Other industry spokesmen felt that implementation of the recommendations would result in greater competition for new programs because of the early competition and the entrance of small companies into the market. The spokesmen felt that implementation of the recommendations would result in less red tape for government contractors, who were being confronted with a maze of procurement regulations.

Pentagon officials took the attitude that DOD was already moving in the direction recommended in the commission's report. The actions initiated by Packard 2 years earlier, and now being refined by new Deputy Secretary of Defense William P. Clements, Jr., were consistent with the commission's recommendations. However, DOD did initiate a change to the defense systems acquisition process. The change required that a greater search be made for alternative concepts at the "front-end" of the process. It was believed that by placing greater emphasis on the front end, the costs in the out phases would be reduced. However, the question that has to be answered on each program is, "How many competing concepts can be funded without having front-end costs get out of line?"

Controversy arose in government circles over the proposal to limit in-house government procurement and in industry circles over the use of government purchasing programs to further social and economic goals.

The report of the commission, while it attracted very little public attention, placed a sharp focus on the procurement process and brought about some needed reforms. Some of the commission's recommendations were implemented quickly; others took longer to implement; and some may never be acted upon either by the Congress or the departments within the executive branch.

NEW PROGRAM MILESTONE

When the new milestone was added to the front end of the defense systems acquisition process, it was identified as Milestone 0. This avoided a renumbering of the original milestones—and the possibility of creating unneeded confusion. Ac-

cording to the new procedure, the milestone decisions and phases of activity are as follows:

—*Milestone 0 Decision.* Approval of mission element need statement (MENS) and authorization to proceed into the concept exploration phase (Phase 0). The MENS identifies the mission, threat (basis for the mission), existing capabilities to accomplish mission, assessment of need, constraints, resources, and schedule to reach Milestone I.

—*Milestone I Decision.* Selection of most promising alternative concepts and authorization to proceed into the demonstration and validation phase (Phase I).

—*Milestone II Decision.* Selection of the preferred alternative concept(s) and authorization to proceed into the full-scale development phase (Phase II), which includes limited production for operational test and evaluation. SECDEF approval also indicates his intention to deploy the system.

—*Milestone III Decision.* Authorization to proceed into the full production and deployment phase (Phase III).

On a major defense system program, only the SECDEF has the prerogative to permit the omission of one or more of the program milestones or phases and to authorize "go-ahead" on the next one. Information for the SECDEF and Congress dealing with quarterly post-Milestone III status and threshold breaches on major defense systems is reported in the selected acquisition report (SAR) as was practiced previously.

LIFE-CYCLE COST AND DESIGN-TO-COST

In the early 1970s, life-cycle cost (LCC) and design-to-cost (DTC) played important roles in the DOD strategy to improve the defense systems acquisition process—a process that had to succeed if the United States were to continue to have a credible defense at an affordable cost.

In 1973, DOD adapted the design-to-cost concept to the systems acquisition process. This concept, used by companies in the commercial business field for many years, involves the establishment of a specific cost figure (in constant dollars for a specified number of systems at a defined rate of production) early in the system life cycle—before entry into the full-scale engineering development phase of a program.

In the initial issue of DOD Directive 5000.1, it was stated that "discrete cost elements (e.g., unit production costs, operating and support costs) shall be translated into 'design to' requirements. System development shall be continuously evaluated against these requirements with the same rigor as that applied to technical requirements. Practical trade-offs shall be made between system capability, cost, and schedule. Traceability of estimates and costing factors, including those for economic escalation, shall be maintained." The design-to-cost

concept recognizes that the best system design is a function of need, performance, life-cycle cost, and the number of defense systems required to meet the threat. It does not compromise system performance (capability) to meet cost objectives.

The Aerospace Industries Association concluded in 1973 that the design-to-cost concept would not have an impact on defense business unless some positive action were taken by DOD to ensure its effective implementation. Shortly thereafter, AIA began working with the OSD staff to develop a sound design-to-cost policy, and with the Joint Logistics Commanders to develop effective implementing procedures. The directive published in 1975—DOD Directive 5000.28— was favorably received by industry. To comply with this directive, the military departments had to revise their joint guide to make it more compatible with the policy contained in the directive. This revision was accomplished and industry found most of the practices set forth in the revised guide to be acceptable.

In the ensuing years, application of the design-to-cost concept has proved to be helpful on many programs by reversing the trend toward high unit production costs. However, application of the concept has not been successful on all programs. In spite of this, advocates of the concept are convinced that proper application of the design-to-cost concept can lead to reduction or elimination of unwarranted complexity and sophistication in new defense system designs.

DOD discovered that the design-to-cost principles are critical to controlling LCC. The initial design-to-cost goal should be decided in the conceptual period of a program, because cost is a feasibility issue. When there is a problem of buying sufficient defense systems to counter a potential enemy threat, high-cost solutions are not affordable.

Up to 35 percent of the LCC can be consumed in production, and up to 50 percent in operation and support. Therefore, the dollars spent prior to production to lower either production costs or operation and support costs can result in a significant return on investment. (See Figure 8.) It should be understood that costs distribution on a specific defense system program may vary considerably from that shown on the chart. Also, the cost of the demonstration and validation phase always tends to be significantly understated because contractors may finance up to 50 percent of that effort.

A review of the applications of life-cycle costing—initiated in November 1974 and completed in April 1976—was conducted by a National Security Industrial Association (NSIA) *ad hoc* committee at the request of the ASD (Installations and Logistics). This review on the subject of LCC established a dialogue between DOD and defense industry and a better understanding of life-cycle costs.[21] The

21. *Report of the NSIA Ad Hoc Committee to the Assistant Secretary of Defense (Installations and Logistics)*, subject: "Life Cycle Cost," April 1976.

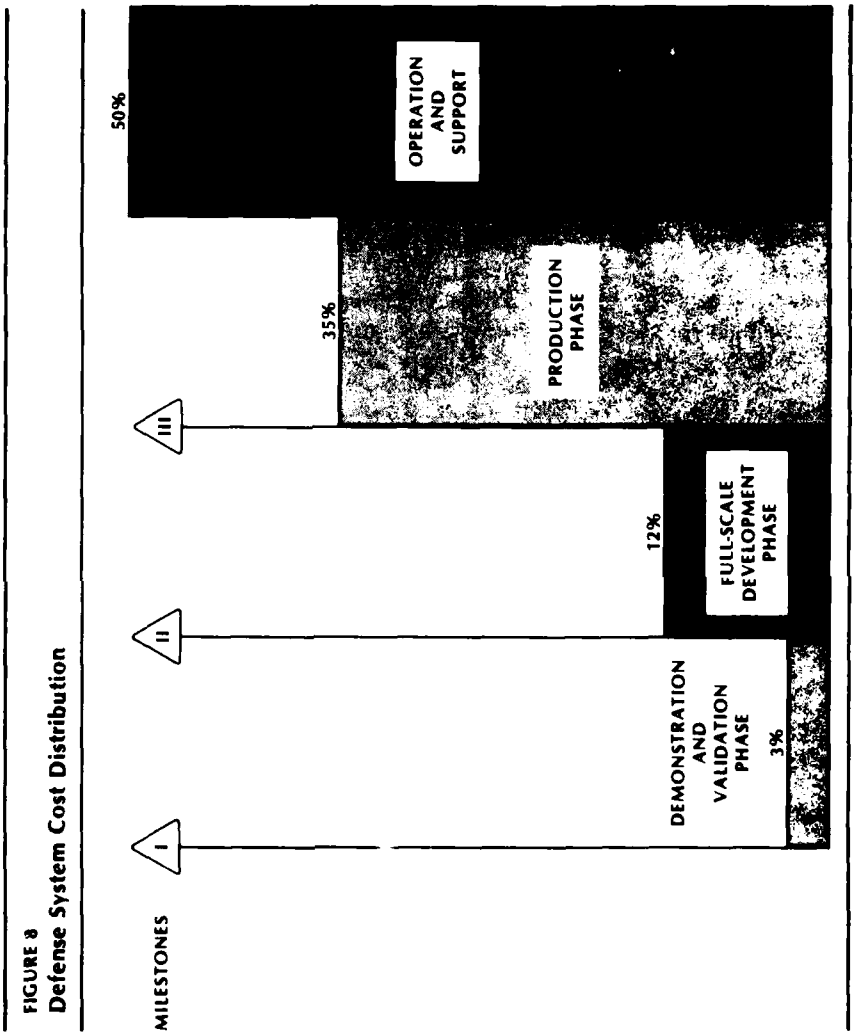


FIGURE 8
Defense System Cost Distribution

major findings of the *ad hoc* committee are summarized below:

—If the LCC of a system is to be managed throughout the life cycle, it must be specified, designed to, monitored, tested, and validated. This is not happening.

—LCC is only a qualitative consideration in source selections. The three principal

factors influencing LCC are unit price, mean-time-between-failures, and required operating and maintenance personnel. LCC cannot become a quantitative consideration until these three factors reflect increased validity.

—The procedure of considering logistic alternatives is being applied on some programs to reduce operation and support costs. However, this procedure is not being applied as a planned subset of either design-to-cost or LCC.

—There is a gross lack of knowledge of major cost drivers and the impact they have on total cost.

—The treatment of discounting and escalation in cost estimating varies from program to program.

—Total LCC cannot become a "design-to" objective if data bases aren't developed by both the contractors and the military services.

—Industry has applied very little new technology to reduce costs. Further, there is little coordinated LCC research underway in industry.

JOINT-SERVICE PROGRAMS

Joint-service acquisition programs have been strongly supported and generally encouraged by OSD and Congress for some time. In 1973, the Joint Logistics Commanders issued a memorandum of agreement (MOA) setting forth principles of joint program management.[22] The MOA introduced the concept of an executive (or lead) service and participating services and established the general authority and responsibilities of the services on a joint program. The MOA also addressed multiservice program charters, program master plans, and joint operating procedures to be used in joint-program management. To implement the concept, the MOA was promulgated as a joint regulation. A joint program is generally structured in such a way as to ensure accomplishment of specific goals. The importance of the program, as well as its size and urgency, affects the organizational structure and the way the program business is conducted.

Most of the policy and procedural guidance during the 1970s was developed by the cooperative effort of the services; however, the servicewide procedure for joint-program contracting was documented in the Defense System Acquisition Regulatory System (DARS).

To initiate a joint program, the Under Secretary of Defense for Research and Engineering prepares a memorandum designating the executive service and directing that service to charter the program. The concerned services, under the leadership of the executive service, negotiate the ground rules of the joint pro-

22. Memorandum of Agreement on *The Management of Multi-Service Systems Programs/Projects*, approved by the Joint Logistics Commanders, 20 July 1973. Published as a joint regulation: AFLC/AFSC R 800-2 AMCR 70-59/NAVMATINST 5000.10A.

gram and the assignment of program authority and responsibilities. The interstaff agreements are documented either in a memorandum of agreement or a charter approved by the JLC. At any time during a joint program, the program manager may submit a proposed charter change to the JLC for approval, if—in the manager's opinion—the joint program no longer represents the management needs or the service relationships.

The JLC sponsored in the late 1970s the development of a guide to assist the people involved in joint-service program management. The guide was published by the Defense Systems Management College in March 1980.[23]

INDUSTRY CONCERNS AND DOD ACTIONS

In the middle of the 1970s, industry voiced a concern that not all of the system acquisition policies issued by OSD were being carried out as intended. The industrial associations sounded the alarm. The National Security Industrial Association (NSIA), in a letter to Clements in April 1975, identified industry concerns and offered suggestions for improving the credibility of the DOD procurement process "in the eyes of the public and Congress, and strengthen mutual trust and respect between DOD and industry in the contractual relationship."[24] An attachment to the letter addressed such problems as excessive requirements, underestimating, overoptimism, unrealism of costs and schedules, buying-in, best and final offers (an auctioning technique), cost growth, overcontrol of industry, and change orders. The proposed remedies included ways to reduce acquisition costs, develop more realistic cost estimates, enhance the integrity of the procurement process, and improve the DOD-industry relationship.

After thoughtful consideration of the industry recommendations, revisions were made to DOD directives and instructions, as well as to appropriate service regulations. In some cases, problems were eliminated when the intent of the directives already issued was clarified. One of the actions taken by Clements in August 1975 was to require the military managers of 59 designated programs to report program status to him directly on a monthly basis.[25] Such reports were to include such basic information as "cost and schedule performance, critical problem areas, contractor relations and suggestions for improvement. . . ." This action by Clements stirred up the military departments and helped to bring about some

23. Joint Logistics Commanders' Guide for the *Management of Joint Service Programs*, Defense Systems Management College, March 1980

24. Joseph M. Lyle, President, National Security Industrial Association, to William P. Clements, Jr., letter relative to restoration of credibility of DOD's procurement processes in the eyes of the public and Congress, 18 April 1975

25. William P. Clements, Jr., memorandum to the Secretaries of the military departments and Joint Logistics Commanders relative to reporting requirements on designated programs, 28 August 1975.

constructive actions within the overall acquisition process. When Charles W. Duncan, Jr., succeeded Clements in 1977, this reporting procedure was discontinued on the basis that it had served its purpose. It is important to note that although DOD made a sincere effort to resolve the problems highlighted by industry, many of the problems have persisted.

The Technical Management Committee within the Aerospace Technical Council of the Aerospace Industries Association published a list of the desirable characteristics of government documents in 1978 to assist AIA members and others in the review of new or revised DOD policies, directives, and instructions, as well as implementing service procedures and regulations. The characteristics listed were based upon the principles associated with the successful practices used in the defense systems acquisition process in the past. The AIA list (with some minor editing) is shown in Figure 9.

ACQUISITION ADVISORY GROUP REPORT

In April 1975, Clements established an Acquisition Advisory Group (AAG) composed of persons at the executive level representing a wide spectrum of professional backgrounds and experience, both military and civilian, in various functional areas bearing on defense systems acquisition.

The AAG was given a charter to examine and assess the recommendations contained in recent reports of the Army Materiel Acquisition Review Committee (AMARC), the Navy/Marine Corps Acquisition Review Committee (NMARC), and the recommendations of the Secretary of the Air Force regarding the management of defense systems acquisition at the OSD level. The September 1975 AAG report submitted by Alexander H. Flax, its chairman, stated that ". . . acquisition management problems in OSD arise from well-motivated but inappropriate and largely ineffectual attempts to compensate at that level for failings in the Military Departments and program offices in the detailed execution of weapon systems acquisition programs."[26]

Some of the major observations and recommendations made in the AAG report were:

—There is no compelling reason to consider any major restructuring of the DOD organization to carry out the major systems acquisition policy.

—The DOD policy for major systems acquisition, as presented in DOD Directive 5000.1, is sound, but implementation of that policy by the services and the OSD can be improved.

---

26. *Report of the Acquisition Advisory Group* to the Deputy Secretary of Defense, 30 September 1975.

FIGURE 9
Desirable Characteristics of Government Documents

Government documents should:

1. Recognize that no two programs are identical.
2. Recognize that good management depends primarily upon the judgment of competent people having appropriate authority.
3. Contain realistic objectives.
4. Recognize that risk is an inherent part of the defense system development effort.
5. Motivate government/industry personnel to achieve overall program objectives.
6. Permit contractor management flexibility.
7. Specify what is needed, not how to achieve it. The need should be known early in the program.
8. Contribute to trust and candid communication between the government and industry—the customer and the contractor.
9. Strengthen the program manager's role and clarify the lines of authority, responsibility, and accountability.
10. Discourage "cookbook" approaches.
11. Recognize that acquisition begins with description of objectives rather than the objects.
12. Recognize the desirability of a number of different system solutions (options).
13. Avoid premature introduction of detailed requirements.
14. Allow contractors to propose the technical approach, the main design features, the subsystems, and the alternatives to schedule, cost, and capabilities.
15. Emphasize the contractor's role in tailoring to the minimum essential specifications, standards, management systems, and data.
16. Place greater reliance on meaningful competition, i.e., demonstrated performance rather than paper promises.
17. Recognize the need to increase the accuracy and credibility of cost estimates when hardware demonstration is proposed.
18. Preclude "technical leveling" and "cost auctioning."
19. Shorten, or do not unnecessarily lengthen, the acquisition process.
20. Encourage cost-effectiveness trade-offs.
21. Authorize the use of contractors' data formats.
22. Allow contractors to determine the requirements to be placed on their suppliers.
23. Tend toward reduced government surveillance.
24. Not duplicate the policy/requirements of other documents.
25. Be consistent with OMB Circular A-109.

Source: AIA Aerospace Technical Council, 1978.

—It is timely for the SECDEF to emphasize the part of DOD Directive 5000.1 policy that entails decentralization of the management of the development and production phases of major systems acquisition programs.
—The front end of the systems acquisition process should be structured to relate to the mission capability evaluation and planning functions, thereby implementing the recommendations of the Commission of Government Procurement. (This action was taken by OSD as described previously.)
—Improvements should be made in the cost management of major systems acquisition programs.
—The quality and quantity of personnel directly responsible for management of programs should be strengthened.
—The DSARC should function as an executive advisory body, confining its attention to decision-point assessments.
—The number of major systems acquisition programs subject to the formal DSARC process at the OSD level should be reduced to approximately 40 programs; the responsibility for the remainder of the programs should be delegated to the service secretaries.

The recommendations made by the AAG were thoroughly studied within OSD and the services. As a result, a series of positive actions were taken. For example, responsibility for programs that had passed Milestone III (commitment to production) was delegated to the service secretaries for surveillance; DSARC reviews of programs meeting objectives were held only in connection with major decision milestones; several programs were transitioned to service control. Joint-service, strategic, or internationally oriented programs, as well as those of major importance, continued under OSD direct decision control.

PROFIT POLICY

In May 1975, the Deputy SECDEF initiated a study to revise the DOD profit policy. This study, known as "Profit '76," was conducted for the purpose of finding a way to correct some of the deficiencies found in earlier profit policies and to motivate defense contractors to make investments that would lower DOD systems acquisition costs. The study, which reviewed a 5-year period, disclosed that major defense contractors realized an average pre-tax profit of 4.7 percent on sales of defense hardware and a 17.1 percent profit on their sales of commercial products. Further, the contractor's level of investment in facilities used for defense work was 10.9 percent of annual sales dollars, as compared with 41.1 percent for facilities used for commercial work. Clements concluded that many defense contractors believed defense business was not sufficiently profitable for the risks involved.

At the completion of its study, the "Profit '76" team arrived at the following

policy, which is in effect on DOD programs initiated since completion of the study:

—Recognize capital (facilities) as a real and essential ingredient of contract performance.

—Uniformly compensate contractors for the time value of facilities capital employed at an inputed interest rate associated with a risk-free investment. Treat this inputed interest as an allowable contract cost.

—Recognize that a special risk attaches to capital investments made for defense work. Provide contractors the opportunity to earn profit to compensate for this risk in the same general manner that they are given an opportunity to earn profit to compensate for the cost risks they assume.

—Emphasize effort and risk as profit determinants rather than contract costs.

—Recognize productivity as a factor in establishing the profit objective for a contract.

The new profit policy focuses on a contractor's effort, assumption of risk, and degree of facility investment. DOD anticipated that the policy would instill in defense industry some motivation for overall cost efficiency; however, there is some question at this time as to whether it will do so. To date there have been no significant improvements in profit margins as a result of implementation of the policy. Consequently, industry acceptance of the new profit policy is still lukewarm.

NEW POLICY ISSUED BY OFPP

In April 1976 the Director, Office of Management and Budget (OMB), and the first Administrator, Office of Federal Procurement Policy (OFPP), issued a new policy for the acquisition of major systems by all executive branch agencies. The new policy, OMB Circular A-109, *Major Systems Acquisitions*,[27] was intended to effect reforms that would reduce program cost overruns and diminish the controversy of the previous two decades concerning whether new systems were needed.

The A-109 policy was patterned after DOD directives in the 5000 series, particularly 5000.1. Consequently, it was consistent with the recommendations made by the Commission on Government Procurement in 1972. More specifically, the new policy required:

—Top-level management attention in each agency to determine mission needs and goals;

—An integrated, systematic approach to establishing mission needs, managing

---

27 Office of Management and Budget Circular No. A-109, *Major Systems Acquisitions*, 5 April 1976.

programs, budgeting, and contracting:
—Early direction of research and development efforts to satisfy mission needs and goals;
—Avoidance of premature commitments to full-scale development and production;
—Early communication with Congress in the acquisition process by relating major systems acquisitions to agency mission needs and goals.

As a result of the issuance of the A-109 policy, the SECDEF took the following action:
—Appointed the Under Secretary of Defense for Research and Engineering the Defense Acquisition Executive (DAE). The DAE is the principal advisor and staff assistant to the SECDEF for the acquisition of defense systems and equipment.
—Called for revision of DOD Directives 5000.1 and 5000.2 to place additional attention on the front end of a program, i.e., the establishment of the need for a program and the reconciling of that need to DOD capabilities, priorities, and resources.[28]

Industry, in an appearance before the House Armed Services Subcommittee on Research and Development in April 1978, indicated its support for improvements to the systems acquisition process—in this case, the issuance of A-109. The subcommittee was told that implementation of the policy would "improve the understanding by all participants of mission needs and goals; increase reliance on the private sector, enhance the competitive spirit . . . better focus responsibilities and authority, and increase and improve communications with Congress."[29] Of particular interest to contractors was the fact that A-109 required substantial technical freedom be provided at the outset of a new program, using "task-oriented" funding that would maintain both program and personnel continuity during the sequential decision-making process. Also, industry felt that, through the implementation of the new policy, it would have a better indication of defense priorities and mission requirements. Further, approval of the mission need prior to the start of a new program would tend to make the program more stable.

THE FOUR-STEP SOURCE SELECTION PROCESS

In 1976, DOD issued a revision to DOD Directive 4105.62.[30] This revision

28. U.S. Department of Defense Directive 5000.2, *Major System Acquisition Process*, 21 January 1975.
29. U.S., Congress. House, Committee on Armed Services, Statement of John H. Richardson on behalf of the Aerospace Industries Association of America, Inc., before the subcommittee on research and development, 94th Cong., 2d sess., 14 April 1978.
30. U.S. Department of Defense Directive 4105.62, *Selection of Contractual Sources for Major Defense Systems*, 6 January 1976.

established a four-step process for the procurement of advanced development, engineering development, and operational systems development effort. The reason for the new process was to put an end to the charges that DOD was engaging in unfair competition and using unsound business practices in evaluating the proposals and capabilities of companies competing for a contract.

The four steps in the source selection process are summarized below:

—*Step 1.* Submission and evaluation of technical proposals;

—*Step 2.* Submission and evaluation of cost/price proposals and, if appropriate, revised technical proposals;

—*Step 3.* Establishment of a common cutoff date for receipt of final revisions to the technical and cost/price proposals;

—*Step 4.* Negotiation of a definitive contract with the selected offeror.

The four-step process has forced more government-industry dialogue prior to solicitation. Also, technical leveling, technical transfusion, and auctioning have been reduced. Buy-ins appear to be declining; however, no process has yet been developed to eliminate all of the factors that motivate would-be contractors to engage in buy-ins.

ZERO-BASE BUDGETING

One of the first actions by President Jimmy Carter after taking office in 1977 was to direct the agencies within the executive branch to implement a zero-base budgeting (ZZB) process for preparation of the fiscal year 1979 and future budgets.[31] ZBB is a management process that provides for the systematic consideration of all programs and activities in conjunction with program planning and the formulation of budget requests. The principal goals of ZBB are as follows: to examine the need for existing programs; to allow proposed new programs to compete with existing programs on an equal footing for resources; to focus budget justifications on evaluations of programs; and to secure extensive managerial involvement at all levels in the budget process.

The ZBB process consists of five basic steps, namely:

—Determining decision units;

—Developing decision packages for each decision unit;

—Ranking the decision packages;

—Consolidating the rankings at higher organizational levels;

—Allocating resources.

Decision units represent the basic program or discrete organizational entity for which a separate budget is prepared and for which managers make significant

31. President Jimmy Carter, memorandum to the heads of the executive departments and agencies, subject: "Zero Base Budgeting," 14 April 1977.

established a four-step process for the procurement of advanced development, engineering development, and operational systems development effort. The reason for the new process was to put an end to the charges that DOD was engaging in unfair competition and using unsound business practices in evaluating the proposals and capabilities of companies competing for a contract.

The four steps in the source selection process are summarized below:

—*Step 1.* Submission and evaluation of technical proposals;

—*Step 2.* Submission and evaluation of cost/price proposals and, if appropriate, revised technical proposals;

—*Step 3.* Establishment of a common cutoff date for receipt of final revisions to the technical and cost/price proposals;

—*Step 4.* Negotiation of a definitive contract with the selected offeror.

The four-step process has forced more government-industry dialogue prior to solicitation. Also, technical leveling, technical transfusion, and auctioning have been reduced. Buy-ins appear to be declining; however, no process has yet been developed to eliminate all of the factors that motivate would-be contractors to engage in buy-ins.

ZERO-BASE BUDGETING

One of the first actions by President Jimmy Carter after taking office in 1977 was to direct the agencies within the executive branch to implement a zero-base budgeting (ZZB) process for preparation of the fiscal year 1979 and future budgets.[31] ZBB is a management process that provides for the systematic consideration of all programs and activities in conjunction with program planning and the formulation of budget requests. The principal goals of ZBB are as follows: to examine the need for existing programs; to allow proposed new programs to compete with existing programs on an equal footing for resources; to focus budget justifications on evaluations of programs; and to secure extensive managerial involvement at all levels in the budget process.

The ZBB process consists of five basic steps, namely:

—Determining decision units;

—Developing decision packages for each decision unit;

—Ranking the decision packages;

—Consolidating the rankings at higher organizational levels;

—Allocating resources.

Decision units represent the basic program or discrete organizational entity for which a separate budget is prepared and for which managers make significant

---

31. President Jimmy Carter, memorandum to the heads of the executive departments and agencies, subject: "Zero Base Budgeting," 14 April 1977.

decisions relative to the amount of spending and the scope or quality of work to be performed.

In applying the ZBB process in DOD, the budgets are submitted from the bottom up. The decision-makers evaluate decision packages (documents providing a brief justification for a program and a statement of resources required) and rank them in a decreasing order of priority. Annual budget requests are combined (by the material acquisition commands in the Army and Air Force and by OPNAV in the Navy) into decision units. At each higher level of command, like decision units are reaggregated, recombined, and reprioritized. Then OSD, in conjunction with the services, selects the decision units and their priorities for the ensuing fiscal year—based upon the program aggregations developed in the PPBS. Between October and December, OSD and the Office of Management and Budget (OMB) work out differences, but provide little opportunity for military departments to reclama on decisions reached.

The cited advantages for utilization of the ZBB process are as follows:
—It represents a rational, optimizing approach to budgeting.
—It requires that objectives be clearly stated.
—It requires a clear statement of program priorities.
—It encourages decentralization.
--It opens up channels of communication between those who are involved.
—*It allows existing programs to be terminated.*

The disadvantages of the ZBB process appear to be as follows:
—It produces results that are no different than they would be if incremental budgeting were used.
—It generates excessive paperwork.
—It increases the manager's workload.
—It requires quantification of program benefits in order to make the decision packages. All program benefits cannot be readily quantified.
—It has a centralizing, rather than a decentralizing, organizational effect.
—It attempts to turn what is naturally a political process into a managerial process.

The real worth, or lack of worth, of the ZBB process is an empirical question that can be answered only after more experience has been obtained. To date, as a result of implementing ZBB, the White House claims:
—A few programs have been eliminated.
—Program trade-offs have been identified.
—Top officials have become more involved in the budgeting process.
—Communication between top, middle, and lower levels of management has been improved.
—The clarity of program objectives has been improved.
Whether these improvements can be directly attributed to adoption of the ZBB process is still debatable.

PLANNING, PROGRAMMING, AND BUDGETING SYSTEM REFINED

In October 1977 the new SECDEF, Dr. Harold Brown, directed that the PPBS be revised to achieve the following objectives:

—Permit the SECDEF and the President, based on the advice of all appropriate offices and organizations in DOD, to play an active role in shaping the defense program;

—Create stronger link between planning the programmatic guidance and fiscal guidance;

—Develop, through discussion, a sound and comprehensive rationale for the defense program;

—Ensure that the defense program is based on sound analysis and contributions from all relevant offices.

Brown believed that the revised system would provide a more coherent basis for guiding the military departments in the preparation of their specific program objectives memoranda (POM). The revised system provided consolidated guidance to the military departments and defense agencies. In prior years there had been three separate forms of guidance from the SECDEF: (1) the defense guidance; (2) the planning and programming guidance; and (3) the fiscal guidance. Further, the revised system incorporated an analysis of the rationale for each aspect of the SECDEF's guidance and the overall defense program. At each step in the system, the SECDEF encouraged interaction, coordination, and open debate, if appropriate. Finally, the consolidated guidance identified fiscal guidance at three fiscal levels—minimum, basic, enhanced—in accordance with ZBB requirements.

One of the major problems in the defense systems acquisition process that still has to be solved is how to effectively connect the SECDEF decisions following DSARC meetings to the PPBS. The cost impact of the alternative designs of a specific defense system on a military department's fiscal ceilings, and the identification of actions that can be taken to maintain the defense system program within fiscal guidelines once a decision has been rendered, should be known before the decision is made.

SYSTEMS ANALYSIS

After the departure of McNamara and his successor, Clark Clifford, at the end of the 1960s, the size and influence of the systems analysis office waned for a short period of time. The advice of the military departments (which had strengthened their systems analysis capabilities during the 1960s) and the Joint Chiefs of Staff (JCS) began to carry more weight. The office of the ASD (Systems Analysis) initiated fewer studies and position papers, but it did provide comments on the papers prepared by the military departments and the JCS.

During most of the 1970s, the influence of the military departments *vis-à-vis*

OSD relative to determining needs became greater than it had been during McNamara's years in DOD. However, the approach taken by Brown since he became SECDEF in 1977, when combined with the increasing influence of the OMB, the National Security Council (especially under the leadership of Henry Kissinger), and Congress, has had the effect of adding more hurdles for the military departments to cross in order to have their evaluation of needs recognized. Today, the ASD (Program Analysis and Evaluation) has a good record insofar as winning post-POM issues.

DEFENSE RESOURCES BOARD

In April 1979, an advisory board, to be known as the Defense Resources Board (DRB), was established by Brown.[32] This board, chaired by the Deputy SECDEF, was given a charter to accomplish the following:

—Improve the efficiency and effectiveness of the PPBS.

—Direct and supervise OSD review of the service program objectives memoranda and budget submissions.

—Examine and resolve major service issues without SECDEF involvement, if possible.

—Present recommendations to the SECDEF for his action when deemed desirable.

It is too early to evaluate the value and effectiveness of this new DRB.

THE INTERNATIONAL ENVIRONMENT IN THE 1970s

During the 1970s, the steady build-up of the Soviet R&D and procurement outlays gave the United States and Western Europe no alternative but to pursue wiser utilization of their combined resources. Failure to do so could have placed the United States and its allies in the position of not being able to preserve credible deterrence and defense in the 1980s.

Western Europe, unhappy with U.S. domination of the defense systems and equipment market throughout the 1950s and 1960s, began to call for a "two-way street," i.e., reciprocal purchases of defense systems and equipment. The defense industries of our allies were growing. Therefore, unless the United States took the lead in establishing cooperative armaments programs, the trend would probably continue. If it did, it would reduce U.S. exports in Western Europe and prevent interoperability of defense systems or equipment within NATO countries.

This situation provided the background for President Carter's initiatives at the NATO Ministerial Meeting held in England in May 1977. At that meeting, President Carter stated the position of the United States relative to meeting the

32. Dr. Harold Brown, memorandum to the Secretaries of the military departments, Chairman of the Joint Chiefs of Staff, Under Secretaries of Defense, and others, subject: "Establishment of Defense Resources Board," 7 April 1979.

military and political challenges of the 1980s through the alliance. He said:

> We must make a major effort to eliminate waste and duplication between national programs; to provide each of our countries an opportunity to develop, produce, and sell competitive defense equipment; and to maintain technological excellence in all allied combat forces. To reach these goals our countries will need to do three things. First, the United States must be willing to promote a genuinely two-way trans-Atlantic trade in defense equipment. . . . Second . . . the European allies (must) continue to increase cooperation among themselves in defense production. . . . Third . . . European and the North American neighbors of the Alliance (must) join in exploring ways to improve cooperation and procurement of defense equipment. . . ."[33]

The "two-way trade"—or "two-way street" as it was identified by Thomas A. Callaghan[34]—is a concept of economic equity needed for long-term economic stability. Callaghan believes that efficient use of our resources by all allied nations is obligatory and it can't be accomplished without economic equity among the participants.

Dr. Walter B. LaBerge, former Assistant Secretary General for Defense Support, NATO, and now Deputy Under Secretary of Defense for Research and Engineering, agrees with this concept. He has said that ". . . the military-economic conflict forced upon the Alliance by the Soviets has . . . demanded economic equity as a condition for cooperation for mutual defense. . . . The flow on the two-way street of plans and technology can lead to cooperative programs to build the same equipment on both sides of the Atlantic. . . . The cost of modern weapon development has become so expensive that large scale cooperation . . . is already obliged."[35]

Dr. William J. Perry, the current Under Secretary of Defense for Research and Engineering, identified the primary thrust of our international programs at the close of the 1970s in his FY 1980 Posture Statement to Congress:

> The primary thrust of our international programs is the enhancement of the overall military capabilities of the NATO alliance to counter the continued growth of the Warsaw Pact forces. The basic objectives of our program are:
> —Reduction of duplicative NATO research and development for more effective and efficient use of collective resources.

---

33. President Jimmy Carter, address at the NATO Ministerial Meeting, Lancaster House, England, 10 May 1977.

34. Thomas A. Callaghan, President, Export-Import Technology, Inc., Washington, D.C.

35. Dr. Walter B. LaBerge, "A Concept of a Two-Way Street," *Defense Systems Management Review* 1:3 (Summer 1977):3.

—Promotion of fuller industrial collaboration in military equipment to achieve economies of scale and reduce unit costs.
—Enhancement of NATO military strength by procuring more and better military equipment because of the effectiveness of R&D and procurement resulting from cooperation.
—Enhancement of NATO military strength through increased interoperability and standardization of Allied military equipment.

Obviously, the objectives set forth by Dr. Perry will not be easy to achieve. They will require a major change to our past business approach. To accelerate the effort being made to rationalize NATO defense research, development, and procurement to meet the Warsaw Pact challenge, a triad of initiatives has been launched. They are as follows:

—*Mutual Defense Cooperation.* A series of general memoranda of understanding (MOU) has been prepared to set forth guiding principles governing cooperation between each NATO country and the United States in research, development, production, procurement, and logistic support of conventional defense equipment.

—*Dual Production.* Cooperative development and cooperative production programs between the United States and other NATO countries are the most visible operating initiatives to date. Defense systems such as the F-16 aircraft, and the NATO *Seasparrow, Hawk, and Roland missiles are dual-production ventures.* Before initiating these programs, unique acquisition procedures had to be developed jointly by DOD and foreign contracting officials.

—*Family of Weapons.* This initiative involves grouping "families" of weapons and then dividing up the development with no two countries or groups of countries working on the same weapon system. For example, one nation, or consortium of nations, will take the lead in developing the next generation medium-range anti-tank missiles. Although this approach reduces duplicative research and development costs, it creates national security issues. These issues include countries experiencing voids in organic technological studies for certain weapon systems; countries lacking control to ensure weapon systems development is timely for their particular needs; and the non-involved countries not having their particular needs met when total development is conducted by other countries.

In the aggregate, Dr. Perry and other OSD officials believe that the initiatives will help to ensure that the NATO forces are equal to the challenge of the Warsaw Pact forces. These officials also believe that the initiatives will not impair the overall competitive position of the U.S. defense industry or undermine the U.S. technology base. Finally, these officials believe that the cooperative programs that are conducted will not lead to the loss of jobs within the U.S. industrial base. They are convinced that the danger of loss of jobs will be more real if cooperation is not improved, because it would encourage expansion of the "Buy European" approach. On the other hand, there is a growing tide of opposition to cooperative

programs. The opposition believes that cooperation would lead to loss of jobs in the United States. The future holds the answer.

In addition to the NATO initiatives, weapons-specific MOUs have been signed with various countries whereby a portion of the total value of a foreign military sale will be expended through U.S. contracts awarded to industries in the foreign country. These MOUs differ from general MOUs in that specific goals force the acquisition community to consider foreign sources in their decision-making process.

At this time, new weapons-specific MOUs cannot include compensatory coproduction and offset agreements. Such agreements tended to create the impression of obligating DOD, and other agencies of the U.S. Government, to place orders for defense systems or components in foreign countries, or to require U.S. defense contractors to placé orders and subcontracts in foreign countries, as a condition of sale of U.S. defense systems or equipment to those countries. As a result, compensatory coproduction or offset agreements made in the past have led to friction between the allies when specific goals were not met. An exception to this policy established by the SECDEF may be made only if there is no feasible alternative to ensure the successful completion of a transaction believed to be of great importance to attainment of the national security objectives of the United States.

Congress has taken action in support of NATO rationalization, standardization, and interoperability (RSI) and its implementation policy. However, Congress has reserved the right to resist the purchase of a specific defense system or equipment from a NATO country for one or more reasons. For example, a purchase might be resisted to protect U.S. industry or U.S. military interests.

Program managers have been experiencing greater involvement in the multinational environment as a result of President Carter's initiatives and new DOD policies, such as those contained in DOD Directive 2010.6.[36] The DSARC must address NATO standardization and interoperability requirements before making a recommendation to the SECDEF to enter the next phase of a program. The NATO needs that are addressed may include the state of readiness and the ability to meet the potential threat using systems already developed by one of the NATO countries. Both the DSARC and the service acquisition review councils incorporate such an assessment in every step of the acquisition process. Thus, it can be seen quite readily that a program manager—performing in the international environment in the 1970s and the beginning of the 1980s—is faced with many challenges. These challenges include dealing with technology transfer, MOUs, third country sales, international business practices, international finan-

36. U.S. Department of Defense Directive 2010.6, *Standardization and Interoperability of Weapons Systems and Equipment within the North Atlantic Treaty Organization (NATO)*, 11 March 1977.

cial issues, and communications problems caused by language differences.

The Next Decade

At the beginning of the 1980s, our adversary—the Soviet Union—is much stronger than it was at the start of the 1970s. The United States has been losing ground for many years in force modernization. However, Dr. Perry, in a statement to Congress in February 1980, said that the United States is turning the corner and ". . . if we sustain the momentum of the new five year defense program, the decade of the 1980s will show us, along with our allies, narrowing the gap in the quantity of equipment deployed, while maintaining a qualitative edge." He added that, "in this era of unprecedented change, technological strength is the key to our long-range survival as a nation. A strengthened and vigorous program in defense research, development and acquisition is fundamental to the maintenance of stability and peace in the years ahead."[37]

The United States is behind the Soviet Union quantitatively in deployed weapon systems and has been falling further behind because of disparities in production rates for new systems. Although this country has maintained a lead in defense technology, it could lose that lead in the 1980s because the Soviets have greatly increased their investment in defense research and development. Dr. Perry believes that the United States still has some distinctive advantages at this time, namely: "a superior technological base, a competitive industry with greater productivity, and allies with a substantial industrial capability." To meet the formidable challenge the United States faces during this decade, our investment strategy must exploit the advantages the United States now holds.

Presently, defense industry is feeling the impact of the high cost of borrowing money. To meet the situation head-on, many prime contractors are cutting inventories and becoming reluctant to make large up-front investments. The high cost of money is significantly increasing acquisition cost and eroding the effective rate of profit earned by defense contractors. As a result, the prime contractors are showing a greater reluctance to expand capacity or invest in equipment to increase productivity. The subcontractors and suppliers—the small companies which are already experiencing problems in meeting delivery schedules—often have a greater need for borrowed working capital than the prime contractors do. These companies are having difficulty in borrowing money because of their size and financial condition. This situation, if not arrested, can lead to further reduction in the number of small companies participating in the defense systems acquisition business, and at the same time make it impractical for those companies that remain to make the kind of capital investments they should be making.

37. U.S. Congress, statement of Dr. William J. Perry on the *FY 1981 Department of Defense program for Research, Development, and Acquisition*, 96th Cong., 2d sess., 1 February 1980.

OFFICE OF THE SECRETARY OF DEFENSE VIEWPOINT

It is Dr. Perry's viewpoint that our defense investment policy during the 1980s must include two important objectives:

—Modernization of U.S. deployed defense systems.

—Maintenance of leadership in technology critical to defense.

The size and complexity of the research, development, and acquisition effort in the next decade will be a challenge to management. However, if the defense systems acquisition process can be further improved and managed effectively, it may be possible to reduce both acquisition costs and delays in deploying new or modified defense systems.

Last year, the Office of the Under Secretary of Defense for Research and Engineering undertook a series of management initiatives. The objectives—continuing into the 1980s—are to:

—Increase competition in procurement.

—Use technology to achieve major cost reductions in manufacturing.

—Extend the useful life of existing defense systems through product improvement.

—Improve cooperation with our allies in armaments development and production.

—Accelerate the acquisition process by permitting tailoring when the benefits appear to outweigh the cost of increased risk and extraordinary attention by management.

If the initiatives are successful, the United States should be in a better defensive posture at the end of this decade.

Cost is a very real problem at the start of the 1980s. The rising inflation rate is reducing our buying power and the DOD budget is still being constrained in order to allow funding to flow to people and welfare programs. Further, the complexity of our defense systems and the rising expenditures for personnel required to design, develop, test and evaluate, operate, and support them are driving up costs.

According to Dale W. Church, Deputy Under Secretary of Defense for Research and Engineering (Acquisition Policy), the production cost of a new defense system has grown at a rate of 4.5 times per decade since 1950 when compared with the cost of the defense system it replaced. In an attempt to spread the available funds, production is being stretched out on some programs. Unfortunately, this practice increases unit costs. If the defense system acquisition budget rises only modestly throughout the 1980s, the downward trend in defense buying power will continue. This is distressing because the total annual investment in defense systems production of the Soviet Union is already 85 percent greater than that of the United States.

Church says that our defense systems programs must be affordable in both "the near and long term." Programs that we cannot afford must be avoided, or

terminated, before substantial investment costs are incurred. It is generally recognized that the longer a program lasts, the larger the constituency that forms to advocate or support continuation of the program. Therefore, Church concludes, "We can accrue significant political and economic benefit from the early elimination of unworthy programs. . . ." Both OMB and Congress support this conclusion; however, there have been very few program terminations. Instead, the trend has been to buy a little bit of everything—sometimes called by some people a "balanced force" strategy—by selecting stretch-out options to minimize annual costs.

Dr. James P. Wade, Jr., Assistant SECDEF (Atomic Energy), has suggested some options for coping with the potential shortfall in deployed defense systems before the end of this decade. The options he sees are as follows:

—Allow the defense systems in the current inventory to age.
—Redesign the defense systems to achieve lower unit costs.
—Reduce force levels to equalize operating and modernization needs.
—Extend the effective operational life of all defense systems by pre-planned product improvement.[38]

Dr. Wade, as well as the Joint Logistic Commanders, suggests that more attention should be focused on the fourth option.

A recent report of a Defense Science Board (DSB) task force chaired by Dr. Richard D. Delauer, a corporation executive, sums up the situation today as follows:

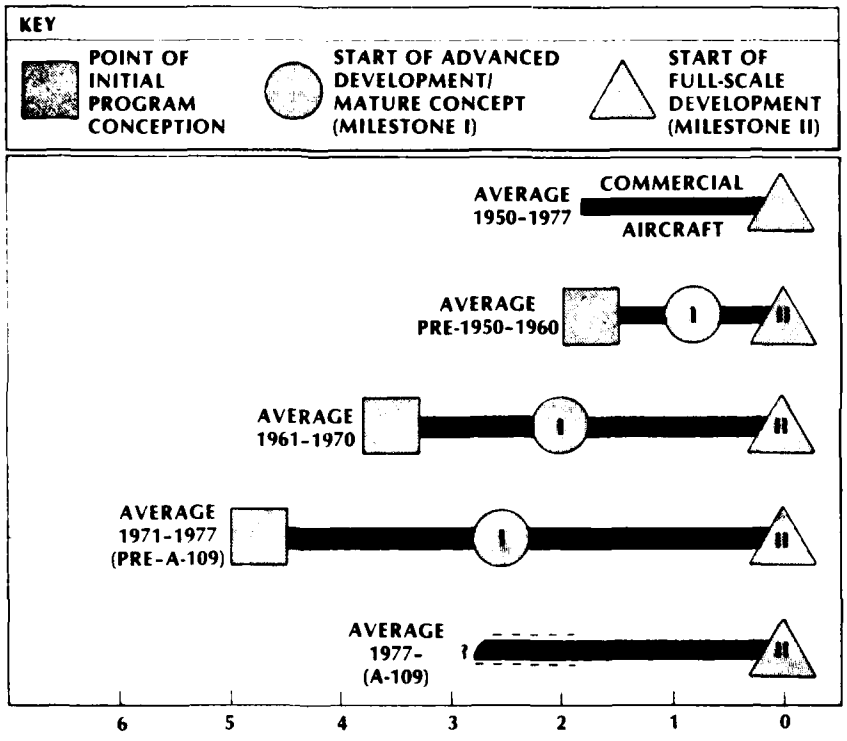
> The progression of acquisition policy changes from Total Package Procurement through the DSARC process, fly-before-buy (to reduce risks), full-scale prototyping, increased emphasis on operational test and evaluation, up to the current OMB Circular A-109 policy, has evolved out of the perceived need to correct deficiencies observed in specific programs by introducing additional management review and decision checkpoints to assure past mistakes would not be repeated. These procedural changes have become institutionalized and have been applied inflexibly to all programs with the result that the acquisition process has steadily lengthened (see Figure 10) and the procurement of defense systems has become increasingly costly.
>
> Lack of realism in the estimation of program costs, changes in specified performance requirements, inflation, and other such causes of cost growth have caused the aggregate cost of planned production programs to substantially exceed the allocated budgetary resources.

38. Dr. James Wade, *Acquisition Shortfalls and Options*, ADPA Seminar/Workshop on Pre-Planned Product Improvement at the Defense Systems Management College, Fort Belvoir, Va., 23 April 1980.

[This has resulted in a] . . . need to delay the completion of the production phases of programs in order to fit the total available defense budget each year.[39]

FIGURE 10

Front-End Trends in Defense Systems Acquisition Cycle



SOURCE: DSB REPORT, 15 MARCH 1978

39. *Report of the Acquisition Cycle Task Force* to the Chairman of the Defense Science Board, based on the 1977 Summer Study, 15 March 1978.

The DSB recommended that DOD directives focusing on major defense systems acquisition be updated to:

—Stress the need to consider the affordability of acquiring the defense system at every milestone.

—Introduce the concept of flexibility and timeliness throughout the defense systems acquisition process.

—Encourage the combining of decision milestones whenever possible.

—Discourage system prototyping unless the prototype is producible.

—Encourage joint development and operational testing, and independent evaluation.

—Require that program decisions be correlated with the PPBS.

—Establish that the Milestone III decision represents approval of rate production.

—Emphasize that the upgrading of existing defense systems is a desirable alternative to new defense system development whenever feasible.

The recommendations of the DSB have been incorporated into the latest revision of DOD Directives 5000.1[40] and 5000.2.[41] The recent revision to the test and evaluation directive (5000.3)[42] and the new integrated logistic support directive (5000.39)[43]—replacing DOD Directive 4100.35—incorporate new or revised policies based upon lessons learned in the 1970s. Among the other top-level documents being prepared or revised at this time are those covering reliability and maintainability, specification tailoring, manufacturing technology, embedded computer software, value engineering, and contractor incentives. Also, a move toward greater use of commercial products, services, and practices has been initiated.

DEFENSE INDUSTRY VIEWPOINT

Many staunch industry supporters of the maturing defense acquisition process are becoming concerned about the deteriorating health of defense industry. They attribute at least some of this to the factors listed below, as put forward by Oliver C. Boileau, Jr., a corporation president.

—Innovation is being discouraged.

—The United States is not producing enough defense systems.

—Too many "review boards" are capable of scrapping a program. The decisions they render may be based on political, rather than military, considerations.

40. U.S. Department of Defense Directive 5000.1, *Major System Acquisitions*, 19 March 1980.

41. U.S. Department of Defense Directive 5000.2, *Major System Acquisition Procedures*, 19 March 1980.

42. U.S. Department of Defense Directive 5000.3, *Test and Evaluation*, 26 December 1979.

43. U.S. Department of Defense Directive 5000.39, *Acquisition and Management of Integrated Logistic Support for Systems Equipment*, 17 January 1980.

—Reporting requirements are too numerous.
—Industry profits are too low. As a result, many defense contractors are seeking non-defense business.
—The government has shifted its role from that of partner to dominant partner to what, in many respects, might be considered an adversary.[44]

DOD and industry management agree that acquisition of new defense systems is taking too long. The 12 or more years usually required to bring new systems into the inventory is intolerable; therefore, a way must be found to reduce the time. Part of the problem, Boileau points out, is that a typical major defense system being procured for the inventory has to run an "obstacle course" from the day it is conceived until the day the last unit is delivered to the customer. Sometimes the technology in the defense system becomes obsolete before all of the units are delivered. Also, the need for the system—based upon capability to meet a threat—often changes while the system is in production. If the need for the system ceases to exist, production must be canceled. When such a cancellation occurs with little or no warning, it can throw involved contractors into extreme financial difficulty.

If DOD doesn't find a way to cope with the conditions cited above, defense contractors may not be willing to invest substantial funds of their own in new defense system concepts. There is at present a strong industry resistance to invest in the facilities and equipment necessary to economical production because of continually shrinking production requirements.

THE CONGRESSIONAL VIEWPOINT

Before presenting the congressional viewpoint, some "stage setting" might be in order. Congress has usually accepted technological parity with our adversary as a criterion for supporting the acquisition of defense systems and equipment. Congressional committees have consistently placed pressure on DOD officials to:
—Carefully assess the threat, and determine the U.S. needs;
—Improve the planning and budgeting process;
—Complete programs in a timely and cost-effective manner;
—Control cost growth; and
—Cancel non-productive programs.
Generally, Congress has disapproved follow-on effort on marginal programs.

Over the years there has been a constant striving to improve the resource allocation process. In DOD, an annual review of mission areas has proved to be a beneficial way of placing defense systems acquisition programs in a broader perspective. Accordingly, the Commission on Government Procurement recommended that the congressional budget proceedings begin with an annual review

44. Oliver C. Boileau, Jr., "Defense Industries and Government: Foolish Adversaries," *Government Executive*. August 1979, pp. 24-26.

by the appropriate committees of the missions, capabilities, deficiencies, and the needs and goals for new acquisition programs. This could then form a basis for budget reviews. This concept was adopted in the Congressional Budget and Impoundment Control Act of 1974. In accordance with the act, the FY 1979 President's defense budget contained the first mission-oriented display of the DOD programs. The most recent budgets also contain such displays. To date, Congress has shown very little enthusiasm for examining service programs from this perspective. If Congress does not do so soon, DOD may find it desirable to return to the former program-by-program approach.

Every year Congress reviews the current defense posture and policies, determines the priorities for defense spending, and authorizes funding. To do so requires considerable study, patience, and time. In order to accomplish this task effectively, the congressmen find it advisable to call upon military and civilian experts in DOD to serve as witnesses and provide advice. In addition, congressmen have to call upon their staff members for support. To function effectively, the congressional staffs must be capable of the following:

—Assessing whether DOD has correctly analyzed the enemy threat.

—Assessing whether each defense system requested by DOD will be capable of fulfilling its mission.

—Judging whether the costs and schedules for the development, production, operation, and support of a defense system are reasonable.

—Recognizing whether the cost growth for an ongoing defense system program is justified and controlled adequately.

When the time comes to cast a vote, the decisions of the congressmen are based upon their appraisal of and confidence in the expert witnesses, the advice of industry executives and representatives of the industrial associations, the arguments posed by military lobbyists, and the findings and recommendations of their staff members.

Two congressmen who have had a continuing concern over the years for the defense posture of the United States are Senator Lawton Chiles from Florida, Chairman of the Subcommittee on Federal Spending Practices and Open Government of the Committee on Government Affairs; and Representative Bob Wilson from California, Senior Minority Member, House Armed Services Committee. Some of their viewpoints relative to defense systems acquisition are expressed below.

Senator Chiles believes:

—A rebalancing of the responsibilities between the Congress and DOD is in order. When this is undertaken, a common framework for decision-making should be devised to permit a clearer separation of program responsibilities.

—The government program manager is always caught in the middle. First, the program manager has to deal with the confused responsibilities of the Congress and DOD. Second, the program manager is caught up in the confusion of respon-

sibilities between DOD and the defense contractor or contractors developing and producing the defense systems under contract.

—Congress cannot afford to become so enmeshed at the detail level in the decision-making and review process that it (1) fails to provide the funding needed for defense systems programs; (2) disrupts ongoing defense systems programs; and (3) denies flexibility to the managers who are already held responsible for executing the defense systems programs.

Senator Chiles' committee has been involved with the preparation and passage of the Federal Procurement Reform Act, S.5.

Representative Wilson believes:

—Congress and our recent administrations must share the blame for the deteriorating strength of the U.S. arsenal compared with that of the Soviet Union. This does not imply that the Congress does not want the United States to be strong; it means that the Congress has not always given defense needs the priority they require.

—The Congressional Budget Committee established during the 1970s adds another step to the process of authorizing and funding defense systems programs. This committee is stacked on top of the Armed Services and Appropriations Committees. Any defense system program that can survive the scrutiny of all these committees is a sturdy one indeed.

—The Congress is deeply concerned about arms sales by the United States to foreign nations. Supplying military systems, equipment, and services to our allies is an important part of our foreign policy; however, common sense must prevail in deciding who to supply and how much to supply. Armaments don't cause wars or tensions between nations, but conflicting ambitions, envies, and antipathies do.

INTERNATIONAL PROGRAM ARENA

The number of defense systems acquisition programs in the international arena is continuing to grow. As it does, more U.S. program managers will be affected by the many managerial problems that have to be solved. Before any program manager can function effectively in this arena, the proponents of international programs must take additional steps to resolve their differences and reach a common understanding as to the benefits to be gained by international programs.

Managers of defense systems programs will have a limited, but extremely significant, role to play in the international arena. DOD officials view the acquisition of defense systems as the activity that follows the making of essential policy-level decisions between the allied nations. The program managers who have to perform in this arena need a first-hand knowledge of the policy and a clear understanding of the procedures and techniques that will lead to successful internationalization of defense systems acquisition programs. The program managers in the 1980s will have to be able to cope with multinational defense

system design, development, and production. The blending and combining of a program manager's efforts with NATO rationalization, standardization, and interoperability policy will continue to be the responsibility of senior-level officials—both military and civilian—in OSD, the State Department, and other concerned offices in the executive and legislative branches of the U.S. Government. Ultimately, the successful acquisition of defense systems in the international arena will depend upon the following:

—The competency of the program managers and their teams;

—The innovative approaches program managers take in areas where no policies have been formulated;

—The ability of program managers to tailor their programs to include only those policies that are applicable;

—The willingness of involved countries to commit adequate resources to ensure achievement of program objectives.

Looking ahead, the defense posture of the allied nations—viewed by many astute observers as being militarily weak and somewhat disunited politically—must be improved. A way has to be found to counteract the Soviet military threat to Europe. NATO can meet the challenge provided that it acquires—in sufficient quantities—suitable new, advanced defense systems. At this time the Soviets are becoming concerned about the links being forged between the United States and China in the Far East, where Japan and Korea already have close ties with the United States.

SUPPORT OF INDUSTRIAL ASSOCIATIONS AND OTHERS

For more than a quarter of a century, the industrial associations and related organizations have done much to enhance cooperation and understanding between DOD, industry, and Congress. The organizations have helped to bring about some significant improvements in the defense systems acquisition process and it is anticipated that this help will continue in the future.

In a recent presentation before a congressional subcommittee, John H. Richardson, a corporation president and industry spokesman, stated a continuing industry belief:

> . . . successful (defense) systems acquisition depends primarily on competent people with appropriate authority, realistic objectives, appreciation of and ability to resolve risk, candid and in-depth communication, contractor motivation, and management flexibility and recognition that all programs are different and require different approaches appropriate to their individual characteristics.[45]

45. Richardson. Statement on behalf of AIA, 14 April 1978.

Summary and Final Thoughts

In the defense systems acquisition community, the late 1950s and 1960s were characterized by centralized control at the OSD level, by overreaction to management problems, by procedures and regulations that were too detailed, by multitudinous paper studies to determine risks (rather than by hardware testing), by management theories that were too often in conflict with real-life practices, and by growing industry frustration.

But the situation wasn't all bad. The findings of the President's Blue Ribbon Defense Panel in 1970 allayed many misconceptions held during that period.[46] For example, the panel report showed that defense industry was not making excessive profits, the contracting practices being used were not illegal, and conflict of interest did not exist between military personnel and defense contractors. On the negative side, the panel found that both DOD and industry had failed in their public relations—the public had not been informed of the remarkable achievements resulting from DOD-industry teamwork.

By the close of the 1970s, the length of the acquisition process—from initial system concept to initial operational capability—was averaging about 5 more years than it did in the middle of the 1950s. Most of this increase was caused by the additional front-end actions and, to some extent, by an increase in the period from the completion of full-scale development to achievement of full operational capability. The average full-scale development time has remained essentially the same over the years.

At the threshold of a new decade, DOD is faced with a series of problems that need solutions if the United States is to at least maintain its current force levels. The Defense Science Board indicates that if the DOD procurement account has only a modest increase during the 1980s, there are four alternatives open. These are to:

> —Reduce unit costs on both new and existing (defense) systems;
> —Increase the capability of current (defense) systems, and major subsystems, where needed, to meet the changing threat;
> —Reduce the number of new starts, buying more of the current systems; or
> —Reduce the number of (defense) systems procured.[47]

The current practice appears to be to stretch out programs. Few have been canceled. Given the same defense funding, termination of some marginal pro-

---

46. U.S., Department of Defense, *Report of the Blue Ribbon Defense Panel* to the President and the Secretary of Defense, July 1970.

47. U.S. Department of Defense, Office of the Under Secretary of Defense for Research and Engineering, *Report of the Defense Science Board 1979 Summer Study on Reducing the Unit Cost of Equipment*, March 1980.

grams would make more funding available to allow more efficient production rates on high priority programs. The second alternative, which addresses programmed or pre-planned product improvement, was mentioned previously. That alternative, in combination with the first and third—or both—might provide a suitable answer.

In reviewing the evolution of the defense systems acquisition process over the past three decades, it is quite clear that many important improvements have been made, despite changes in management philosophies in the executive and legislative branches. The basic process—depicted in a generalized form in Figure 11—has remained essentially the same. A milestone has been added; the names by which the program phases are known have changed; some of the requirements to be met before approval to enter the next phase of a program have been modified; but the basic concept has not been altered.

Through the years, several problems have continued to persist, regardless of changes in policies or procedures made to solve them. This in no way should be considered as an indictment of the process. Rather, it should serve as an indication of the magnitude and complexity of the task to be accomplished. The process has been able to meet the challenges, including those associated with joint-service programs and multinational programs.

At this time, with a somewhat constrained acquisition budget, we must:

—Ensure defense systems acquisition program stability.

—Concentrate on best use of available or projected resources.

—Delegate the authority and assign the responsibility to each program manager to (1) develop his acquisition strategy, and (2) tailor the application of directives and standard regulations to his program.

—Explore use of larger quantities of lower cost systems and smaller numbers of highly sophisticated and expensive defense systems.

—Provide multiyear funding after a defense system has been approved for a production run lasting more than 3 years.

—Increase productivity; provide more contract incentives to encourage it.

—Make further improvements in profit policies imposed on contractors. For example, either profit rates or contract progress payments should be increased in order to offset the profit degradation industry is experiencing as a result of the high cost of borrowing money.

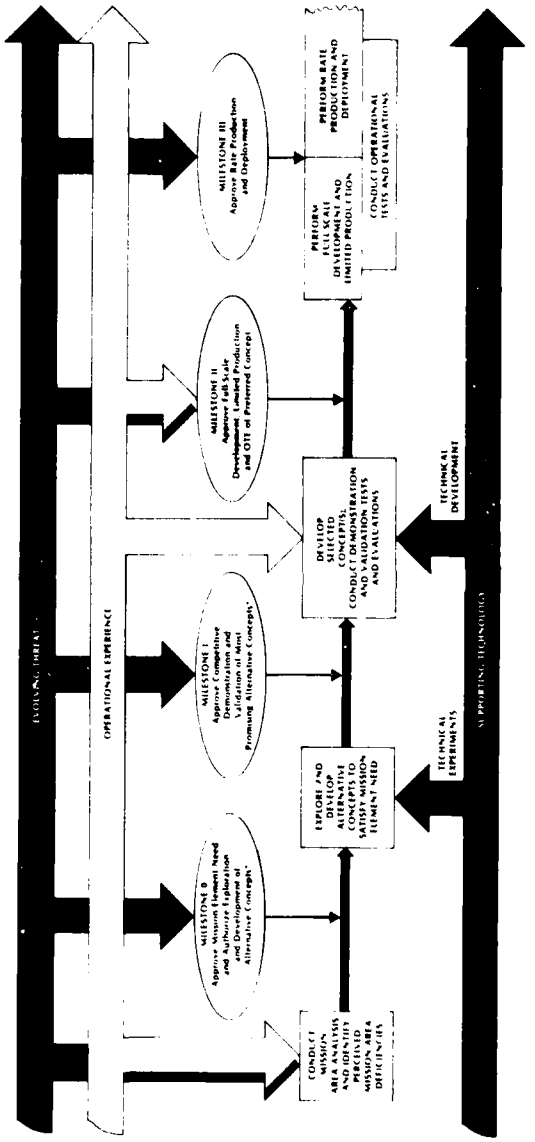
—Employ life-cycle costing as a philosophy on all defense systems acquisition programs.

—Develop better procedures for accomplishing programmed and pre-planned improvements to defense systems during their operational life.

—Decrease the time from recognition of a need for a defense system to deployment of that system.

—Reduce the number of socio-economic programs Congress has tied to defense systems acquisition. The cost impact of each socio-economic program should be a

FIGURE 11
Anatomy of the Defense Systems Acquisition Process



*Improvement of a current defense system should always be a consideration.

serious consideration before it is applied to the procurement of a defense system.
—Coproduce defense systems with friendly foreign governments without causing disruptions in the U.S. defense market or serious problems for logisticians.

In addition to the above, we must:
—Foster the spirit of cooperation between DOD and defense industry.
—Be alert to, and abolish, those DOD policies and resulting practices that are incompatible with one another.
—Be alert to, and modify or cancel, those DOD policies and resulting practices that are unclear, redundant, or not cost-effective.
—Continue to improve communication between DOD, defense industry, Congress, and the private sector.

Our senators and representatives—and their staffs—can help ensure the efficiency of the systems acquisition process by taking the following steps:
—Continuing to monitor the initiation and status of our defense posture, and authorizing the development, production, fielding, and support of those defense systems required to maintain a strong defense posture.
—Refraining from passing costly, non-productive legislation which affects the defense systems acquisition process. When socio-economic programs must be applied to defense systems programs, additional dollars should be made available to cover the additional program costs.
—Finding ways to keep unexpected cancellations of seemingly important defense systems acquisition programs to a minimum, still recognizing that some program terminations will always be needed.
—Providing timely authorizations of funding each year.
—Providing legislation that permits multiyear funding on major defense systems acquisition programs entering a production phase. This would provide program stability and industry would be able to take advantage of more economical production practices.

At a very critical time during World War II, James V. Forrestal was quoted as saying: "When the war is over, I hope that American business will remain close to the Services . . . . The valuable contributions that both the military and industry are now making to the Nation's welfare . . . [should] not be lost."[48] Forrestal's concerns were shared by others. As a result, an effective government-industry working relationship—one devoted to the design, development, production, and fielding of first-class defense systems and equipment—emerged. Since World War II, the industrial associations or other professional groups have played an important role in encouraging continuation of the government-industry teamwork and have served as "sounding boards" for DOD, industry, and Congress relative to

48. James V. Forrestal, while serving as Under Secretary of the Navy, uttered these words to Frank M. Folsom, chairman of the Procurement Policy Committee of the War Production Board, on a flight to the Headquarters of the U.S. South Pacific Fleet in August 1942.

changes that would enhance the defense systems acquisition process. This teamwork should continue throughout the 1980s.

Finally, it is of paramount importance that not only we in DOD, but the citizens who foot the bill and elect the Congress, understand the realities of the world in the 1980s. An attack against the forward deployed forces of the United States could occur at any time with little or no warning. If such an attack does take place, the United States will not have time to mobilize as it was able to do at the start of World War II. Therefore, the United States must be prepared to go into battle and win with the armed forces and defense systems and equipment that it has available at any moment. Although the United States may not be facing an immediate crisis, General David C. Jones, USAF, Chairman of the JCS—in a statement to Congress in January 1980—cautioned that:

> Under the best of circumstances, the 1980s will be a period of widespread international turmoil and instability. . . . The world is in many ways different and more threatening than a year ago and all signs point to even greater risks as the days pass.[49]

With the continuing support of Congress, and the successful application of government/industry teams to the task at hand in defense systems acquisition programs, the United States will be prepared to face any threat it may encounter during the next decade.

In 1922, Jose Ortega y Gasset said, "Nations are formed and are kept alive by the fact that they have a program for tomorrow."[50] Thus, if we—as a nation—want to enjoy the fruits of our freedom tomorrow, we must have well-trained and equipped armed forces, an adequate defense industrial base with surge capability, and an effective program for defense systems acquisition today.

APPENDIX
INDUSTRIAL ASSOCIATIONS AND OTHER PROFESSIONAL GROUPS

The successful establishment of DOD-industry teams to develop and field defense systems, and to improve relations with the Congress is due in no small way to the devoted and continuing efforts of a number of industrial associations—acting either individually or collectively, as appropriate. The dedication of the industrial associations and some of the professional societies to ensuring effective management of defense system programs has enabled our country to preserve—in the most cost-effective manner—the way of life we enjoy today.

---

49. U.S., Congress, House, *United States Military Posture* Statement of David C. Jones, 96th Congress, 2d sess., January 1980.

50. Jose Ortega y Gasset, 1883-1955, philosopher and foremost Spanish thinker of the 20th century.

The Council of Defense and Space Industry Associations

The organization that represents the common interests of the industrial associations is the Council of Defense and Space Industry Associations—commonly referred to by its acronym, CODSIA. The six associations comprising CODSIA include in their membership all of the major companies in the business of producing defense and space systems. The associations also include in their membership many small companies that devote part or all of their time to this effort.

CODSIA was formed in June 1964 as an unincorporated, voluntary, nonprofit, non-lobbying organization for obtaining broad industry views on new or revised government policies and procedures relating to the acquisition and fielding of defense and space systems and equipments. As originally conceived, CODSIA functions as a coordinative and consultative organization. It is not an industry or trade association, because it in no way diminishes or disturbs the authority of its individual member associations. The members of CODSIA are completely free to deal directly with DOD personnel, and vice versa. Relative to the DOD, CODSIA provides a central channel of communication that simplifies and expedites industry-wide consideration of proposed or revised policies, directives, instructions, and regulations associated with the defense systems acquisition process. CODSIA also serves as the organization through which problems and questions concerning DOD acquisition policies and procedures may be channeled for industry consideration and response.

CODSIA is composed of six associations. These associations and their purposes are briefly discussed below.

NATIONAL SECURITY INDUSTRIAL ASSOCIATION

NSIA, founded in 1944, is a national organization of diversified manufacturing, research, and service companies. The stated purpose of NSIA is to: express broad industry points of view in advising the government on problems of national security; and to maintain and improve the communications between industry, the DOD and defense-related agencies, and NASA. This association does not advocate or represent the special interests of any trade or group.

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

AIA, founded in 1919, is a voluntary national trade association of the manufacturers of aircraft, missiles, spacecraft, propulsion, navigation and guidance systems, support equipment, accessories, parts, materials, and components used in the construction, operation, and maintenance of these products. The primary purpose of AIA is to foster the advancement of aeronautical and astronautical parts and products in direct support of national policies, industrial preparedness, and the overall public interest.

ELECTRONIC INDUSTRIES ASSOCIATION

EIA, founded in 1924, is the national trade association of the manufacturers of electronic parts, equipment, and systems for all applications including national defense and space exploration. The preparation of engineering standards, the gathering of marketing statistics, and the development of a general industry position on legislative and regulatory matters are typical of the functions which this association performs for industry.

MOTOR VEHICLES MANUFACTURERS ASSOCIATION OF THE UNITED STATES, INC.

MVMA, founded in 1913, is a national trade association of motor vehicle manufacturers. The association promotes the general welfare of the industry consistent with the law, the public interest, and the attainment of our country's economic, social, and environmental goals. The association strives for effective communications between government and industry, and supports the concept of a free competitive economic system. Member companies contribute to the defense program through the design, development, and production of military and space products, including personnel carriers, cargo trucks, wheeled and tracked vehicles, aircraft engines, guns, missiles, and inertial guidance systems.

SHIPBUILDERS COUNCIL OF AMERICA

SC/A, founded in 1921, is a national trade association composed of companies engaged in the design, construction, and repair of ships, other marine craft, and marine equipment for the U.S. Navy and the U.S. Merchant Marine. The association's objectives are to inform and appropriately present the collective views of its members. Member companies—most of the U.S. shipbuilders—are concerned with pertinent government legislative, executive, and judicial trends, as well as worldwide industrial and economic trends, that might affect the maintenance of a sound private shipbuilding and ship-repairing industry—one capable of supporting our national needs in time of emergency.

AMERICAN ELECTRONICS ASSOCIATION

AEA, founded in 1943, is a national trade association comprised of companies engaged in a broad spectrum of electronics research and development. All of the member companies operate in fields of high technology, designing and manufacturing sophisticated equipment to meet the needs of both the government and the commercial markets. The association is concerned with governmental affairs, international trade, and management education.

Other Associations and Professional Organizations

In addition to CODSIA and its member associations, some other organizations have been doing much to enhance government-industry cooperation and support relative to acquisition of defense systems. Among the more prominent

organizations in this endeavor are the following:

—The American Defense Preparedness Association (ADPA), a society of concerned citizens and military personnel who are interested in industrial preparedness and dedicated to fostering progress in science, education, and management.

—The National Contract Management Association (NCMA), an association of individuals who are concerned with administration, procurement, negotiation, and management of government contracts and subcontracts. This association is also concerned with education and improvement of the professional skills of its members.

—The American Institute of Aeronautics and Astronautics (AIAA), an organization of individuals who are concerned with fostering overall technical progress in the field of aeronautics and astronautics and increasing the professional competence of its members.

—The Society of Logistics Engineers (SOLE), a society of managers and technical practitioners who are concerned with the art and science of management engineering and technical activities associated with requirements, design, and supplying and maintaining resources to support objectives, plans, and operations.

—The Armed Forces Communications and Electronics Association (AFCEA), an association devoted to maintaining and improving cooperation between the armed forces and industry in communications, design, production, and maintenance, as well as to fostering the development of scientists and engineers.

—The engineering societies, such as the American Society of Mechanical Engineers, the American Institute of Industrial Engineers, and the American Institute of Electrical Engineers, who are concerned with engineering, production, and effective management of projects.

This list is by no means complete. It is included here only to make the point that a large number of responsible, dedicated, and patriotic organizations are concerned with ensuring that the United States has available for its armed forces those defense systems and equipment capable of successfully deterring any enemy aggression.

Affordability—Let's Not Make It a Dirty Word

78

Rear Admiral L. S. Kollmorgen, USN
Lieutenant Commander S. E. Briggs, USN

In the years since President Nixon's Blue Ribbon Panel and the institutionalization of the "DSARC process" in 1970, there have been several "outside" reviews of the acquisition process. Nearly all of these reviews have noted the increasing length of that process. Over the last 10 years, the acquisition process has lengthened by about 3 months per year—with virtually all of the growth occurring in the "front end."

The institutionalization of the concept of affordability could, if great care is not taken, add to the length of the acquisition process. To avoid that, we must have a firm idea of what affordability is—and is not.

The recently signed revisions to DODD 5000.1 and DODI 5000.2 have added affordability as a concept which must be dealt with in the DSARC process. Yet, it is also noted that the concept is "principally a determination of the PPBS [planning, programming, and budgeting system] process." This apparent disparity is symptomatic of the continuing need to reconcile the often conflicting guidance of the two processes. Now a real, and more importantly a double linkage has been made official DOD policy.

Unfortunately, 5000.1/.2 leave us hanging on the affordability issue; policy and procedure are given without a firm definition of what the term means. It is a good top-level management practice to set policy and leave implementation to the user, but a common understanding of the concept to be implemented is essential.

Understanding the Concept

The term affordability has appeared in articles, papers, and even directives to such an extent that it is already an established "buzz word." Most users of the term think of it as a philosophy; few consider it a tool, and even fewer have discussed the mechanics of its application. Since affordability is at the leading edge of today's budgetary dilemma—and, judging from some recent writing,

---

Rear Admiral Leland S. Kollmorgen, USN, is Director, Systems Analysis Division, Office of the Chief of Naval Operations, responsible for providing evaluations of Navy programs, analytical support for decision-making, independent cost estimating, and management of scientific, analytical, and technical studies. He has served in the office of the Director, Defense Research and Engineering (now USDR&E), and the Director, Navy Program Planning. Rear Admiral Kollmorgen holds a B.S. degree from the United States Naval Academy and an M.S. degree in international affairs from George Washington University.

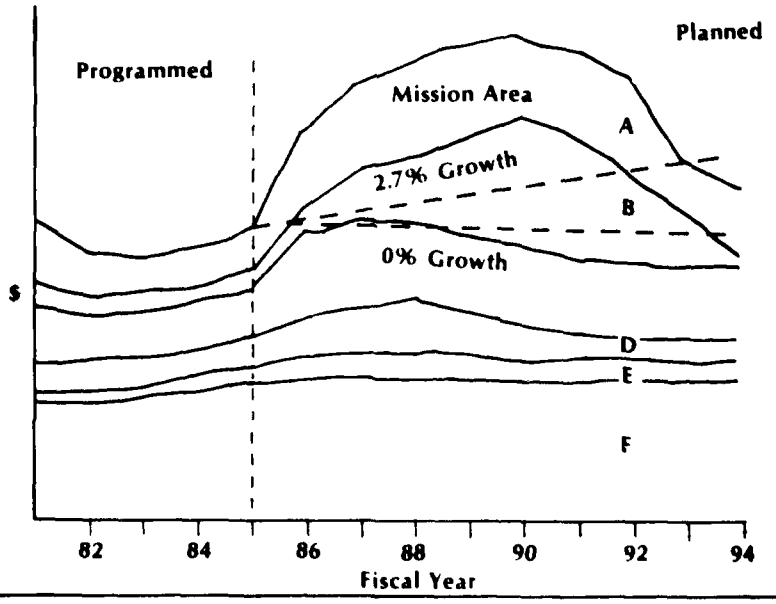
Lieutenant Commander Steven E. Briggs, USN, is the Systems Acquisition Coordinator, Systems Analysis Division, where he serves as the focal point for acquisition policy and program review. Lieutenant Commander Briggs holds a B.S.A.E. degree from the University of Virginia and an M.S. degree in operations research from the Naval Postgraduate School.

already subject to interpretive misunderstanding—it is worth our time to examine its value, intent, and useful application.

The fiscal necessities that force affordability considerations have been documented well enough so that only a brief synopsis is necessary. Notwithstanding increased public sympathy for larger defense budgets, the Office of Management and Budget policy has fixed the DOD budget as a percentage of the Gross National Product (GNP) (about 5 percent), thus tying defense budget growth to GNP growth. But, the average rate of GNP growth over the past four decades has gradually slowed from 4.8 percent in the 1940s to 2.9 percent in the 1970s. At the same time, inflation has shown an opposite, faster trend in growing from under 2 percent in the 1940s to over 8 percent in the 1970s. In terms of purchasing power, the decline has been some 30 percent over the past three decades. Thus, defense is getting effectively less no matter how you look at it.

At the same time, knowledgeable observers recognize that the services have more programs in development than can be produced and deployed given current and projected budgetary support. Figure 1 graphically illustrates the dichotomy

FIGURE 1
Funding Projections



between the programs planned and the funding available. The result is the "bow wave" phenomenon. The size of this bulge is such that a 1979 Defense Science Board study projected a required 40 percent reduction in unit cost just to maintain current inventory numbers. This translates into a 17 percent growth in the defense budget, far in excess of what can be expected.

Aggravating the problem is a growth rate in weapons systems costs which exceeds that of the defense budget (and the GNP). The sobering conclusion is that the DOD (services) must concentrate their declining purchasing power on the most important things, and that means fewer things. Even if real growth in the defense budget is obtained, the cost of sophistication will still force difficult decisions.

The crux of the problem is how to go about doing that, i.e., how to determine how many "most important things" to concentrate on. That is where affordability analysis can help.

What is required is a responsible, top-down look at needs, priorities, and availability of the resources. Affordability can fill the bill if we adopt the simple definition that *it is nothing more than an evaluation of total needs in relation to anticipated resources.*

Applying the Concept

When dealing with an inherently simple principle, there is the ever-present danger that we will define, interpret, and policy ourselves into an institutional monster. In reality, the mechanics of affordability are simple.

You can start by projecting the resources ($s) that can be expected within some definable and defendable boundaries. This can be done by use of historical data or, to be analytically sophisticated, by a linear regression of past budgets. Then perform an affordability check by aggregating programs by appropriation, mission areas, functions, etc. That is, structure a set of "Figure 1" type graphs. Apply boundary conditions (0 percent growth and 2.7 percent growth are shown in Figure 1). Then a review of the needs and a prioritization of the programs to fulfill those needs will be a logical fallout. You will be looking at the outyear effect of today's decisions—a useful perspective for the decision-maker.

Because it is an outgrowth of fiscal constraints, we in DOD usually think of affordability in monetary terms. But, there is no real reason why it cannot be applied to any situation where the combination of demands exceeds the available supply. Even now this check is being applied to the manpower requirements of new and existing programs. It is sometimes held that higher technology will reduce manpower requirements, but this is not proving true. Sophisticated systems are demanding higher skills, which are in short supply. Already, some manpower demands are exceeding the boundaries of projected manpower available.

In reviewing needs you will undoubtedly find that there are options; e.g.:
—Keep some weapon systems longer
—Buy more of the same
—Modify the existing system or systems
—Buy a lesser capability system developed elsewhere
—Develop a new system

Simple, you say? It is! The aggregations, the boundaries, and the necessary simplifying assumptions are all yours to control. In short, it is not rigorous and the temptation to "model" affordability should be resisted.

Top-Down Management

There are already spokesmen on the street linking affordability directly to trade-off considerations at the program-manager level. Wrong! It should be used as a macro-management tool. Program managers should be aware of the concept, but they cannot set their own program's region of affordability. The service or agency head must determine the affordability boundaries. PMs can provide input to the process and test boundaries for feasibility in an iterative process—*if* required.

Affordability is primarily a tool for senior management to use in making the first screen of the need and establishing the feasibility of financing the acquisition within anticipated resources. It is essential that these same decision-makers concentrate on meaningful aggregations in order to determine trade-offs.

A System for Senior Managers

In the authors' view, the DOD acquisition process could be speeded up and improved substantially if the Secretary of Defense and the service secretaries were to agree on a procedure whereby:
—The service conducts mission area analyses and prepares application Mission Element Need Statements (MENS) for submission during the budget cycle. (DODD 5000.1 .2 support this.)
—The MENS is submitted as a notification of the need and the intention to proceed with the preliminary steps to find a solution to the need.

The Secretary of Defense would review those needs annually in the context of broad mission categories and budget projections—a top-down, macro look. The tools for such top-level OSD mission area trade-off decision-making is available in current PPBS documentation, the extended planning annex (EPA), the Five-Year Defense Plan (FYDP), and the program objectives memoranda (POMs) from each service. Such procedure would lead to a necessary and desirable convergence of the PPBS and acquisition processes.

The service secretaries and chiefs should be involved to establish the proper framework and baseline for subsequent budgetary and planning activity to carry

out the decisions. The aforementioned top-level OSD involvement in mission area trade-offs and prioritization would enable each DOD component to prioritize effort rationally within each mission area.

OSD has clearly provided the framework for each service's affordability check. Some form of an affordability analysis must be used by the services to construct their POM, and the Navy has used this process for some time in conjunction with POM development. Through rational programmatic choices, efforts are slowed, cancelled, or deferred until the total funding requirement is brought within the bounds of resource projections. This same approach can be applied with ease to mission areas, appropriation areas, functional areas, or any category desired.

The PPBS/Acquisition Process Linkage

Revised DODD 5000.1/.2 and amplifying memorandum have emphasized the desire for the MENS (or its equivalent) to be the basis for a program's inclusion in the POM. But at the same time, these directives require that the need described in the MENS be reconciled with the resources available/necessary to satisfy it. Obviously, each service must develop an affordability analysis in conjunction with developing the MENS. Just as obviously, this same analysis can be used by the services in constructing their annual POM.

Since mission area budgeting has been mandated by Congress on all federal agencies, it follows that mission area analysis should be linked with the annual PPBS cycle. The marriage of mission area and affordability analysis provides a direct and useful linkage. Mission area breakdowns form a structure for an affordability analysis used in POM preparation.

The affordability linkage continues throughout a program's acquisition cycle. DODD 5000.1/.2 specifically require an affordability consideration at each milestone. Annual POM development provides the check. The only disconnect that can occur is a dramatic change in priorities occasioned by the threat, funding constraints, or perspectives of the principal participants. Once a program is established, its "affordability" and yearly funding is governed by the budgetary process.

Another Plus

Improved means must be devised to stabilize or reverse the upward spirals in cost and development time. Quicker agreement on resource allocation decisions can induce substantial savings—time is money, particularly in the period of rapid inflation we are now experiencing. Since opinions differ radically concerning what is affordable, it is beneficial to establish procedures reasonably common to the services and OSD for agreeing on the affordability of certain efforts in relation to others. In attempting to agree on the "worth" or affordability of a given

effort, the parties obviously must first agree on the relative priorities of the efforts underway or contemplated.

To do that, the decisions must be grouped into aggregates, so that the overall number of decisions required is reduced to more manageable proportions. This can easily be accomplished if requirements are grouped by mission area and forwarded annually with the POM. There are provisions for out-of-cycle submissions, but the track record is poor. Delays for out-of-cycle "new starts" are inherent, and decisions often slip into the next cycle. An annual review process tied to the POM process makes sense. Thus, a common criterion could be established for program comparison which would remain valid throughout the year, one which would support DSARC decisions at any time.

The Payoff

Successful application of the affordability and review concepts sketched above will result in:

—Quicker agreement on resource allocation decisions—shortening the front-end of an acquisition program.

—Reduction in the program turbulence resulting from revisited decisions—a better DSARC/PPBS package.

It is important that all concerned understand what affordability is and what it is not. Homogenous, across-the-board OSD rules governing the application of the affordability concept are tempting but inappropriate. That trap must be avoided. We can no longer afford the inefficiency and slow reaction characteristic of the current process. ‖

What We Always Knew About Acquisition but Were Afraid to Do

84

Dr. William C. Wall, Jr.
Leonard L. Rosen

There is a persistent dichotomy in the military acquisition process—the necessity to ensure design maturity and minimize post-deployment changes that cost so much money on the one hand, and the desire to field materiel rapidly in order to meet military need, which carries the risk of higher costs, on the other. The first situation in the dichotomy portrays a cost-emphasis approach. Acquisition costs are minimized, but program phases are predominantly sequential with little overlap. The latter program description reflects a time-emphasis approach. Program phases are overlapped, with experience indicating generally higher acquisition costs.[1] Thus, the schedule philosophy underlying a program plan may influence both program costs and system design.

A total answer to this acquisition Catch 22 between time and design maturity has not yet surfaced. The surer we are of design maturity before committing to production, the longer the development cycle will be; the longer the development cycle, the later total fielding will be; the later total fielding, the higher the likelihood that the need will have been refined; and the higher the likelihood that the need will have been refined, the greater the review and modification to the development program. Further, as time to deploy is extended, the cost savings resulting from operation and maintenance improvements are delayed. The process, at this point, becomes self-perpetuating in the extreme case, and program balance among design maturity, time, and cost begins to fade rapidly.

This article, while not claiming a total solution, does offer a concept consistent with current policy and in keeping with today's search for effecting further

1. The basic concepts of cost and time emphasis programs are described in J. Stanley Baumgartner, "Comments on the Value of Time and Its Effect on Defense Systems Acquisition," *Defense Management Journal* 8 (July 1972): 53–56.

Dr. William C. Wall, Jr., is Chief of the DARPA Projects Office, U.S. Army Missile Laboratory, U.S. Army Missile Command, Redstone Arsenal, Ala. Prior to his current assignment, he was Deputy Project Manager of the Ground Laser Designators Project Office. He holds a B.S. degree in mechanical engineering from Lafayette College, and M.A., M.B.A., and Ph.D. degrees from the University of Oklahoma.

Leonard L. Rosen is Program Manager, Improved Hawk Weapon System, Tactical Ground Delivery Systems, Missile Systems Division, Raytheon Co. He has held this position for 3½ years, and was previously Deputy Program Manager. Prior to joining Raytheon in 1974, Mr. Rosen was Manager, Avionics Systems Engineering Department, Autonetics Division, Rockwell International. He holds a B.S. degree in electrical engineering from the University of Nebraska, and an M.S. degree in electrical engineering from the University of Southern California.

improvements in the weapon system acquisition process.[2] It suggests a means of maintaining technical integrity during the development cycle while concurrently reducing normal time to materiel fielding. The keystone of the technique lies in the precedent sequencing of quantified development milestones with specific, phased, production tasks. The technique preserves the requisite fidelity of the technical program while permitting the design agency a means of buying, almost without cost penalty, the most precious commodity of all—time.

Perspective

The dichotomy addressed in this article focuses on the issue of schedule concurrency, which may be defined as the overlapping of the development phase and the production phase in the execution of a program plan. The effect of concurrency is program schedule compression. The greater the degree of concurrency and the tighter the schedule, the greater the amount of overlap between the development and production phases. Conversely, the smaller the degree of schedule concurrency and the more relaxed the schedule, the smaller the amount of program phase overlap. Of course, concurrency is a matter of degree, since some overlap between development and production almost invariably exists in military acquisition.

In essence, schedule concurrency is a method for attempting to shorten the time required to put a new weapon system, or a significant product improvement to an existing weapon system, into operational use. The perceived need may also arise when a development program schedule slips, and the date for initiation of fielding remains critical. Under the techniques normally associated with schedule concurrency, volume production is initiated with a system design that has demonstrated some level of maturity, but which has not completed a full test program and, therefore, is lacking final design specifications. Typically, when this happens, test sequences are altered, the number of tests is reduced, individual activity times are contracted, and technical analyses and judgments are hurried—all in order to accelerate the development program. The objective of all this activity is to reduce the gap between initiation of production and completion of final design specifications or, better still, return to the preferred sequencing of achieving final design specifications prior to initiation of production. Not only does this typical approach fail to reduce program risk in the production phase as intended, it actually *increases* program risk because of the disruption of the comprehensiveness and balance of the development program.

2. For an excellent summary of major milestones in weapon system acquisition in the 1970s, see Rear Admiral Rowland G. Freeman III, USN, "Fundamentals of DOD Acquisition Directives," *Program Managers Newsletter* 7 (January-February 1978): 2-5.

Viewed from a cost perspective, excessive concurrency carries with it a heavy premium. Extensive redesign of a product after it is in volume production is a costly affair when it impacts production processes, procured vendor items and parts, raw materials, and tooling, and also causes retrofit of already produced items.[3] From a technical standpoint, it may result in imbalance among subsystem developments, reduction in development testing and evaluation, significant increase in the number of engineering design changes, and impairment of required performance characteristics.

On the other side of the ledger, time-emphasis schedules may result in earlier deployment with the combat user, earlier "ring-out" of a new system or product improvement by the user, reduced influence of inflation on program costs, and longer operational life prior to obsolescence.[4]

It is worth noting that even the cost-emphasis program may be a costly venture, due in large measure to the time-value of money. In other words, the longer the program runs and the further back production is pushed, the greater the impact of inflation. Just the simple delay of a production program from one fiscal year to the next, without a change in system configuration, will result in program cost increases. Additionally, there is also the natural tendency of a relaxed schedule to attract additional engineering change which, like inflation, adds cost. In sum, both excessive concurrency and unreasonable extension of program schedules will cause costs to be higher than necessary. These relationships are depicted in Figure 1. It will be observed that a trend toward greater schedule concurrency carries with it a tendency toward higher costs. Similarly, a trend in the direction of unreasonable schedule "stretch-out" also carries with it a tendency toward higher costs. The region of successful schedule concurrency occurs in the cost trough.

Historically, concurrency has been regarded as a contributor to cost overruns in the military acquisition process.[5] However, in today's time frame, there is a general belief that the acquisition cycle has been increasing in terms of both time and money and that it is imperative that the cycle be shortened.[6]

Successful Concurrency

Reasonable program scheduling for a weapon system or a product improvement need not be a trade-off between design maturity and time. It is possible to

---

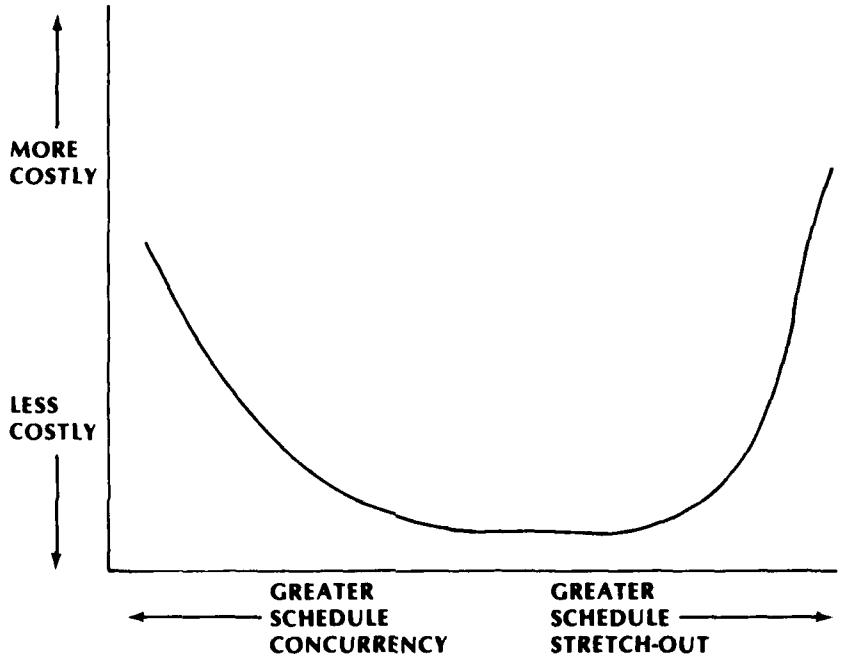
3. Baumgartner, "Comments on the Value of Time and Its Effect on Defense Systems Acquisition," p. 54.

4. *Ibid.*, p. 56.

5. U.S., Congress, Joint Economic Committee, *The Acquisition of Weapons Systems*, Hearings Before the Subcommittee on Economy in Government, 91st Cong., 2d sess., 1970, pp. 441, 446.

6. The harmful effect of increasingly longer acquisition cycles is emphasized by Charles W. Duncan, Jr., former Under Secretary of Defense, in "Defense's Streamlined Acquisition Program," *Commanders Digest* 21 (18 May 1978): 7.

FIGURE 1
Typical Cost/Schedule Relationship



shorten the total time of bringing a weapon system into the operational inventory without compromising design integrity or forgoing required testing.

Our basic premise is that as tight as money is these days, money can be productively employed to create more money, but time is not similarly reproducible. Once time has passed, it can never be reacquired. This is not intended to attenuate the importance of affordability concerns.[7] Quite the contrary, our thesis suggests that once a particular answer to a military requirement has been determined to be affordable, it is essential that time to fielding be made as short as is technically feasible. We are advocating, however, a change from the typical business-as-usual, risk-aversion production approach.

7. The salient issues involved in the affordability problem are discussed by Dale W. Church, Deputy Under Secretary of Defense for R&E, in "Defense Management: An Outline of Efforts to Improve Acquisition Policy," *Program Managers Newsletter* 7 (November-December 1978): 4–8.

A fundamental tenet which must never be violated in any complex development program is that the designers establish a comprehensive and balanced total program plan. How the plan is implemented is a subject for management direction and is influenced by many factors. The principle that the technical community must provide a basic, complete, and reasonable development plan should never be debated, however. A summary example of a representative development program plan is depicted in Figure 2. The plan is comprehensive and balanced. It includes testing for all critical phases of the program, covers all necessary disciplines, and culminates in the submission of complete documentation.[8]

The plan commences with an analysis of technical and operational requirements; moves then into system design and advanced development model (ADM) fabrication and test, followed by preproduction model (PPM) release, fabrication, and test; and concludes with the submittal of an engineering change proposal (ECP) that contains final design specifications, integrated logistics documentation, and all other necessary data.

Structured within the basic program plan in the example shown are six quantified milestones that define predetermined thresholds that must be met or bettered or corrective action initiated before the next phase of activity may begin.

Quantified milestones[9] represent major decision points in the accomplishment of the program plan. These are events of technical significance strategically placed throughout the program plan. Properly established, quantified milestones occur at sensitive points in the program life cycle and provide a quantitative means of measuring and evaluating technical performance. The quantified milestone concept for a program is based on the premise that each full development program has several major milestones. Each major milestone acts as a control gate to the succeeding activities. The succeeding activities will not be initiated until a predetermined set of performance parameters has been met, exceeded, or known alternatives taken. In this manner, development progress toward initial goals is assured at interim points which will, in general, eliminate surprises later in the program. Table I, column (a), defines the quantified milestones for our example program, and Table II provides a typical example of critical parameters at quantified milestone number 4 (QM 4 in Figure 2).

At the completion of the development program in month 33, the government possesses a detailed technical data package that is used to form the basis for pro-

---

8. The positive influence that adequate testing has on reducing program risk is discussed in a compelling manner by Rear Admiral L. S. Kollmorgen, USN, in "Reducing Risk Through Testing," *Defense Management Journal* 13 (October 1977): 2–9.

9. The authors wish to acknowledge John Robins, Deputy Project Manager, Hawk Project Office, U.S. Army Missile Command, for his concepts on utilization of quantified milestones.

FIGURE 2
Typical Development Program Plan

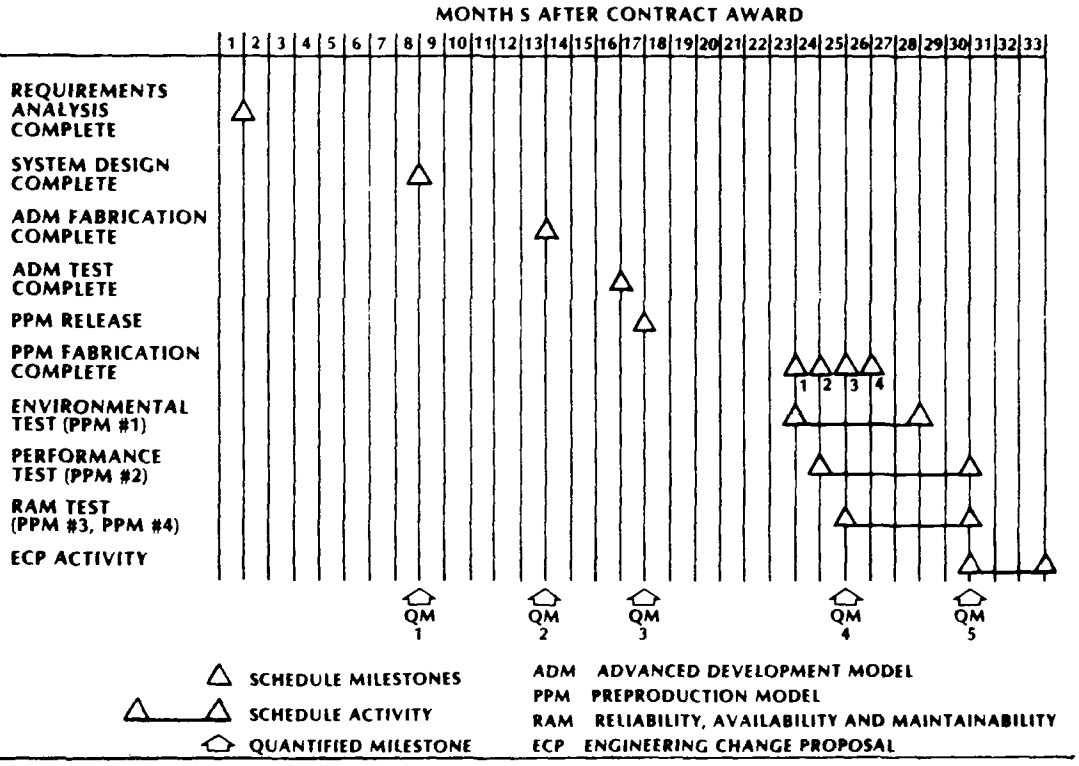


TABLE I
Quantified Milestones

Technical Basis for Quantified Milestone	(a) Quantified Milestone Name and Utilization in Development Program	(b) Utilization for Production Program Under Proposed Concept
1. System Design Complete	Initiate ADM Fabrication	None
2. ADM Fabrication Complete	Initiate ADM Test	None
3. PPM Release	Initiate PPM Fabrication	None
4. Complete HI/LOW Temperature Test in Environmental Program on PPM 1	Initiate RAM Testing	Initiate Production Make Ready Phase-Use Interim Documentation
5. Complete Performance Test Program	Initiate ECP Submittal Activity	Initiate Production Manufacturing Phase
6. Documentation Complete	ECP Approval	Initiate Formal Production Documentation Configuration Control

duction contract award. While it is possible that the development contractor may not be the initial production contractor, this is considered unlikely. In any event, to present the concurrency concept postulated in this article in the simplest manner, it will be assumed that the development and initial production contractor are one and the same.

Figure 3 shows a typical production program plan, starting from the completion of the development program through initial delivery. A comparison of the date of completion of development contract effort in Figure 2 with the date of in-

TABLE II
Example of Critical Parameters Q.M. #4*

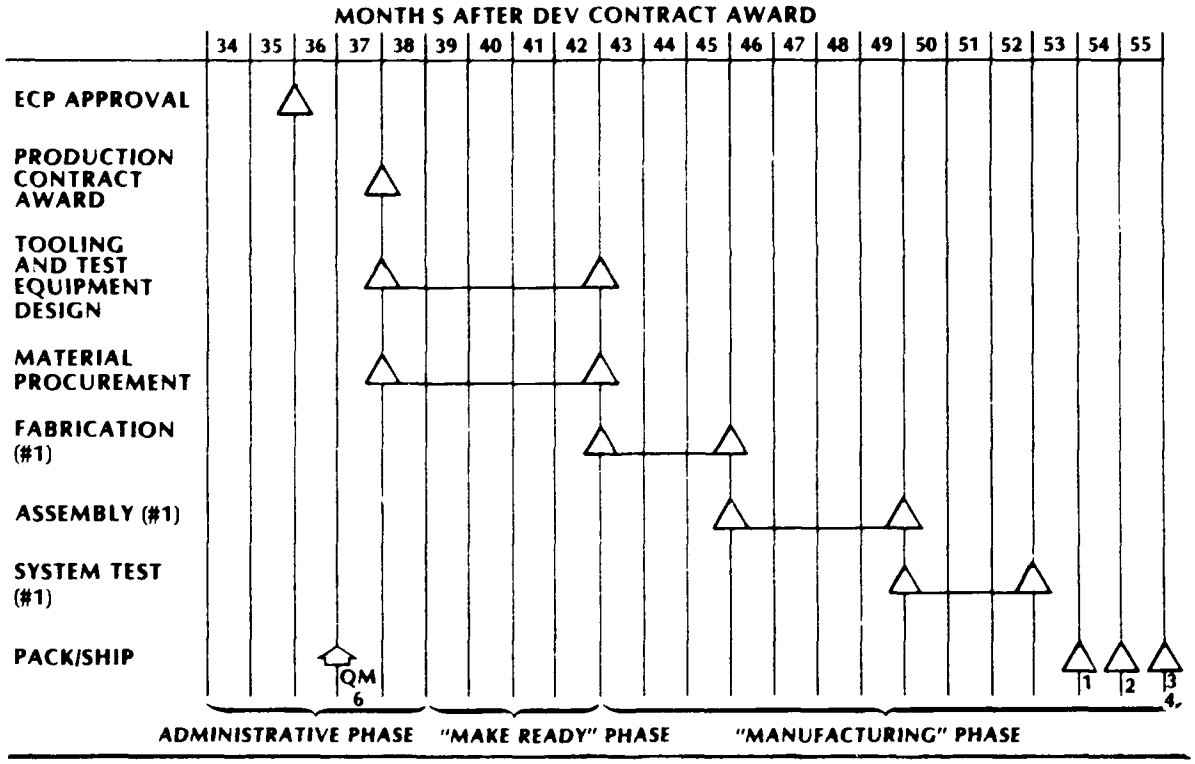
QM #4 = (INITIATE RAM TESTING)

PARAMETER	REQUIRED VALUE	NOTES
System Weight	#1600	Excluding Shipping Container
System Tracking	1.0°	
Boresight Stability Over Temp	0.5°	
Predicted MTBF (Mil Std Handbook Calculation)	300 Hrs	Derate Factor of 2 in Analysis
Scan Rates		
AZ	100 DEG SEC	Over
ELEV	30 DEG SEC	Full Range
Warmup Time (From - 65°F)	2 MIN	Following 12 Hr Soak
Environmental Qual (Mil Std 5400)	Sand, Dust Humidity, Temp (High/Low)	Pass Performance Requirements of Specification 52117 (On Adm)
Estimated Production Cost	$800K	Constant 80$'s Qty of 100 Units Recurring Unit

*QM #4 in the proposed concept has doubled significance. For the development program, successful completion of these objectives allows the initiation of RAM testing. For the production program, successful completion permits the award of the contract to initiate the "make ready" production phase.

itiation of production contract effort in Figure 3 will reveal that four months (from end of month 33 through month 37) are scheduled for evaluation and approval of the ECP and award of the production contract. This four-month period

FIGURE 3
Production Program Plan



is composed of purely administrative time.

The five-month "make ready" phase begins in month 38 and runs through month 42 or until start of fabrication activity. This phase consists of tooling and test equipment design and procurement of long-lead-time raw and finished material. The "manufacturing" phase of the production program plan is scheduled to commence in month 43. This phase consists of fabrication and assembly of deliverable and test equipment hardware, final system test, and delivery. From initiation of activity under the production contract to first hardware delivery requires a total of 16 months. First delivery occurs in month 53—almost four and one-half years from initiation of development effort to first hardware delivery.

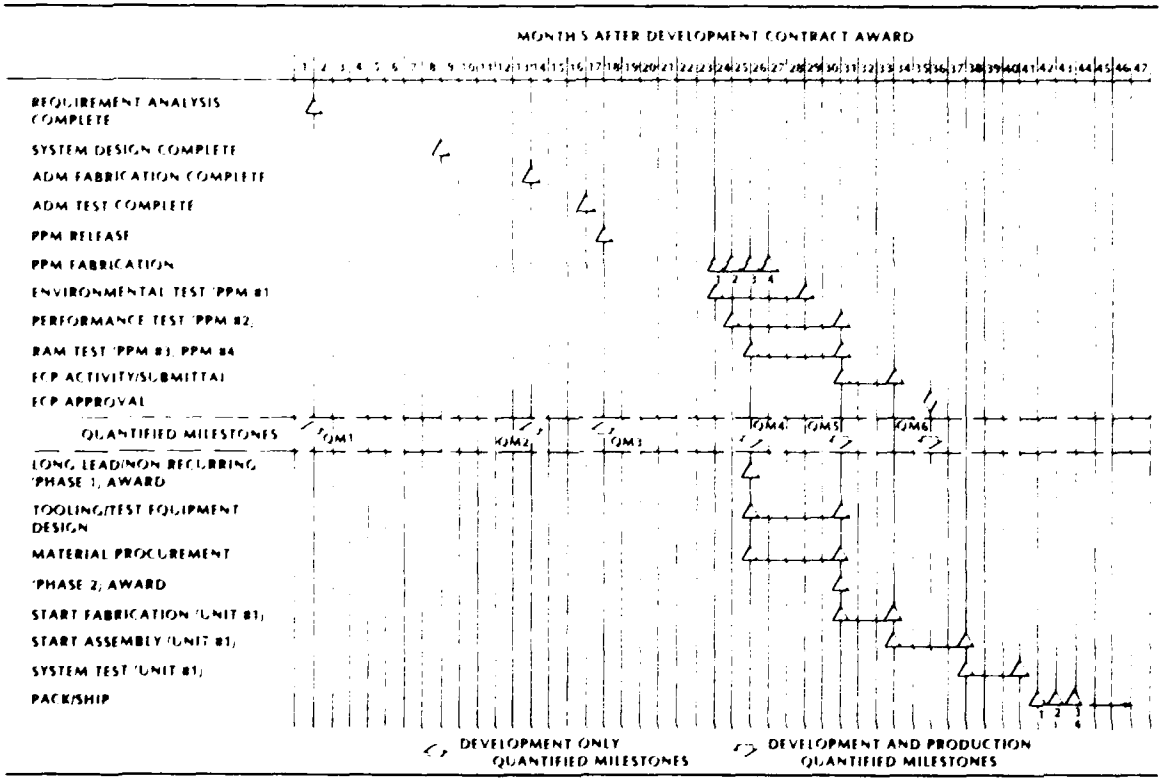
Implementation of the Technique

Successful concurrency is implemented not by "crashing" activities or by telescoping dates, but rather by "folding" schedules at carefully selected milestones. In this technique, total elapsed time from start of development activity to first delivery is contracted, but not at the expense of individual segments of the plan. The development program plan is implemented just as planned, but the "make ready" phase of the production program is initiated earlier than in the typical serial arrangement illustrated by Figures 2 and 3. In other words, the development program and the production program are lapped rather than butted.

In the example being illustrated, the folding occurs between months 26 and 38 as depicted in Figure 4. A phased production contract is awarded in month 26 (in lieu of month 38) with authority to proceed only with the "make ready" phase, which is the procurement of long-lead-time material and design of non-recurring tooling and test equipment. This award is tied completely to the successful achievement of quantified milestone number 4 objectives. In this illustration, quantified milestone number 4 objectives are sufficiently stringent to provide the project manager with the necessary confidence to proceed with the "make ready" portion of the production program. The slight risk attending this decision is limited strictly to a small percentage of authorized dollars, since the integrity of the development program has not been compromised and a significant technical level of confidence has been established. In other words, the decision is a trade-off of dollars for time.

It should be noted that the initiation of the "manufacturing" phase is similarly linked to successful achievement of quantified milestone number 5 objectives in month 30. Should achievement of these objectives not occur as planned, the authority to commence activity under the "manufacturing" phase will be withheld until these are achieved or a suitable "work-around" plan has been developed and approved.

FIGURE 4
Combined Development/Phased Production Program Plan



Key to Success

The keystone of successful concurrency is the precedent sequencing of quantified development milestones with phased production program tasks.

The dimensions of quantification must be minimum essential capabilities of mandatory technical characteristics and program parameters. The dimensions must be so defined that failure to demonstrate ability to meet or exceed the objectives is sufficient cause to curtail further work until the performance capability can be successfully demonstrated or an adequate and acceptable recovery plan is formulated.

Quantified milestones assure that technical decisions are consciously based on hard technical fact rather than omitted inadvertently and made by default merely through passage of time. The concept of controlled concurrency preserves the technical integrity of development while providing for significant reduction in time to first deployment.

Summary

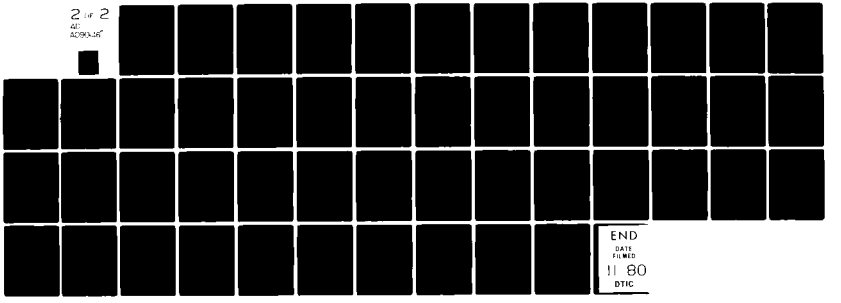
The gain in the presented concept may be expected to provide a 20-25 percent reduction in time to deployment for a reasonably successful program. Figure 4 depicts how the conventional sequential approaches represented by Figures 2 and 3 are combined under successful concurrency. The risk involved is bounded by a small percent of the total cost of the ingredients of the "make ready" production phase. For a properly structured milestone gate, it is estimated this cost could range from 0 to perhaps as high as 10 percent of initial production costs. Even if the estimate should turn out to be on the high side in our current economic environment, inflation would more than offset the potential cost risk.

Thus, it is the authors' contention that if this concept is properly implemented, a significant amount of acquisition time can be saved, at very little, if any, real cost, while the program's technical integrity is fully maintained. This technique, properly implemented, will result in a balanced program of minimum lead time, optimum acquisition cost, and preservation of technical integrity. There is, of course, always some cost risk involved, but in these days of galloping technological advances, can we afford not to take such a risk?

AD-A090 146 DEFENSE SYSTEMS MANAGEMENT COLL FORT BELVOIR VA F/G 5/1
DEFENSE SYSTEMS MANAGEMENT REVIEW, VOLUME 3, NUMBER 3, SUMMER 1--ETC(U)
1980

UNCLASSIFIED NL

2 OF 2
AD
A090146



END
DATE FILMED
11 80
DTIC

Government Data Policy: Is It a Threat to U.S. Technology?

96

Charles S. Haughey

Some of you may recall the post-World War II musical in which a soldier tries to get out of the Army on the grounds that he is crazy, and thus unfit for service. The Army doctor patiently explains that in the wartime Army everyone is a bit crazy. This is a normal state, and under Rule 22 not an excuse for discharge. Thus you can't get out unless you are crazy, but since being a bit crazy is normal, one who is crazy can't get out. "Catch-22."

Wouldn't it be fascinating if U.S. Government data rights policy turned out to be the main ingredient of a "Catch-22" that actually inhibits technological growth in the United States?

Decline in U.S. Innovation

The relative numbers of U.S. patents issued to U.S. inventors have declined in comparison to inventors of other countries. The proportion of sales of "new" products (developed within the previous 10 years) to sales of older products has declined for many leading U.S. companies. One such company, Monsanto Chemical, testified at hearings in Washington, D.C., that 10 years ago their product mix was over 50 percent new products. Today the mix is only 14 percent.

Does the U.S. technical data rights policy tend to alleviate this decline—or promote it?

The United States is in world competition today more than ever. Our trade deficit has worsened, and sales of aerospace and military products abroad are needed more than ever. It would seem that we should be trying to improve our trade balance in this area, or at least be maintaining what we have while improving other aspects of our foreign trade. This would encourage innovation.

The New FAR Data Policy and NATO RSI

Our government data rights policy will soon be embodied in the new Federal Acquisition Regulation (FAR). It is intended to be a "meld" of the policies of several agency regulations, primarily those of DOD, NASA, and the Department of Energy. I perceive the DOD policy as the most developed, and as having the greatest impact on foreign trade. This is due in part to the rapidly developing policies and programs for NATO rationalization, standardization, and in-

---

Charles S. Haughey is a Patent Counsel with Hughes Aircraft Company, and as such has responsibility for contract questions relating to patent, data, and proprietary rights matters. Mr. Haughey has been a member of the Data Task Group of the Government Procurement Commission, a consultant on Patent and Data Rights to the President's Blue Ribbon Defense Panel, and has served with several task groups of the Council of Defense and Space Industry Associations. He is also a member of the board of managers of the American Patent Law Association. Mr. Haughey holds engineering degrees in metallurgy and chemical engineering from the University of Michigan, and a Doctor of Jurisprudence from the University of Toledo.

teroperability (RSI) that are demanding an acceleration of licensing within the NATO community (primarily between the United States and European NATO countries) to establish the capability to simultaneously manufacture military equipment on both sides of the Atlantic.

NATO RSI licensing will require licensing in three major areas of intellectual property rights: patents, proprietary data, and technical assistance, sometimes called "know-how." Patent and data rights can be divided into government-owned rights and contractor-owned rights. Contractors' rights can be divided into rights arising from privately funded business or development, and rights arising out of contract work.

Development of U.S. Data Rights Policies

First, let's briefly discuss the development and implementation of government data policies, especially those of the DOD. Then, let's look at some effects of current policies on our NATO licensing policies and programs and discuss a fascinating "Catch-22" facing the government in attempting to acquire valid patent rights in NATO countries—a "Catch-22" that results from a combination of European patent laws, European customs in government contracting data policies, and our own enlightened government data policies.

As I clarify several apparently independent policies and practices, I think you will see a major problem, which I think can be alleviated. This is one case where, in order to solve a "Catch-22" in acquiring rights, the government may have to help industry solve some of its own problems—in other words, "What is good for the country *is* good for General Motors."

DOD Data Policy

Until 1964, DOD had a policy of almost always acquiring contractor-generated technical data with "unlimited rights" and, even though a full data package might be ordered, contractors were authorized to withhold delivery of proprietary data. This resulted in delivery of many drawings from which details were literally cut out, thus the term "holy drawings." This policy applied to R&D contracts. For supply contracts, a provision was available to acquire full disclosure drawings subject to "limited rights," but it was little used.

In 1964 this policy was changed to routinely require actual delivery of all technical data ordered, but to allow that material related to items, components, or processes developed at private expense (other than certain data such as form, fit, and function data and instructional materials), could be submitted with "limited rights." Under this policy, "limited rights" meant no disclosure outside the government, but allowed use and disclosure of the information anywhere within government so long as it was not used by the government for manufacture.

The government reserved the right to challenge whether data submitted was properly subject to limited rights. Gradually, as it developed this practice, the point in time at which a contractor can now expect to be put to the proof on any data so marked for an item that goes into the government inventory is often after first production.

The Changing Burdens

The government did not like the withholding by contractors under the "holy drawings" policy, but did not have a practical way to challenge contractor claims and to enforce delivery. Since 1964, the irritation has been with claims to limited-rights treatment, and the government has possession of the drawings and the right to challenge limited-rights claims. The contractor has a severe and, with the passage of time, a virtually impossible burden of proof. This is an open invitation for the government to remove legends after due notice and an opportunity by the contractor to be heard. Unfortunately, there is no requirement for the government to explain or justify the basis for such removal, and no relief is provided for the problems of loss of evidence due to loss or destruction of records. The pendulum has swung to the government's side.

Protections for Contractors

There have been some bright spots for the contractor. The government used to rather freely contract for development of competitive items or to acquire competitive supplies where one contractor had a sole-source item due to independent development. This raised questions about rewards available in DOD business for outstanding developments, and the Armed Services Procurement Regulation (ASPR) was amended to provide that such development would not be undertaken at government expense unless the projected savings from future procurement overbalanced the cost of such development.

The government would also, on occasion, negotiate for unlimited rights in such technical data in an atmosphere where refusal to sell, or perhaps give for the award of the contract, would result in loss of a competition for an important contract. As a result of contractor protests, ASPR (now DAR) 9-202.2(f) was issued requiring certain findings of record before such unlimited rights were purchased as a part of a contract; and that the data rights were required to be priced as a separate item of the contract. This provision still exists, and is one of the better-known ASPR (DAR) provisions designed to protect contractors, but it is routinely bypassed and ignored by the government. Although contrary to DOD policy, it is not uncommon for a contract to require that "all technical data shall be delivered without the limited rights legend," even after the contractor has notified the contracting officer that some of the data is eligible for "limited rights," and no

line item is available for price or payment. In many cases, refusal of the provision is tantamount to refusal of the contract.

Another problem area for contractor-owned technical data rights is in predetermination of data rights. DAR 9-202.2(a) states as general policy that the DOD ". . . acquire only such technical data rights as are essential to meet government needs," and section 9-202.2(f), discussed above, requires findings on a documented record before rights are acquired. Payment is to be made for such rights. The policy of section 9-202.2(a) is violated whenever such findings are not made, which is almost routine these days.

Another protection for contractor proprietary data is the policy on predetermination of rights in technical data, DAR 9-202.2(d), which provides that the procedure is to agree prior to contract on data eligible for limited rights. The government often demands detailed documentary proof of such rights, then refuses to agree or to even negotiate toward agreement. The refusal to promptly agree is a problem. Another problem is that the material furnished as proof is usually not protectable from release under the Freedom of Information Act (FOIA). Such proof should be audited in the contractor's facility, then left there where it is secure.

Subparagraph (b) of DAR 9-202.2(d) requires that the procedure be limited to only that technical data for which rights can readily be identified, and that the predetermination procedure not be used to acquire with unlimited rights data which under the basic policy are eligible for limited rights. A special RFP clause, DAR 7-2003.61, is specified for starting the predetermination procedure. More often than not, each of these protections is bypassed by demanding (often at the last minute after all other negotiations, including price, are completed) that "all technical data shall be furnished with unlimited rights."

These problems in contract negotiation and application of the data rights policy are intended to show that after a contract for development, when production has started, a contractor has done well if he has retained a limited-rights technical-data position. It can perhaps be argued that these practices are justified in the government's interest in securing follow-on competition for DOD. They are detailed here to show some roadblocks to retaining data rights from privately developed items when we are ready to implement NATO RSI licensing.

Freedom of Information Act

Our government's well-known policy of acquiring unlimited rights in technical data effectively removes such data from a proprietary position for licensing purposes. The DOD argues on some programs that such technical data represent substantial investments, and thus are valuable property. Although reliance on this policy in the face of Freedom of Information Act demands for

release of information has not, to my knowledge, been tested in the courts, there are mixed feelings whether the position will survive challenge. In any event, to test this, there first must be a refusal to release unlimited rights technical data; this does not seem to be the usual practice with unclassified data.

We often presume that proprietary data submitted with limited rights, or as protected proposal data under DAR 3-507.1, will be protected from release under the FOIA. Recent court decisions and a letter from the attorney general to agency heads challenge this, especially regarding proposal data, ignoring the contractual obligation assumed by the government to protect the data, and requiring a showing of substantial value, or damage to the owner on publication, to bring the data within Exemption 4 of the FOIA.

Rights for NATO RSI Licensing

So far, we find that as a contractor approaches NATO RSI licensing, it is fortunate if he has retained proprietary data rights in his privately developed items, and he generally has no rights in government-sponsored development items. In other words, some of his originally proprietary data, and virtually all of the data relating to government-sponsored developments, are "available to the public."

In U.S. patent law, we may file for a patent up to 1 year after public use, publication, or placing "on sale," of an invention. Our government's technical data rights policy of unlimited rights, and publication of data for government-sponsored developments is of no great concern here, since we have a 1-year grace period after such publication to file our application.

In the European patent laws, some countries (such as England) by recent adoption and some (such as France) of long standing, a patent application must be filed before the invention is available to the public—anywhere. This is the "absolute novelty" requirement. In both U.S. and European practice, contractors usually retain principal patent rights, and the governments acquire rights by license. Where contractors do not apply for such rights, the governments may do so. There is an apparent, but deceiving, equality here in *words*.

Data Rights Policies

In European practice, perhaps in part due to their requirements for patent filing before publication, and now the "absolute novelty" rule, which requires filing before availability to the public anywhere, contractors usually retain proprietary data rights to government-sponsored development items. Thus, contractors control release of such technical data, and have adequate time to file patent applications in European countries. Of course, they also have adequate time for filing under U.S. law, because we give them an added year of grace.

We find, then, that European government contractors not only control their privately funded patents and technical data, but they also control patent and data

rights—in Europe *and* in the United States—for their government-sponsored developments.

The situation for U.S. contractors is dramatically different. Our 1-year grace period lulls us into bad habits, with respect to European patent practice. Even though we file before the end of the 1-year grace period allowed by U.S. patent law, thus securing U.S. patent rights, we often fail to file before availability of the information to the public, such as availability as unlimited rights technical data from the U.S. Government under the FOIA. It is, in fact, virtually impossible for a contractor to file for a U.S. patent on a government-sponsored invention before reporting it—in technical data reports—to the U.S. Government, even though "invention reports" may be delayed. This appears to make the invention available to the public under the absolute novelty rule, thus barring any patent in Europe.

Contractor Rights

United States contractors who are being obliged, as a condition of contract, to license their technology for European NATO RSI production, and to acquire licenses from European NATO manufacturers, find that they are fortunate to retain proprietary data rights in military equipment developed at private expense, or to acquire European patents on such developments. It is virtually impossible to acquire either patent or data rights in Europe on U.S. government-sponsored developments, owing to the effect of our unlimited rights data policy on foreign patent law. On the other hand, European contractors easily acquire both patent and data rights because of their protective technical data rights policies.

With the increasing importance of NATO RSI and the licensing both ways across the Atlantic to implement it, this consequent result of the U.S. data policy, when placed against the European data policies, becomes a very real and serious concern. It is a problem when U.S. contractors are allowed to negotiate licenses directly with European NATO companies. It becomes worse when the U.S. Government insists upon the right to directly license European companies under such rights as remain to a contractor, especially when such companies may be competitors to existing licensees for related technology.

U.S. Government Rights to European Patents

The DOD agencies have for some time acquired U.S. patents and corresponding NATO European patents on contractor inventions made under government contracts. It is their right to do so even under the "title in the contractor" policy when the contractor declines to file.

When an invention is made by a contractor under a U.S. R&D contract, it must be reported promptly to the government. It is reported formally as an "invention report" under the patent rights clause, and is usually disclosed earlier,

orally and in contract reports or line-item drawings submitted under contract. All of these are with unlimited rights, and are presumed to be available to the public. If available to the public, filing for patent rights in European countries is then barred.

"Catch-22"

The U.S. Government cannot file for a patent in Europe for a contractor invention sponsored by the government until it is reported (because it does not know what the invention is). The report *bars* the filing in Europe under the absolute novelty rule. This "Catch-22" results primarily from the combination of the U.S. technical data rights policy of unlimited rights in data relating to sponsored developments with the European absolute novelty rule.

WHAT CAN OR SHOULD BE CHANGED IN DATA POLICY?

We have little influence on the European patent law. Even if we wanted to, we couldn't change it in each country and in the new European patent treaties.

DELAY PUBLICATION

We do have some control over U.S. data rights policy. We could adopt a new policy which, subject to free license rights to the government, delayed availability to the public of technical data resulting from government-sponsored developments, at least until the end of the contract plus sufficient time to identify and apply for patents on "subject inventions."

CONTROLLED DATA RIGHTS

Owing to the present interpretations of the Freedom of Information Act, especially Exemption 4 for proprietary information, it probably would be necessary to make such technical data the proprietary data of the contractor—at least until a reasonable time has elapsed to file for patents in Europe. If we were to compete with European practice, we could leave such data rights with the contractor as "controlled data," and give the U.S. Government license rights for U.S. production.

AMEND THE FOIA

We could amend the Freedom of Information Act to clearly exempt technical data from the act, thus allowing government agencies to withhold release of such data to the public.

DO NOTHING

Of course, we could do nothing and watch Europeans and other foreign competitors continue to acquire U.S.-sponsored technology, add it to their own, and

compete with U.S. companies in our home markets, as well as abroad. This would continue to discourage innovation in the United States and seriously impact our ability to compete in the marketplace.

Is It Time for a Change?

The U.S. technical data policy of unlimited rights in sponsored technology was developed in a post-World War II atmosphere when we were world leaders in technology. It seemed to be more important then to make such technology available to everyone for competition, and development of science and the industrial arts, rather than to protect it for business purposes.

We are in a new situation today, characterized by declining innovation, declining foreign balance of payments, and increasing burdens of energy cost. Perhaps we should be considering a basic turn in our government's technical data rights policy to place U.S. contractors in even competition with their European counterparts. ‖

International Transfer of Intellectual Property for Defense Materiel

104

John S. W. Fargher, Jr.

In light of rapid advances in technology throughout the world and the trends in world economy toward balanced payments, the Department of Defense and U.S. and foreign corporations are changing management policies on technology transfer. The technology more frequently being transferred involves design, engineering, and production capabilities. Technology and management assets are earning returns to foreign and U.S. firms while fostering standardization and interoperability of the allies' weapon systems. But, at the same time, purchasers of technology become future industrial competitors, motivating new strategies and a growth of restrictions, regulations, and limitations.

Intellectual property is the result of man's creativity. Men jealously guard these intellectual rights much more than items produced by manual labor or purchased from others. Individuals, corporations, and governments are differentiated by the unique intellectual properties they possess. In addition to being an emotional issue, intellectual property (IP) also represents valuable national assets. Transfer must therefore be based on mutual trust and confidence.

This paper explores the international methods for transfer of intellectual property, new strategies to foster this transfer, the roles of the industrial and DOD project managers, emerging initiatives, and recommended directions for future transfers. Intellectual property covers a broad range of managerial and technical knowledge and expertise including patents, technical data, know-how, manufacturing methods and techniques, and trade secrets. Patents and technical data usually are readily transferable in the form of drawings and narrative. The know-how and techniques based upon experience and insights of individuals usually are not transferable without intellectual transfer such as in training and/or personal consultation programs. The NATO Intellectual Property Group, AC/94, has defined IP to include ". . . inventions, patented or not, trademarks, industrial designs, copyrights and technical information including software. . . ." The rights to use or have used intellectual property (IP) are termed intellectual property rights (IPR) and include rights derived from patents, trademarks, copyrights, industrial designs, contract clauses, disclosure in confidence techniques or other means of control of IP.

Cooperation Is Paramount

It is essential to understand that without the cooperation of the holder of the intellectual property rights, intellectual property transfer cannot take place.

John S.W. Fargher, Jr., is a Professor of Acquisition Management at the Defense Systems Management College. Prior to joining the College in 1978, he served as Deputy Chief of the Materiel Systems Development Division, Directorate of Combat Developments, at the U.S. Army Transportation School, Fort Eustis, Va. Mr. Fargher holds a B.S. degree in engineering science from the Montana College of Mineral Science and Technology, an M.E. degree in industrial engineering from Texas A&M University, and an M.S. degree in systems management from the University of Southern California.

Direct firm-to-firm exchanges are essential to a successful IP transfer, particularly in the key role of know-how and technical assistance. The same problem exists in the transfer of manufacturing drawings in competitive procurements; the firms that actually expect to follow the drawings, rather than convert the drawings to suit their own shop processes and practices, rarely possess the technological capabilities and processing know-how. Figures 1 and 2 illustrate the product and process of intellectual property transfer mechanisms.

In the development cycle of a weapon system, the government usually acquires technical data, software, and license to inventions. With regard to inventions, DOD follows the 1963 presidential memorandum and statement of government patent policy (as amended somewhat in 1971). Under the President's policy, the government obtains title to contract inventions in four situations: (1) when the principal purpose of the contract is to develop or improve products or processes that are required by government regulations, (2) the government is the principal developer in the field and where the retention of the rights by the contractor would confer a dominant position, (3) public health, safety, or welfare is concerned, or (4) the contractor is operating a government-owned research or production facility, or is directing other contractors (DAR 9-107.2[a]).

Title for inventions remains with the contractor in the majority of cases not covered by DAR 9-107.2(a). Where the purpose of the contract is to build upon the contractor's expertise as demonstrated by know-how, experience, and patents held, the contractor retains exclusive rights throughout the world in the inventions (DAR 9-107.2[b]). Independent research and development (IR&D) programs do not accrue rights to the government.

Where it is not clear, based upon the examples above, whether the exclusive rights are retained by the government or contractor, the rights issue can be deferred for resolution at a later date. The burden then reverts to the contractor to challenge the government's exclusive right.

Standard patent rights clauses based upon acquiring or reserving rights to inventions are available as "boiler plate" to research and development work in the United States, its possessions, and Puerto Rico, as outlined above. Patent rights clauses for foreign contracts may be tailored to meet requirements peculiar to the foreign procurement, provided the replacement clauses are consistent with the principles of DAR 9-107.2.

Technical Data and Software

In production of weapon systems, the government acquires technical data and software, but no license to inventions. Technical data are procured, whether on R&D or production contracts, as stated in the Contract Data Requirement List, DD 1423. The government has extensive needs for many kinds of technical data to support standard and unique types of equipment to be procured, operated, and logistically supported, including the functions of supply and cataloging, provi-

FIGURE 1
Product Intellectual Property Transfer

Product	Licensee's Required Level of Technology	Mode of IP Transfer	Effect on Receiving Nation	Types of Contract	Control Mechanism	Risk
Training of Nationals	Low	Training of skilled workers and managers (counter part program)	Creates Technology Base	CPAF CPFF	Outside influences to licensee and licensor	Low to medium based upon society of licensee
Turn Key Plant	Medium	System and industry specific	Bridge Technical Gap	CPIF CPFF FPI	Schedule	Low
Assembly of Components	Mediun	Industry Specific	Co-Production	CPIF CPFF FPI	Schedule	Low to Medium
Technical Data Package	Must be comparable to licensee	Technology Specific	Dual Production	Fees and Royalties	None	Medium to high, based upon technology base of license
End Product	Low	Operation and Maintenance	Limited	FFP	Cost and Schedule	None

FIGURE 2
Process Intellectual Property Transfer

Process	Licensee's Required Level	Mode of IP Transfer	Effect on Licensee	Types of Contracts	Control Mechanism	Risk
Retooling and new *equipment*	Medium to High	Terms of Sale	Creates new efficiencies	FFP	Terms of Sale	Medium
Information Exchange	Comparable	Reports and Seminars	New applications	Fee or Free	Limitation of Essential Know-How	Medium to High
Contracted Technical Assistance	Medium to Comparable	Training and Technical Assistance	Selected Learned Skills	CPFI	Normally used with licensing agreements	Medium
Technology Transfer	Medium	Training of skilled, engineering and managerial personnel	Creates major new industrial capability	CPAI CPFF	Economic and Political outside influences	Medium

sioning of spares, overhaul and repair, inspection and quality control, and training of operator and maintenance personnel. Commercial organizations are also vitally interested in technical data pertaining to their equipment, and such data are closely held (proprietary), because disclosure might jeopardize the competitive advantage of a firm. The policy of DOD requires only that essential technical data rights be acquired.

In the negotiation of a contract, a predetermination should be made of technical data for which rights may be identified as practicable. Technical data are categorized into "unlimited" and "limited" rights. Unlimited rights should be acquired (1) if reprocurement of the item, component, or process is anticipated for which the technical data are required, no other suitable alternate design is available, and additional technical data are not required for a reasonably competent manufacturer to produce a suitable alternative; and (2) anticipated savings in reprocurement are greater than the cost of the unlimited data rights. Technical data can be delivered to foreign governments in the national interest under DAR 9-201(b) even if only limited rights in data are obtained, subject to the same limitations as the U.S. Government. Data rights clauses may be modified to meet the foreign procurement requirements, provided the replacement clauses are consistent with the policies and principles of DAR 9-202.2 and 9-602.

Software is acquired with restricted or unrestricted rights and listed as a contract data requirements list item. Restrictions on the right of the government to use computer software are acceptable provided they permit the government to meet the requirement for which the software was acquired or leased.

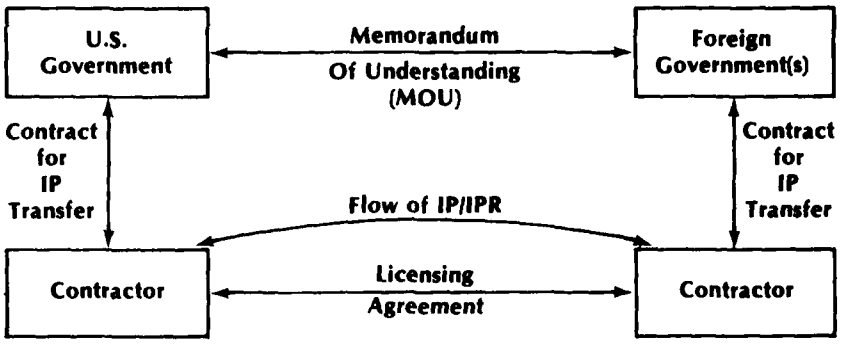
The laws of our European allies in NATO covering rights in inventions, data, and software are substantially different from those of the United States. The inventor maintains ownership of inventions with rights to use the invention. IP/IPR is usually owned by industry and the individual. However, provisions committing a contractor to enter license agreements are part of the Federal Republic of Germany's (FRG) development contract regulations (ABEI) and the United Kingdom's regulations in the "International Collaboration Clause." The reasonableness of the licensing fee is addressed in the FRG regulations. See Figure 3.

Whenever intellectual property transfer is anticipated for the purpose of developing or encouraging the development of foreign or American sources of supply, there are usually licensing agreements where the concern holding the IP agrees to furnish patent rights and technical assistance in the form of data, know-how, training of personnel, and manufacturing equipment. The licensing agreement should include statements on the following:

—Contractor agreement on production capability sharing, including, specifically, the establishment of research, design, engineering, and production capabilities. The agreement should precisely define the equipment and technology involved, and ownership of equipment and special tools.

FIGURE 3

Modes Of Intellectual Property Transfer



—Contractor agreement to provide technical assistance and specific training/consultation programs to facilitate IP transfer, including the scope of the information to be furnished.
—Unrestricted and restricted rights to furnish information to other participating governments.
—Unlimited and limited rights in technical data and patents.
—Continued support/exchange in R&D, design and manufacturing, operation and maintenance, and spares breakout programs.
—The period of duration of the agreement.

Whenever the U.S. Government holds a royalty-free license, unlimited data rights, and pays for technical assistance from a second source, the primary source and his subcontractors are barred from charging the second source. In this case, the price paid by the government is limited to the actual cost of providing data, personnel, manufacturing aids, samples, spare parts, and the like; royalties are not an allowable cost.

Foreign license and technical assistance agreements between U.S. and foreign contractors (including foreign governments) must meet the requirements of Section 124.04 of the International Traffic in Arms Regulation. The Department of State controls the exportation of data relating to items in the United States munitions list, which includes arms, ammunition, and munitions of war.

The issue of intellectual property rights must be considered early in a collaborative program with the appropriate personnel, including the project manager, consulted and involved to ensure that international licensing

agreements are consummated, and that proper IPR clauses are in place in the contract to facilitate the IP transfer. Although early collaboration within NATO is not always possible because of requirements or budgeting phasing, provisions for the IP transfer should be considered for possible prospective partners. Since the contractor provides the actual IP transfer, he must be consulted before the memorandum of understanding for a collaborative program is signed. The IPR provisions must be clearly and precisely stated in the MOUs, similar to contract data clauses to a contractor. Provisions for the modification, improvement, overhaul, repair, and manufacture of spares by the industry receiving the IP transfer also should be precisely stated.

Periodic Armaments Planning System

With the initiation of the periodic armaments planning system (PAPS) with NATO for the harmonization of member nations requirements and facilitating exchange of information on weapons development, we expect that competitive international selection of systems on a national basis will occur more frequently. Problems to be addressed in the MOU during the competitive phase are how to safeguard IPR during and after the evaluation; licensing of the IPR from the winner; recoupment of the R&D costs of the government and contractor; and easing the economic and industrial impact on the unsuccessful competitors. I stress again that licensing and disclosure of IP/IPR for NATO purposes must be accomplished with the full participation of the owner of the IP/IPR, and that governments cannot legally transfer IP/IPR owned by industry unless such transfer is provided for legally and contractually.

Of signficant concern is the right of sales to NATO and non-NATO countries subject to the economic and political considerations of the participating countries. This must be precisely defined in the work-sharing arrangements to assure equitable sharing of the benefits, including increased NATO standardization and interoperability.

Since the beginning of NATO, a number of firm-to-firm licensing agreements have been concluded for the manufacture of U.S.-designed and produced systems. An early example is that of Lockheed entering into agreements with German-licensed firms for production of the F-104G in 1959. Shortly thereafter, Lockheed had production license agreements with Italy, Japan, the Netherlands, Belgium, and Canada. Agusta (Italy) has concluded production licensing and marketing territorial agreements with Sikorsky, Bell, and Boeing-Vertol for manufacture of helicopters. The F-16 aircraft coproduction program appears to be the deal of the century, however, with large IP transfers to Belgium, the Netherlands, Denmark, and Norway. These European participating governments (EPG), as the four countries are known, have a specified share in the production of the F-16 aircraft, 10 percent of the value of the 650 F-16s being procured for the

USAF, 40 percent of the 350 aircraft being produced for the EPG, and 15 percent of all F-16s sold to third countries. Key provisions for the MOU and General Dynamics contract call for a royalty-free license to the EPG for all IP, a royalty-free license by EPG for all contract-generated IP, agreement by the U.S. Government to assist the EPG in obtaining IP, technical assistance from U.S. firms involved in F-16 components production, and restriction of certain advanced technologies from transfer.

Two Methods for IP Transfer

Two new methods for IP transfer are identified. The first method, being incorporated in Navy and FRG MOUs, creates a system of restricted and unrestricted rights. "Restricted rights" refers to information that cannot be furnished without incurring liability to a third party; unrestricted rights do not create such a liability. Prime offerors, when bidding, must state whether technical information is unrestricted or restricted, and state terms for providing restricted information. This is usually included as a priced option to be exercised when a clear agreement between governments can be obtained.

The second method is a contractual option in the limited production contract to license production of the contractor's design to another contractor. This permits domestic or international second sourcing of the production. The contractor receives a non-negotiated royalty rate.

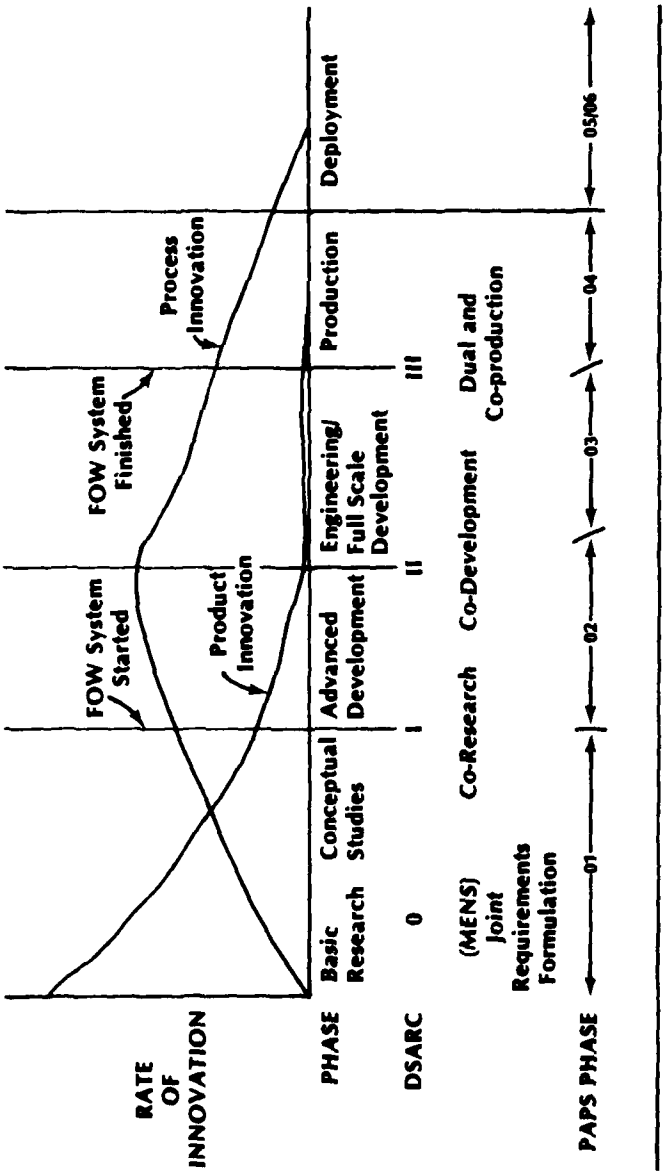
Two of the three legs of the NATO RSI acquisition are (1) dual and coproduction and (2) family of weapons: As one country completes development of a system meeting the operational requirements, that system is made available for production to the other members of the alliance by licensing agreements or contract option. Coproduction is the manufacturing and/or assembling of completed systems at separate production lines in different countries. Dual production is the manufacturing of several specific systems. While the F-16 aircraft represents coproduction, a dual production arrangement is typified by an arrangement between General Electric and SNECMA of Paris to jointly produce the CFM-56 aircraft engine.

Under the family of weapons concept, NATO countries jointly agree to program packages. Each country agrees to joint military requirements, in the form of a mission element need statement (MENS), and utilizing a system such as the periodic armaments planning system (PAPS), initiates joint schedules, and allocates responsibilities for development of equipment to meet the joint requirements. This approach, while fostering direct interoperability and standardization of equipment, also avoids expensive dulicative R&D efforts. An agreement of the participating countries is necessary to specify respective scope of work and financial obligations such as:

—System and subsystem acquisition management responsibilities in accordance

FIGURE 4

Transfer Opportunities During The Life Cycle



with a time and cost schedule and a reporting system.
—Financial sharing and cooperative agreements for recouping R&D costs on third country sales.
—Full competition of all participating countries' industries in the evaluation for the development contracts.
—Plan for adoption of the subsystems for which each country has a military requirement, including use of common components, where possible.

Figure 4 illustrates the integration of the family of weapons, dual and coproduction, process and product innovation opportunities into a preliminary armament planning system life cycle.

Conclusions

The following factors are common to IP transfer:
—The importance of industrial involvement is critical to any extensive transfer.
—Transfers have been for mature equipment normally already in production in the United States. Transfer at earlier phases creates many very different problems and concerns.
—The project manager and his team are the instruments for DOD to institute IP transfer. If this team does not consider IP rights and the transfer mechanisms early, IP transfer becomes much more difficult and expensive. The PM must be aware of NATO-developed equipment to meet approved requirements, especially if the equipment is related to a European scenario.
—Unrestricted and restricted rights and an option for licensing must be provided for. Provisions for multiple licensees, time limitations on the exercise of the option, protection of the IP transferred, resolution of disputes, configuration control and engineering changes, and the level of the work breakdown structure of piece parts and subcontracted material should be included in the option clause, as well as limitations on payments, such as royalties, to the contractor.

Recommendations

We must recognize that industry will carry out any initiative for IP/IPR transfer. To accomplish this, U.S. firms may decide to "team" with foreign firms to facilitate the transfer for business. This arrangement would also likely result in a competitive advantage for the contractor on U.S. procurements where NATO standardization and interoperability are an issue. It would also allow the U.S. firm to operate overseas on its own terms, rather than terms dictated by an MOU. Several of the problems of legal rights in invention, data, and software disappear if the foreign firm also is involved throughout the development process. As our European allies develop their own defense industries, the "teaming" mode is expected to be the preferred manner for penetrating the European defense market.

Rambling Through Economics

114

Dr. Franz A. P. Frisch

It seems wide agreement exists that American business is not in good health. And this despite (or because of?) the fact that we have more economists per square mile than any other country in the world. Hence, to nobody's surprise, free thinkers and heretics are asking, (a) if economists know what they are talking about, and (b) if economics is a science at all, or rather a belief.

Self-preservation and a sense of brotherhood with my learned colleagues entice me to be mute on the first question. But the second question I will pick up and answer with professorial impertinence by telling you—it all depends on what *you* think science ought to be according to *your* perception of our transitory world. This might not be very polite, but it brings us to a solid starting point for an orderly discussion.

The perception of what science is, is changing. Once upon a time, religion, philosophy, and science were a single package. Today, we separate the components and are inclined to call "science" only that which can be measured and calculated with exactitude, the terms "soft" and "hard" science having been developed in colloquial usage. If a discipline of advanced knowledge claims to be "scientific," at least scientific methods of inquiry and formality of problem presentation is a *sine qua non*. I personally consider this a most unfortunate development, and especially detrimental if applied to our efforts at higher education. It implants in the young acolyte of science the impression of a solid scientific taxonomy, which in reality is at best a tool of convenience—at worst, an instrument of propaganda for one or the other fields of "scientific" endeavor.

In my opinion, science is any sincere activity that searches for causal connections and for the understanding of causal chains, regardless of whether those causalities can be measured with precision, or can only be documented with a logical construct. If we can measure with precision, then our search will lead to firm rules, expressed in either deterministic or probabilistic fashion depending on

---

Author's note: This paper uses highly condensed and selected material from a forthcoming book on industrial economy by the author. Some philosophical ideas are sketched in order to challenge the "thinking about economics." The concept of "graphs in economics" is introduced.

Dr. Franz A. P. Frisch is Professor of Engineering Management at the Defense Systems Management College and an adjunct professor in industrial engineering at Virginia Polytechnic and State University. He has 30 years' experience in shipbuilding and related subjects in Austria, Denmark, Sweden, Germany, and the United States. Before joining the College faculty in 1978, he was associated with the Naval Sea Systems Command, involved in special projects. Dr. Frisch holds engineering degrees from the Technical University of Vienna, Austria.

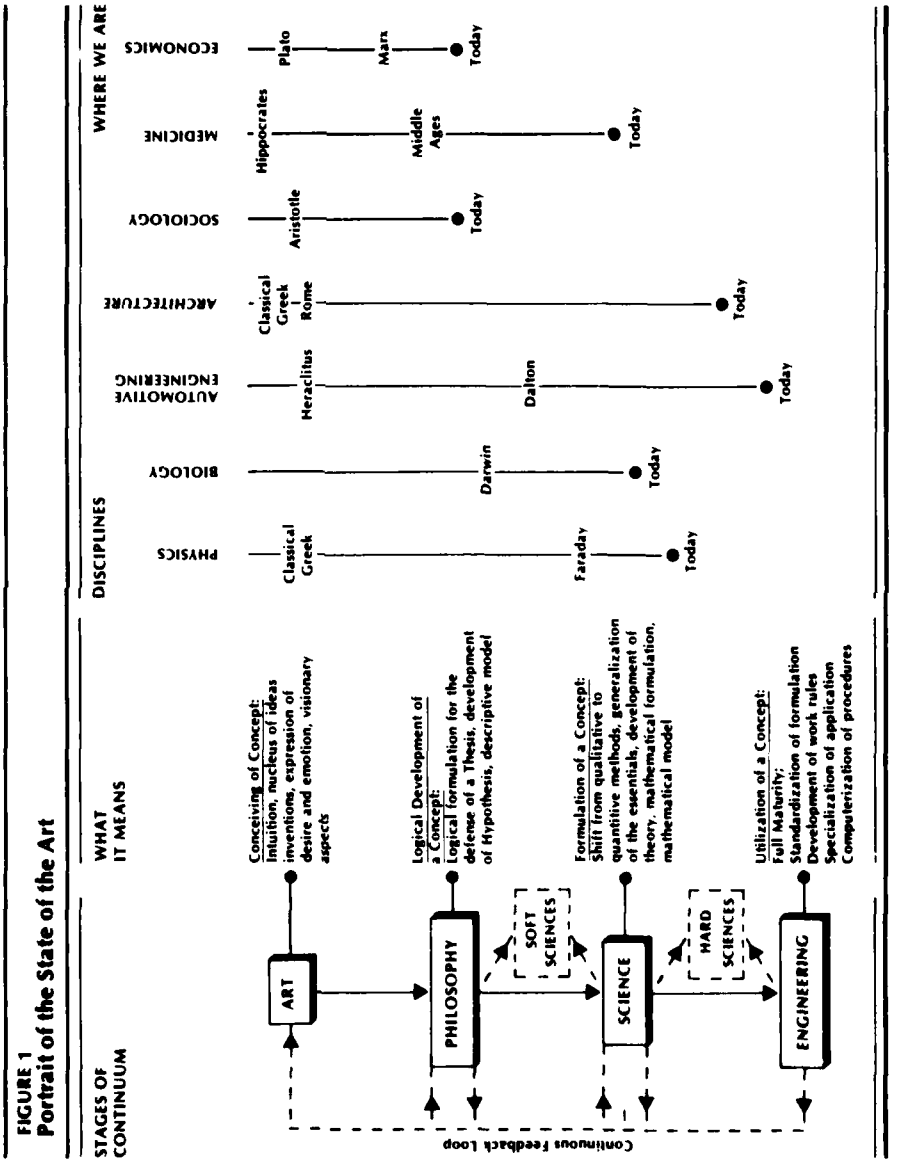
whether we refer to an individual phenomenon or to a set of phenomena in nature. If we cannot measure, we might only arrive at a second category of science—descriptive recognition of a behavioral pattern.

Physics and other sciences of nature, with their deterministic or probabilistic results, belong in the first category. Economics and all social and political sciences might fall into the second category. But—and this is the crux of the matter—all categories are of the same importance; only the first group may represent a more mature state of science, while the latter group may be more representative of a young and emerging discipline. Remember, even those parts that we call the firm body of knowledge in classical physics have evolved in a tedious way from a mixture of beliefs, mythology, philosophy, and formulated superstition. Even religion is nothing else than a search for the causal connections between the infinite dimensions of eternity and the limited scope of our lives. It has even been said that religion, and even superstition, is the first step in the search for causality and in the climb away from absolute wonder and toward the ultimate deterministic comprehension of some, but never all, causalities. On the other hand, what sense does it make to search for the determination of causality if we do not presuppose a deterministic (although dynamic) structure of the universe from the smallest to the largest? If, and only if, we believe in this determinism will we have the inspiration and the endurance to peregrinate from the hesitant feeling, from the unconscious perception of order and orderliness, toward the conscious recognition that such order really exists. To search for order while not believing in it would be a logical contradiction.

But, whenever we cannot penetrate to the rules of orderliness in all details, we may have to be satisfied with understanding the overall probable behavior of the quantums of the family on a statistical basis. Differently expressed, the family behavior may satisfy our need to know for the moment, while the behavior of each family member may either escape our grasp or may not be of interest at all. Hence, probability has three aspects: first, the aspect of not knowing the detailed causalities; second, the aspect of not needing to know the detailed causalities; and third, knowing but not being able to handle the multitude of individual causalities. Pragmatically, this implies the existence of a continuum of science with an orderly progression in the refinement of the recognition of causalities, beginning with the earliest artistic intuition toward the modern term of "scientific" formulation expressing, ultimately, a deterministic causality. This continuum of science is portrayed in Figure 1 together with an indication of where some of our contemporary disciplines might stand. Of course, the figure is a brutal simplification—but I hope the meaning it is supposed to convey is clear.

The maturity of a discipline can be measured by the sheer quantity of theories and hypotheses offered for the causal explanation or behavior interpretation of a

FIGURE 1
Portrait of the State of the Art



phenomenon. The more certainty we have about a phenomenon, the simpler and with less rhetoric are we able to describe it. If we master a phenomenon completely, then we are able to express this definite knowledge with ultimate precision—in what is frequently called a "formula." The formula in turn is the ultimate abstraction, the ultimate condensation, and the ultimate clarity of knowledge. By arriving at the formula, we have crossed the borderline where science becomes scientifically neutral. The formula is free of ideology and free of value—the formula is simply correct until proven wrong; the formula, however, has no "ifs" and "buts" and no plethora of philosophical interpretations.

From this point of view, economics must be a young science. And *de facto*—compared with physics, astronomy, and others—it is. Only modernity—the last 300 years or so at best—has brought economics as science and discipline into the foreground. Economic philosophies developed and emerged in response to and as an explanation for the dramatic social upheavals introduced by new tools and methods of production. As a most familiar example, let's recall the time of the industrial revolution. Only when the industrial revolution was an established fact was it possible to search for interpretations, as, for that matter, it would not be possible to discuss today the post-industrial society if the first signs of it were not already here. Make no mistake, and let's not claim, that philosophies are creating facts; philosophies and philosophers only *interpret* facts. To paraphrase Immanuel Kant, philosophers think new thoughts about things that everybody else has seen and thought about before. Those new thoughts can give new directions, but they do not create the fact.

As we have noted, interpretation can only come *after* the fact. But the time at which those facts are recognized to exist can vary; this is what separates the giants from the dilettantes. Nowhere is this more true than in economics. The dilettante will recognize the facts only when they are blatantly obvious; the giant may recognize them in infancy. But even the giant cannot foretell history as dictated by facts yet unborn. Even Karl Marx would have to admit that technological facts have overtaken his predictions. But so would Thomas Malthus and Adam Smith and even all of the lesser and minor preachers of yesterday's economic wisdom, preachers whose sermons were valid for a day and not much longer.

Again, the observation of the short-lived validity of many economic theories points toward the juvenile character of this discipline. With economics we are in a stage of development equivalent to that of the science of medicine in the darkest Middle Ages—and prior to systematic study of anatomy. At that time, a large experience base (but not a systematic, experimental base) existed about the impact of herbs, spices, and flower elixers on the pains of the human body. But no one had the vaguest idea of what happens inside the human body when one swallows

an elixer; no one knew how the various parts of the body either functioned or cooperated. The human body was what we call today a "black box" maintained by technicians with only a fuzzy notion of input-output relationships and with no means to diagnose the problems within.

Is not this what we do today in economics? The body of economy and its anatomy is still a mystery to us—but we measure with precision inputs and outputs, often without even knowing what is what. Are the forces of recession and inflation driving unemployment—or is functional unemployment driving inflation and, in turn, recession? What is the egg and what is the chicken? In addition, we are pushing our analyses through various dogma filters and hence arriving at various colored "conclusions" and prescriptions that are indigestible to many patients and fatal to some.

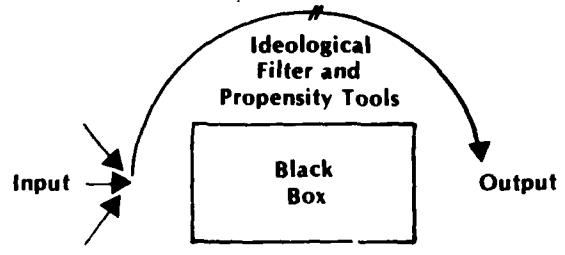
The input and output game we are playing today in economics is sketched in Figure 2 in two versions.

In version A, the inputs enter the black boxes of our economy as something like the factors of production, and leave as undefined economic output. But at

FIGURE 2
Input and Output the Same

Version A: Passing-Through Mode (Micro Economics)

Version B: Bypassing Mode (Macro Economics)



least we acknowledge that the factors are channeled through the magic black box, which might represent a process, a production, or a service of any kind. This version of the economic process we label, according to convention, as "microeconomics." In version B we are much bolder: We simply ignore the black box of structure and process, with the sole exception of the ideological filter and the embedded propensity tales, which leads us mysteriously into the arena of macroeconomics. Versions A and B together describe my view of the state of our economic knowledge. But, at the same time, I have at least implied some problem definition. First, there is the necessary search and understanding of the ubiquitous anthropological structure of any economy, whether ancient, primitive, or modern, and regardless of the level of aggregation, sophistication, and size. As long as such structure is not defined, economy must remain in the domain of philosophy and dogma. Second, there is the systematic search for a taxonomy of possible input/output relationships, resulting in a unified representation called "The Graphs in Economics."

I will explain my approach to the first problem definition in other places. Presently, however, I will sketch what I mean by "The Graphs in Economics." To do this, let's start with the "uncommitted graph" as shown in Figure 3, which we may define as a purely pictorial representation of a not-further-defined phenomenon plotted against an uncommitted or nameless coordinate system. Expressed in a more pedestrian way: I will not tell you what the graphs or the coordinates represent; I will, as teachers are wont to do, ask you to tell me what they mean. What are lines 1, 2, 3, and 4?

FIGURE 3
Uncommitted Graph and Coordinates

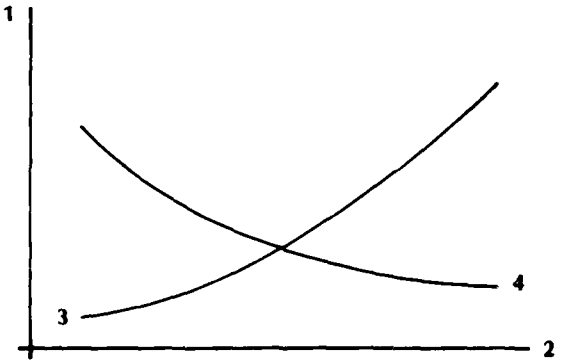


TABLE I
The Uncommitted Graph Can Be Related To

	Supply/Demand Condition	Capital/Labor Ratio	Specialization Management Balance	Learning/Inflation Trade-Off	Risk/Information Expenses
LINE 1	Price of Apples	Cost of Process (Tooling & Labor)	Cost	Element Cost	Cost
LINE 2	Quantity of Apples	Degree of Tooling	Size of Manufacturing Module	Time Frame	Information Density
LINE 3	Supply	Cost of Tooling	Cost of Management Effort	Cost of Inflation	Cost of Information
LINE 4	Demand	Cost of Labor	Gain from Specialization	Gain from Learning	Reduction of Risk
Leading to the Determination of	Market Equilibrium	Mimimum Cost For Products	Optimal Size of Production	Maximization of Benefits Over Time	Maximization of Profit Potential

Not to confuse you, but to make my point in few words, I offer you various explanations for the lines 1, 2, 3, and 4 as shown in Table I.

Although the table could probably use some explanation, I beg you in the interest of brevity to accept it "as is." The point I want to make does not necessarily require the knowledge of all entries in the table. The point I want to underscore is that many areas of economic inquiry are leading to identical generic configuration or identical graphical forms or portrayals—even though their meaning can be completely different. Hence, it should be possible to develop a group of uncommitted graphs that are able to depict all possible behavior patterns we know today in economics. Thereafter we can tabulate for each graph the various problems and the dimensions and nomenclatures of the uncommitted curves.

I am convinced that our entire wisdom in economics can be summarized in *five to ten basic uncommitted graphs and their combinations. This, of course,* does not make the present teaching of economics obsolete—it only summarizes the phenomena. Of course, it will be necessary to develop, together with the neutral or uncommitted graphs, a neutral and uncommitted language of general behavior patterns—a language free of ideological connotations.

Interesting to note, I developed my idea of the graphs of economics (and I am still working on it) out of necessity when I accepted an invitation to teach graduate classes in advanced engineering economy for a state university, and continuing education classes in industrial economy for the Navy. There I was (and am) faced with a student body whose knowledge of the fundamentals of economics was acquired to one degree or another at various colleges across the nation and then diminished with time. Hence, I had to do two things: first, bring them all to the same starting point; and, second, refresh their memories without too much time lost from my teaching.

Finally, let's assume the research work as alluded to above is finished. What do we have? Definitely, we have a most comprehensive review of economics, and the condensation of all essentials into a few pages. We might have gotten some of *the formulae of economics, the never-changing quintessence.* But I am also fully aware that we will never be able to make a "hard" science out of all aspects of economics. Much will always remain embedded in philosophy and politics. I have no illusion about that and recommend that you not have one either. However, at the same time, I am convinced that we should be able to reduce the esoteric part of economics to a bare minimum. In short, more things in economics are the logical consequences of our own invented tools and mousetraps than we think, and ideology is much less important than some people would like us to believe. In other words, it should be possible to talk even about economics in a more rational and less emotional-ideological way than we have been used to.

Problems in Numerical Input for the Source Selection Decision

122

Robert F. Williams

Source selection is a very large part of acquisition management. Millions of dollars ride on the result of source selection decisions. The government is, of course, interested in making this decision process just and equitable, and consequently spends a great deal of administrative resources to ensure the proper source is found. Yet, in spite of great care, source selection is fraught with areas where unintended breaches can jeopardize our intentions. This article concerns some of these areas.

The government must consider many factors (e.g., price, technical factors, management factors) in selecting a source to provide certain goods or services. Moreover, these factors are not all of the same importance. Somehow the decision-maker must assemble all of these factors and assign them relative weights for consideration. Often a numerical approach will help assemble this kind of information for the decision-maker and aid him (or her) in deliberating on the award decision. The most common approach used is the direct scoring of factors, multiplication of these scores by weights, and the summation of these multiplications to give a total score for a firm (source).[1]

Researchers have modelled this kind of approach in many applications and call it the multiattribute utility model.[2] The model can be seen this way:

$$TS_j = \sum_{i=1}^{n} F_{ij}XW \qquad (1)$$

where

TS_j = Total score for firm j (that is, the utility the government has for firm j).

F_{ij} = Score firm j has for factor i

1. For example, *Proposal Evaluation and Source Selection*, AMC Pamphlet 715-3, U.S. Army, 1969.

2. For example, George P. Huber, "Multiattribute Utility Models: A Review of Field and Field-Like Studies," *Management Science* 20:10 (June 1974):1393-1402.

Robert F. Williams is Chief, Test and Evaluation Group, Army Procurement Research Office, Army Logistics Management Center, Fort Lee, Va. He has consulted with program managers of a number of the Army's major development programs on such topics as source selection and acquisition strategy. Mr. Williams holds a B.S. degree in aeronautical engineering from the University of Wyoming, a master of commerce degree from the University of Richmond, and is a candidate for a Ph.D. in marketing at the University of Alabama.

W_i = Weight for factor i

n = Number of factors

Source selection practitioners should recognize the kind of model they are using and attempt to learn from research findings. The above model, for example, has undergone a lot of study by decision scientists[3] and marketing researchers.[4] Their work, as will now be shown, has immediate implications for government decision-makers.

It must be kept in mind that the output of this model is merely *advisory* to the ultimate decision-maker, who will consider it, along with the criteria that could not be readily quantified, before making the decision.

The Choice of Factors

Great care must be taken in the selection of factors to be used in source selection.[5] Simply choosing all the factors believed to be appropriate is a dangerous practice. Planners should appreciate that in using the multiattribute model above they are assuming that the factors (for best results) are (1) independent, (2) unidimensional, (3) compensating, (4) relevant over all contexts, (5) exhaustive, and (6) determinant.

The factors must be *independent* of each other to avoid double-counting or missing interaction among factors. Planners should scrub the factors to ensure there are no common elements in the factors or too much interdependence among factor performances. By *unidimensional*, the theorists mean that the factor scores can be realistically seen as increasing in one decision dimension and can be meaningfully added together. Consequently, if the decision-maker feels uncomfortable with adding scores, for example, for speed, weight, reliability, number of seats in design, sprocket strength, and cost, to get a total score for a firm, then perhaps another model (e.g., multidimensional scaling) would be more suitable. The model is *compensating* in that the decision-maker acknowledges that low scores for some factors can be compensated for by high scores on other factors. The model assumes that the factors will be *relevant over all contexts*; a little scenario planning would be in order here to test for this.

The list of factors should be *exhaustive*; that is, planners should attempt to include all appropriate factors. But all factors should be *determinant*, actually

3. *Ibid.*

4. For example, William L. Wilkie and Edgar A. Pessemier, "Issues in Marketing's Use of Multiattribute Attitude Models," *Journal of Marketing Research* I:(November 1973):428-41.

5. This section is drawn largely from the Wilkie-Pessemier study, which reviewed 42 other studies. Consequently, many findings left unfootnoted are found in that work.

useful in the selection decision. This is one case where more is not necessarily better. Packing an evaluation with more and more factors will not help source selection but will lessen discrimination among competitors and perhaps lead to a bad decision. Studies have shown that it is not the number of factors in the decision that is critical, but having the determinant factors.

It must be emphasized here that the factors must be determinant, not merely important. When selecting a bank, one might suggest that "safety of money" is indeed an important factor. But since, today, money is safe in virtually all banks, that factor is not determinant in the decision. The lesson in planning for factor weights is that beyond asking officials how important a factor is, the officials should be asked to what degree they really see a difference in anticipated competitor response.[6]

The Weighting of Factors

Strangely, weighting is also an underestimated task. Putting down in a solicitation one's first set of weights may again lead to being locked into a poor decision. Sensitivity analysis and computer simulation might be used to check early factor weighting to see if it will lead to the desired performance.[7]

There are many approaches to weighting factors—rank ordering, weighting by rating scales (e.g., 1-6), and constant sum scaling (dividing up x points among factors) are three common approaches. All of these approaches give similar results, but when the approach employed does not directly compare competitors (e.g., rating scales), there is a problem in that weighting officials may operate at different importance levels and their responses may not be equivalent (e.g., one person's "4" is not necessarily the same as another's). In this situation the resultant weights have to somehow be normalized to minimize the effect of their differing values. That is, individual weighting officials have to have their weights adjusted up or down depending on propensity for low or high scoring (relative to the norm of all officials).

The multiattribute model also assumes constant weights that do not vary over varying situations. To check on the reliability of the weights, planners can see if

---

6. James H. Myers, and Mark I. Alpert, "Determinant Buying Attitudes: Measuring and Measurement," *Journal of Marketing* 32 (October 1968):13-20.

7. Robert F. Williams, "Proposal Evaluation Planning and Simulation," *National Contract Management Journal* 10:2 (Winter 1976-77):54-60; Thomas P. Tytula, "A Method for Assessing the Risk Associated With Additive Weighted Multiattribute Decision Models," U.S. Army Missile Command (in-house working paper), November 1976; David A. Lee, "Sensitivity of Offerors Score to Variations in Item Weights and Item Scores," *Proceedings, Seventh Annual Acquisition Research Symposium*, 1978, pp. 134-138.

the weights hold over a number of scenarios and possible external inputs. If the weights do vary, for example with levels of factor performance, then again another model is more appropriate. One model that handles curvilinear utility curves, that is, distributions of weights over varying factor performance, is conjoint analysis.[8] Using this model the final score would be found by multiplying the scores for each factor (weighted by the level of factor performance).

The Scoring of Factors

There are also many ways that factors can be scored (i.e., evaluated and assigned a rating). The rating scale (e.g., 1–6) tied to adjectival descriptions (e.g., 1 = poor, does not understand the requirement; 5 = very good, likely to exceed requirement) for each point of the scale is a common one. Another is the assignment of points for different perceived levels of performance (e.g., x points for y miles per hour). A variation of the general multiattribute model would include an ideal point:[9]

$$TS_j = \sum_{i=1}^{n} W_{ij} \left| F_{ij} - I_i \right| \tag{2}$$

where

F_{ij} = The actual level of performance for factor i, offeror j.

I_j = The ideal level of performance for factor i.

Since all deviations from the ideal are counted down, this approach has the advantage of forcing the government not to reward performance past the requirements ("gold plating").

A stated assumption of the multiattribute model is linearity of utility for factor score (e.g., 10 percent more performance receives 10 percent more score). Studies, however, have not found serious difficulties in violation of this assumption. Planners for source selection should, therefore, not be tied to assigning linear utility and, if desired, can develop utility distribution for each factor score. The problem of gold plating can be minimized here by showing downturns in utility at certain levels of performance.

---

8. See, for example, Richard M. Johnson, "Trade-off Analysis of Consumer Values," *Journal of Marketing Research* XI (May 1974):122–127.

9. G. S. Day, "Evaluating Models of Attitude Structure," *Journal of Marketing Research* 9:3:(August 1972):281.

Scoring also has the difficulty of divergent value levels in different scoring officials. Where there is an ideal point or prearranged point assigned for specified levels of performance, there is little problem in averaging the input of various scorers and measuring the closeness of the average score to the ideal. When a rating scale or similar device where each individual uses judgment to assign points is used, there may be difficulty in averaging scores that have different meaning (e.g., one scorer's 7 points may be the same as another scorer's 8 or 9). Consequently, a normalizing scheme such as that mentioned earlier may be needed.

Another difficulty in scoring is the so-called halo effect. Knowing who the firm is or knowing the score for another factor may influence and bias the scoring of a factor. Studies have found the best way to minimize this effect is to prevent comparison of ratings and to mask identity. The government has often not experienced the inter-factor problem because it uses specialists on individual factors, and one set of specialists is not privy to the score by specialists on another factor. Another halo effect takes place between weighting and scoring. Knowledge of the weights of factors may bias scoring; scorers may overemphasize a factor in scoring or may be less attentive to scoring the lower-weighted factors. The government minimizes this problem (more often for large programs) by having one group (high-grade managers) weight the factors, and another (operational-level personnel) independently score the factors.[10]

As mentioned earlier, the simple utility model does not consider interaction among the attributes. Many authors have suggested alternative specifications to bring in these effects. Wind *et al.*[11] have proposed a relatively straightforward two-attribute interaction model (with 2^n terms) with the form:

$$TS_j = \sum_{i=1}^{n} W_i f_{ij} + W_o + W_{1\text{-}2} f_{j1} f_{j2} + W_{1\text{-}3} f_{j1} f_{j3} + \ldots + W_{1\text{-}2\text{-}3} f_{j1} f_{j2} f_{j3} + \ldots \quad (3)$$

where

W_o = A term drawn from configural analysis

10. Williams.

11. Wind, Yoram, Green, Paul, and Patrick J. Robinson, "The Determination of (no go) Selection: The Evaluation Function Approach," *Journal of Purchasing* 4:3 (6 August 1968):29-41.

W_{i-i+1} = The weight (or configural value) of the interaction between two attributes and other terms drawn from equation (1)

Typically, however, because source selections involve so many attributes and the decision is so complex, the evaluators will use only main effects in considering the attributes,[12] and the simple utility model will suffice.

One final problem in scoring is the risk propensity of the scorer. If the scorer perceives a relatively risky situation, he may be willing (risk prone) or unwilling (risk averse) to take a risk. If the scorer does not perceive risk (a riskless situation), the simple utility model will be appropriate. However, the risk-prone or risk-averse scorer will give a distorted score with this model. One prominent approach to this problem is the von Neumann-Morganstern utility theory, which considers risk. A recent treatment of this theory by Hauser and Urban renders a relatively practical model for direct use in source selection.[13] With the extensive interaction of scorers, it would be hoped that much individual risk averseness or proneness will be moderated on the usual source selection.

Variations in Use of the Model

Of course, when assumptions are stretched too far, the use of the model is not advisable. In the example above, when one wants weights to vary with the level of factor performance, another model, such as conjoint analysis, should be used. Also as shown, there is some latitude (e.g., ideal point, non-linear scoring) in the basic model's use.

In addition, there are acceptable variations to the model. The use of the conjunctive model would require that there be a minimum level of performance for each factor; recall that this denies the compensating assumption of the basic model. A disjunctive model would call for a mixture of factors with and without minimum levels. A variation commonly used in government source selection is a composite model where many factors are incorporated into the conventional model, and the remainders are simply scored for acceptability ("go/no go"). Theoretically, firms could be thrown out for being unacceptable on any of the latter factors, but traditional usage has seen few ruled out on this basis. Studies have been done on the comparative performance of these models on various analogous applications, but there were none found for use on source selection.

---

12. Day.
13. John Hauser and Glen L. Urban, "Assessment of Attribute Importances and Consumer Utility Functions: von Neumann-Morganstern Theory Applies to Consumer Behavior," *Journal of Consumer Research* 5 (March 1979):251-262.

Final Discussion

This article has surfaced research findings from other fields that are appropriate for adaptation by source-selection planners. This surfacing was possible only because of the basic conceptualization of the source selection and recognition of the resultant model as being a form of a commonly researched, more general model.

This paper offers a conceptualization and theorization of the source-selection process that is perhaps appropriate for other contracting and acquisition processes. The intent is to give a more rigorous framework for suggesting improvements to these processes. The more common approach of generalizing from accumulated "lessons learned" leaves much to be desired, because it does not get to the heart of what is going on. A more rigorous approach would be to diagram what is taking place, identify all the parts of that diagram, identify the relationships among the parts, and determine all assumptions and conditions. Only then could one truly hypothesize what is wrong with some process and determine how to test that hypothesis.

Both contracting and acquisition researchers and practitioners have responsibilities in bringing about conceptualization of contracting and acquisition processes to bring about improvements. Researchers, of course, have the responsibility of providing this data, challenging concepts, and attempting to implement these concepts.

It will take the cooperation of both of these groups to make fundamental improvements to the problems that have resisted the solution represented by intuitive, less rigorous approaches. ‖

129 The Origins of the Military-Industrial Complex

Maureen P. Sullivan

The term "military-industrial complex" is a relatively recent one. It was first brought to public attention in 1956 by C. Wright Mills in his book *The Power Elite* and was given added legitimacy by President Eisenhower in his 1961 farewell address. Mr. Eisenhower warned of the potential "dangers" of the misuse of power by those people and institutions making up the military-industrial complex.

The military-industrial complex (MIC) refers to domestic groups in the United States having "vested interests in the continuance of military spending and international conflict."[1] These domestic groups purportedly are (1) the military, specifically high-ranking professional soldiers; (2) owners and managers of industries engaged in military supply at the prime contractor, the supplier, and the subcontractor levels; (3) high-level government officials whose careers are tied to military expenditures; (4) legislators whose districts or constituents benefit directly from defense procurement; and (5) universities, study groups, think tanks, and academicians whose work is directly related to the military, or whose income is directly subsidized by military funding. Besides this relatively small elite of power-wielders, theorists hold that a broad spectrum of American society is directly related to, or influenced by, the military-industrial complex. This would include war veterans' groups, ROTC organizations, defense-related workers and their unions, etc.

Since 1956, the definition of the military-industrial complex has been expanded and refined by a host of political scientists, sociologists, quasi-economists, and other theorists to reflect their individual causes or ideologies. These varied attempts to characterize the military-industrial complex and its functions have distorted its image to the point that defense industry (which is only one component of the MIC) has been exposed to the brunt of criticism by the public.

A distinction must be made in regard to the use of the terms "defense industry" and "military-industrial complex." As noted at the outset, the broad definition of the military-industrial complex does include defense industry as one of its main components; however, the two terms are not synonymous. Nonetheless, they do refer to one single activity—the production and acquisition

1. Steven Rosen, *Testing the Theory of the Military-Industrial Complex* (Lexington, Mass.: D. C. Heath & Co., 1973), p. 2.

Maureen P. Sullivan is a Senior Research Associate with Edward M. Kaitz & Associates, Washington, D.C., a small economic research firm. She is responsible for economic and financial research and analysis of defense industrial base issues. Ms. Sullivan holds a B.A. degree from the University of New Hampshire and a master of science in foreign service from Georgetown University.

of major weapon systems. The term "acquisition" is frequently used "to distinguish major weapon systems procurements from the more run-of-the-mill variety such as food, fuel, clothing, and medicine. Unlike repetitive procurement of off-the-shelf items or commercial-type supplies, major weapon systems usually involve complex technologies, heavy costs, extended development, and relatively limited production quantities."[2]

Thus when theorists speak of the military-industrial complex, they are often referring to defense industry businesses and the acquisition process, unless they distinctly specify the other components—the government and the military.

Historical Survey

There have always been "elites" made up of industrial, governmental, and military leaders, but their interaction, until recently, has not been perceived as a deliberate conspiracy to strengthen their economic and political power. Before World War II, defense industries (non-government, privately-owned companies) were virtually non-existent. Government arsenals were the major producers and suppliers of military ordnance and equipment. With the exception of major war-time periods such as the Civil War, the Spanish-American War, and World Wars I and II, the demand for defense-related equipment was minimal.

The reason for this was that, throughout much of its early history, the United States was considered to be virtually invulnerable to outside attack. It was thought neither necessary nor practical for the country to support a large military force. Congress, in June 1784, substantiated this point of view when it passed a resolution stating that "standing armies in the time of peace are inconsistent with the principles of republican governments, dangerous to the liberties of a free people, and generally converted into destructive engines for establishing despotism."

The main functions of the small armed forces in the late 18th and early 19th centuries were to protect the nation against invasion by European armies, and to protect American merchant ships from seizure by European vessels. In the mid-19th century, U.S. military policy shifted. The attention of the armed forces was refocused on the defense of the frontier settlements against the Indians (and occasionally the Mexicans) and on promoting national development. The Navy was performing similar duties by protecting U.S. merchant ships in non-European waters.[3]

Toward the end of the 19th century, policy shifted once more in response to

---

2. Major James B. Lincoln, "Trends in the Weapons Acquisition Process," *Military Review*, August 1971, p. 42.

3. Samuel P. Huntington, "Military Capabilities and American Foreign Policy," *The Annals*, March 1973, p. 2.

European expansionism overseas, and the U.S. quest for its manifest destiny. A battle fleet was designed and created with the capability to mobilize and protect a major military force abroad.[4] This strategy was executed during World War I and remained in effect during the early 1920s while America pushed for a democratic, free world. By the 1930s, the United States, primarily because of its inability to promote global democracy, the failure of the League of Nations, and the onset of the depression, became pacifistic and isolationistic, which was reflected in its defense-oriented military policy

Role of Business—Pre-World War II

During the pre-World War II years, American businesses directed their productive capabilities almost exclusively to civilian markets. Only in times of armed conflict did commercial industries mobilize and convert their production to war materiel. When the conflicts ended, the industries would return to their prewar production patterns. These industries were generally able to convert easily between peacetime needs and wartime needs, because innovations in weaponry were dependent upon civilian technology, meaning there was little specialized tooling required for mobilization. For example, musket manufacturers could produce more muskets as weapons; powder manufacturers who made blasting powder for building purposes, such as the expansion of the railroad in the West, were able to produce gunpowder for Civil War armaments; wagon manufacturers and, later, automobile manufacturers could produce gun wagons, armored trucks, and tanks with little difficulty.

The comparatively simple technology of pre-World War II weapon systems, then, made it possible for American economy to shift relatively easily between war and peace. The government arsenals were able to supply the military with armaments as the need arose with only the occasional assistance of civilian industries. With two exceptions, there were no true defense-related industries; exceptions were the shipbuilding and the airplane industries.

Shipbuilding and Aircraft

The U.S. Navy, from its inception in 1775, depended upon both government-owned and privately owned shipyards for its vessels. Since the time of the Revolutionary War, many private shipyards have been engaged in the production of both naval and commercial vessels. It is therefore accurate to say that there was an industry outside the government arsenals working to provide weapons to a branch of the armed forces. In fact, as the design for naval ships

4. *Ibid.*

(and later submarines) grew increasingly sophisticated, a truly specialized defense industry emerged that included a subcontractor base supplying armored steel plating, gunnery equipment, torpedoes, and the like.

The U.S. Air Force and the aircraft industry had a slightly different history. Aircraft were introduced as military weapons by the United States and its allies in Europe during World War I. Planes were used primarily for bomber-reconnaissance missions. After World War I, the Army Air Corps was given a diminished role, principally the protection of the American coastline from enemy surface fleets. The wartime budget in 1918 of $500 million for aircraft production was reduced to less than $33 million by 1922.[5]

By 1920, most of the wartime aircraft industry was dismantled. The Army Air Corps during the next two decades depended mainly upon surplus planes and engines to supply its needs. Although some aircraft design and development was carried out by the Army and Navy at McCook Field, and the Philadelphia aircraft factory, the major developments in aerodynamics, and all production of military planes, on a contractual basis, as well as production of commercial planes, was done by privately-owned companies.

The precision production standards and the specialized knowledge required to manufacture aircraft signaled the emergence of a distinct industry. The fact that private companies dominated the state-of-the-art meant that the military depended upon them to supply aircraft to the Air Corps. A close working relationship developed between the military and the aircraft industry.

The invasion of Czechoslovakia in 1938 and the outbreak of war in Europe in 1939 demonstrated the strategic capability of aircraft and the necessity for an adequate American Air Corps to match that of Germany. This recognition of the importance of aircraft prompted the mobilization of industry (aircraft and others, such as the auto industry) to mass produce the needed planes. After WW II, many of the aircraft factories were dismantled, but the military services maintained contracts with a number of aircraft manufacturers, much as it had with private shipyards over the years. Thus emerged another specialized, defense-oriented industry.

Role of Business--Post-World War II

The beginning of World War II also marked the beginning of defense industry as it is today. For the first time, extensive efforts were made to expand military technology far beyond the levels of peacetime production. As hostilities grew

---

5. William Wagner, *Reuban Fleet and the Story of Consolidated Aircraft* (Fallbrook, Calif.: Aero Publishers, Inc., 1976), p. 69.

worldwide, it became evident that the nation(s) possessing the most effective weapon systems would win the war. As a result of this and because science had progressed to new thresholds of technology, rockets, radar, sophisticated electronic systems, and the atomic bomb were developed and used. These weapons and their systems were developed jointly by civilian and military personnel and were manufactured by the mobilized wartime industries. For the first time, *new* technology was co-developed by the military and civilian industries to produce weapons. This was a departure from the historical pattern of taking existing civilian technology and adapting it, under wartime conditions, to produce weapons.

Innovations in weapon technology advanced the production of weapon systems far beyond the capabilities of many civilian industries. As a result, even though the U.S. economy reverted back to its peacetime patterns almost immediately after World War II, some of the industries involved in making new weapons remained defense-oriented; they had manufacturing knowledge, R&D facilities, and infrastructure necessary to produce modern weapons. Another change that followed World War II was the alteration of the weapons acquisition process. As J. Ronald Fox pointed out in his book *Arming America*, the weapon systems acquisition process, before and during World War II, was relatively uncomplicated. The methods used to produce such items as tanks, ships, guns, and aircraft were based on standard methods of mass production. The classical manufacturing cycle of planning, designing, tooling, producing, and distributing, which served the industry well before and during World War II, was made obsolete by the growing complexity of weapon technology.[6] Technology advances in weapon system programs necessitated that firms and individuals involved in defense work become increasingly specialized.

This specialization has rendered the development and production of modern weapon systems beyond the capabilities of the military working alone. The military has found it essential to depend upon defense industry for ordnance and equipment. In turn, some defense industries have grown to depend on military contracts to remain in business; others have found it profitable to use DOD contracts to expand their businesses and develop new technology.

Effect of the Cold War

The establishment of a group of industries primarily producing military equipment was the result not only of the advancements made in weapon

6. J. Ronald Fox, *Arming America* (Cambridge, Mass.: Harvard University Press, 1974), p. 12.

technology during World War II, but also the events of the immediate postwar years.

To U.S. leaders, the greatest threat to international order after World War II was the political and economic chaos of Western Europe. They feared that the Soviet Union would take advantage of these conditions and strengthen its hold on Europe. The threat of a Communist-dominated Europe after years of fascist dominance was abhorrent to Western leaders. The takeover of occupied lands in Eastern and Central Europe by the Soviets under allied agreement (the Yalta Conference), and then Soviet intervention in the free-election process preventing the establishment of self-government in those nations verified the West's fears that the Soviets intended to establish hegemony in Europe.

This threat seemed to be economic in origin. To counter it, the West—primarily the United States—applied economic remedies. Europe had been devastated by the war and its recovery was slow and arduous; no one country was financially strong enough to lift itself out of the economic morass in which it found itself. Even Great Britain, which had been giving economic and military assistance to Greece and Turkey after World War II, was reduced to bankruptcy in 1947 by the combination of one of the worst winters in history and the cumulative economic consequences of the war.[7] In 1948, the United States, perceiving a Soviet threat to the faltering governments of France, Italy, Iran, Turkey, and Greece, created and implemented the Marshall Plan. This was an economic program geared to aid Europe's postwar recovery. To aid Europe militarily, a mutual defense alliance was agreed to in 1949 by the United States and its European allies; this was the beginning of the North Atlantic Treaty Organization (NATO). Soon, owing greatly to U.S. assistance, the political, economic, and military recovery of Europe, including West Germany, was well underway.

On the military side, President Harry S. Truman's administration concluded that the United States "was confronted with a multidimensional Soviet threat aimed at nothing less than Western civilization. The only apparent remedy to Soviet power was struggle and confrontation because all they (the Soviets) understood was force."[8] It was therefore imperative, in the administration's view, that the United States maintain its military strength in order to deter Soviet aggression. "The manipulation of the threat of war had to become the most important facet of diplomacy when dealing with the Soviets."[9]

---

7. James A. Nathan and James K. Oliver, *United States Foreign Policy and World Order* (Boston: Little, Brown and Company, 1976), p. 75.
8. *Ibid.*
9. *Ibid.*

Unfortunately, the public and the Congress, in the immediate postwar years, were more concerned with domestic recovery and a return to normalcy than with building up or even maintaining a strong defense establishment. Their perception of the Soviet threat was at odds with that of the Truman administration. There was public opposition to the continuation of the draft, to universal manpower training, and to increases in the defense budget. Gradually, this would change. The Berlin Blockade, the fall of China to the Communists, the first successful Soviet atomic bomb, and the beginning of the Korean War served to confirm the necessity of the increasingly military definition of America's global role. The Congress and the public were finally convinced of the Soviet threat.

Increases in the defense budget were approved in 1950. The U.S. role in Korea was supported. The Cold War was a reality. It was a time of constant preparedness. The security of the United States, the most basic of foreign policy objectives, was to be found in the maintenance of international peace and stability. Any disturbance of the established world order and any subjugation of free peoples "by armed minorities or outside pressures" would have to be dealt with by the United States.[10]

The prolonged state of international tensions that resulted from the positions taken by the United States and the Soviet Union during the Cold War was and has been characterized by high levels of military expenditures by both superpowers. The sophistication and complexity of modern weapon technology assures that present and future weapons will be global in reach and capable of unprecedented destructiveness and almost instant delivery. "A nation under major attack no longer has the time to mobilize its [industries], to convert its peacetime businesses to wartime production, and to update its technology. Its potential retaliatory time has been cut to hours and even minutes."[11] To meet the necessary level of preparedness for a "come-as-you-are" war, the United States has created a large and permanent armaments' industry.

Thus, since World War II, in response to the perceived Communist threat and to the abiding necessities of the Cold War, an industry and its subsequent subsets geared towards providing the military with weapon systems has developed—the so-called military-industrial complex.

The Theories

The groundwork for the military-industrial complex theory was laid by C. Wright Mills. Subsequent theorists have used his concept to explain the

10. *Ibid.*
11. *Ibid.*

growth of defense industry and its suspected machinations in the years following World War II. The theory has been employed to explain the high cost of defense, the longevity of the Cold War, and the "perverted priorities of the Federal Budget."[12]

Mills wrote of the power elite as being an ever-present clique of power holders at the pinnacles of politics, industry, and the military. He depicted these influential men and women as a natural phenomenon of the evolution of American society. He saw reflected in them the same decreased emphasis on intellectual achievement and moral values that, in his view, characterized American society as a whole. Mills thus took a philosophical approach to explaining the emergence of the military–industrial complex.

The school of thought that has followed from Mills' work has contended that the military-industrial complex is a direct result of the change in military strategy and the resultant increase in demand for military equipment over the past 25 years. The MIC is a rationalization of "high levels of military spending with an ideology of international conflict, mainly the ideology of the Cold War."[13] And, it is contended those who manage the MIC—top echelons of politics, government, and defense industry—conspire to continue the arms race, the obsolescence of technology, and the increase in federal funds for defense work in order to perpetuate the acquired power and to profit from the public's perceived need of a large defense base.

Several groups of theorists have emerged from this school of thought. One group sees the MIC as a "self-conscious conspiracy acting [illegible]ts own main interests." Others describe the MIC as a "coalition of special interests who wrongly believe themselves [to be] acting in the broader or national interests."[14]

Adversaries of the MIC

One widely quoted opponent of the military-industrial complex is Sidney Melman. In several books, including *The Permanent War Economy* and *Our Depleted Society*, he has asserted that American capitalism since World War II has featured the growth of a war economy. Economic planners, he says, have been unable to foresee or identify the economic qualities and consequences of a permanent war economy because they believed in the fallacy that military spending brings prosperity. In addition, he thinks, these economic planners have relied upon the premise that a war economy is equivalent to full employment. Melman

12. Jacob K. Javits *et al.*, *The Defense Sector ...t the American Economy* (New York: New York University Press, 1968), p. 22.
13. Rosen, p. 1.
14. *Ibid.*, p. 3.

insists that lowered U.S. industrial efficiency and the severe inflation of the 1970s are results of government-based managers having superseded private American firms in control over capital. As a result of the war economy, the economy as a whole has become stagnated; military-based policies incur large budgets and major manpower and material resources. The result of this concentrated military spending and the use of limited resources is that non-military industries have been depleted to the point that they are non-productive and non-competitive.

Sidney Lens is another adversary of the military-industrial complex. He wrote a definitive work, *The Military-Industrial Complex*, that described the makeup of the MIC, its origins, and purposes. He contends that there has always been some form of a MIC, even before World War II; that the MIC gained public recognition and power after World War II because of the rise of communism; and that the Pentagon and its military programs were the primary defense against communism. Although this is the accepted version of the rise of the military-industrial complex, Lens says there was a hidden motive for the close cooperation between military, industry, university, and labor hierarchies. He says that the role of American defense was to be the missionary of capitalism and democracy; that global imperialism was the key; and that the Soviets threatened to curtail American free enterprise by closing overseas markets. "To guarantee markets and supplies a new strategy was needed, economic, political, and military, to make the American system a world system."[15] The existing military-industrial complex was the means used to establish the American system worldwide, and to secure those markets and resources.

Several other explanations of the military-industrial complex have received considerable attention. One group of theorists says that the MIC promotes unnecessary arms buildups, arms profiteering, militarism, and war through its manipulation of the supply and demand of military weapons. Others, more moderate in their condemnation, contend that the arms race is furthered by a contrived international conflict, particularly between the superpowers, and by a heightened "cycle of mutual fear between those states."[16] Members of the MIC are portrayed as self-aggrandizers who use the devised external threat of Communist expansion for their own interests, i.e., the entrenchment of their economic and political power.

To these thinkers, many of them economists, the military-industrial complex is the absolute function of capitalism. They predict that large defense budgets will continue in spite of any decrease in defense needs. "Modern capitalism requires high levels of government spending to maintain an adequate level of aggregate

15. *Ibid.*
16. Sidney Lens, *The Military-Industrial Complex* (Philadelphia: Pilgrim Press, 1970), p. 23.

demand."[17] These economists believe that military spending has become the cornerstone of the U.S. capitalist economy; that large cuts in the defense budget would drastically alter the very fabric of the economy and would depose the most powerful interests in the defense and political systems, an idea abhorrent to those in power. It is further maintained by these economists that it would be almost impossible to shift monies from defense to social programs (where they claim there is a critical need) because defense programs are perceived to be imminently more profitable and more productive.

The foregoing views are at odds with the opinions of the defenders of the military-industrial complex, i.e., defenders of defense spending. These economists, and political and military thinkers, do not perceive the MIC as a giant conspiracy—quite the contrary. It is pointed out that the Department of Defense budget, in real dollars, has dwindled since the mid-1950s—the height of the Cold War. Where defense once took a very large share of real growth from FY 1950 to FY 1961, it has taken virtually none from FY 1961 to the present. Defense shares of the GNP, labor force, and federal budget are at the 1951 level. Defense shares of total public spending and employment have fallen below the levels of World War II.[18]

In 1968, at the peak of the Vietnam conflict, procurement outlays equaled $44 billion. In 1976, procurement outlays were $17 billion (real dollars), the lowest since World War II.[19] The figures are used to prove wrong those who claim there is a conspiracy to maintain high levels of defense spending. The reduction in defense dollars has led to a reduction in the production of weapon platforms—tanks, ships, aircraft, missiles, etc.

In turn, say the proponents of defense, the defense companies have suffered a multitude of financial troubles. Prime contractors have been hurt the most. They have incurred heavy debts; they have lost from underutilized plants and equipment, and have not been able to reinvest money into capital equipment. The second-tier industries have had similar problems, including some bankruptcies. Even those companies not totally dependent on military contracts have lost money. Claims of excess profits have been fallacious; few defense companies have earned profits higher than commercial corporations.[20]

As a result, many people point out that there is in the U.S. economy no military-industrial complex that exists as a coherent entity as claimed by

17. Rosen, p. 7.
18. *Ibid.*
19. U.S., Department of Defense (Comptroller), *The Economics of Defense Spending. A Look at the Realities*, July 1972, p. 33.
20. Jacques S. Gansler, "The Nation Effectively Achieves Its Objectives," *Defense Management Journal*, March-April 1979, p. 8.

Melman, Lens, *et al.* Since the industrial base, upon which the military has come to exist, has been allowed to deteriorate, there must be little commonality of interest between the military, government, and industry.[21]

Furthermore, the very acquisition process as regulated by the Department of Defense has produced an adversary relationship between DOD and the industry that serves it. Legislation, regulation, and institutional practices often result in conditions of extreme confrontation.[22] This is not a relationship that would exist between co-conspirators.

Summary

The numerous studies that have been done on the military-industrial complex have been as diverse in their definitions of the MIC as they have been in their conclusions. Some studies have viewed the military-industrial complex as a dangerous conspiracy; as having the potential to wreak havoc with the economy and the U.S. political system; as being able to produce "Dr. Strangeloves," or worse.

Few studies recognize that there is a legitimate need for a diverse defense industry, or that current U.S. defense policy, based on a just perception of the Soviet threat and the availability of technologically complex weapon systems, dictates a need for an adequate defense industry. Nor do these studies recognize that the size of the industry is determined by the demand for weapons, based upon the prevailing doctrine. There are, of course, problems when the development and deployment of new technology in traditional mission areas has occurred without questioning the future mission need or the long-run program affordability.[23] However, efforts are being made by the DOD to correct this problem.

As noted earlier, the term "military-industrial complex" is extremely imprecise because of its reliance on a conspiracy theory, because of the simplistic economic explanations based on self-interests, because of an inconsistent definition of its components, and because of an inability to determine quantitatively or qualitatively the extent of its real power.

In general, the conflict surrounding the issue of the military-industrial complex is the result of a subtle interplay of interests and perceptions. To get a clearer understanding of *why* there is a military-industrial complex, it is necessary to trace its origins, as it has been attempted here. ‖

---

21. Department of Defense, *Economics of Defense Spending*, chapter 20.
22. Gansler, p. 9.
23. *Ibid*., p. 10.

Reading Computer Programs as a Managerial Activity

140

Dr. Harlan D. Mills

It is standard business practice for managers to measure the quantity and quality of their organization's production. But this practice does not apply well in the area of programming, where the work has been looked upon as a mysterious, *ad hoc* process with results more visible in execution than in the processs itself. As technical foundations emerge and programming becomes manageable, however, this condition should change.

Programming began about 30 years ago and has seen a succession of increasingly sophisticated machines. Initially, machine operations were simple and sequential, related to a single set of data storage elements. Since then, we have gone through three major generations of increasingly sophisticated hardware.

There are new complexities in concurrent data-processing operations, which involve several processors. For each processor, there are many channels, themselves special processors, which operate from the same memories as do the main central processing units.

Extensive data storage and addressing techniques have been developed in terms of based and indexed addressing in main storage, multiple register addressing for multiple high-speed processing, and in a variety of mass storage and I/O units, each having a peculiar data storage and transfer linkage with the main storage.

These changes in hardware architecture have had the effect of keeping the programming state-of-the-art "off balance," making obsolete much of the knowledge of earlier machine generations (e.g., *IBSYS in the 7094, insofar as the* 360 is concerned) and keeping programming the mysterious, black art that it often seems to be today.

New Stabilities in Hardware and Programming Languages

As painful as hardware development has been in terms of software adaptation and programming state-of-the-art, that hardware development has produced spectacular results in terms of processing and storage capabilities. Machines can now process and store several orders of magnitude more data for the same cost than could be done at the beginning of computing. Hardware has proliferated complexity in the software, but this very economy in hardware has also made certain simplifications in software development possible, by allowing the hard-

---

Dr. Harlan D. Mills is an IBM Fellow and Director of Software Engineering Development for IBM's Federal Systems Division. He is noted for his work in developing technical and management foundations for orderly and disciplined software procedures and applications. Dr. Mills holds B.S. and M.S. degrees, and a Ph.D. degree in mathematics from Iowa State University. He was named an Honorary Fellow of Wesleyan University in 1962.

ware to be used in less efficient modes. For example, high-level languages such as Fortran or PL/1 are possible and practical in today's machines, where they would not have been reasonable for the efficiencies required of the early machines. Machines today can be used to help supervise their own activities and the activities of programmers. This would not have been possible in the early days of computing when machines were too scarce and expensive a resource to be used in this way.

These economic and technical influences are converging into a new mode of operation in which the baseline for programming and software development is a "virtual machine" composed of hardware, software, and sometimes firmware, i.e., microprogramming. As a result, the software management problem has a more stable platform from which to develop. This platform includes languages such as PL/1, Fortran, and Jovial, in which it is practical to carry out the main sections of large programming systems, and in which the idiosyncracies of various machines are largely hidden by automatic and practically error-free translation from high-level language to machine language.

This stable platform introduces a possibility for managing programming and developing large programming systems that has not existed before. Until now, it has not been useful for managers to learn to read programs written in certain machine codes, because this knowledge would be rendered obsolete by the next project, when a new machine architecture would be implemented. But the stability of the present software platform, which allows programming language levels above individual machines, makes program reading a valuable skill for managers. The skill is worth acquiring and in fact, is necessary for the effective development of large programming systems, and the evaluation of programmers in development projects.

This Opportunity for Program Reading

Programs are imperative statements to machines that allow them to accomplish the objectives set forth by the machine's users. These imperative statements are phrased in programming languages, and their authorship is called "programming." But, as with any language, it is usually easier to learn to read a programming language than to write it. At the same time, there is much to be gained from reading such language. It therefore seems that the time has come for managers to begin to read programs in a systematic way, even though the writing of such programs is not now, nor will it ever be, part of their responsibility. The advent of structured programming has made the reading of programs easier than ever before. Structured programming permits the reader to enjoy a special privilege in his reading; namely, that of reading in a sequential, systematic way,

as in ordinary English text, in order to follow the imperative requirements laid down by the program. Non-structured programs are not written in sequence and therefore require the reader to keep mental track of many contingencies at which branches might be taken and special or different conditions handled. Structured programming forces the writer of a program to organize the statements so that they can be read sequentially.

The main beneficiary of this discipline is the programmer himself. Quite often, a programmer writing an unstructured program will have in mind some pattern of operation which allows him to jump back and forth in an efficient way. But just as often, that jumping back and forth serves merely to confuse the original programmer, resulting in program errors that may go as far as system integration or into user operation before being detected. Structured programming eliminates this problem, while at the same time allowing someone unfamiliar with the program to read and evaluate it.

Programming Performance

With the wholesale reading of programs by managers, we can expect other anomalies of programming to be resolved. It is curious that, in programming, the typical programmer never expects anyone else to read his program. He will be judged by its execution, and judged in highly superficial ways, at that. When machines do a million multiplies a second, a factor of 10 in inefficiency is not even detectable unless it occurs in a well-worn set of problems done for comparison by other people. Similarly, the use of core is difficult to judge unless there are well-worn standards of comparison around. We know from experience and spot sampling that programs can be very inefficient in both through-put and core, and we also know that program logic can be tortured, difficult to maintain, and practically impossible to build upon or extend. And yet, programs with such gross deficiencies successfully pass "the inspection of execution" every day. It is small wonder that programmers have psychological problems at times, because they are deprived of a very human need in their work—the need to be appreciated and commended for work well done. So long as no one reads their code, and so long as everyone concerned knows that the inspection of execution is so gross a measurement tool there is not a great deal of incentive for or reward in doing an exceptional job.

Programming is less than 30 years old and, as a management activity, is less than 20 years old. Yet, it has already grown some sacred cows. For example, some programmers see the reading of code as a sign of mistrust, or consider the judgment of code by anything other than the gross inspection of execution as an impertinence of management. But these sacred cows have arisen easily and can be disposed of easily as well. Experience has shown that when code is read intelligently by managers, the programmers become much more motivated and proud of their work in a way not possible otherwise.

The Psychology of Precision

The reading of programs by managers will also introduce a new level of precision in programming, a precision made possible, but not inevitable, by new technical developments in programming. Structured programming and results in program correctness give programmers a technical foundation for writing nearly error-free code; however, this potential will not be realized without a psychological transformation as *well*.

We go back to the problem of a comparatively young activity groping its way into a systematic process, moving from a frustrating trial-and-error, highly "creative" activity in which cleverness and complexity are attributes of pride, to a systematic, engineering-like process in which the emphasis is on precision, logic, and repeatability. This psychological transformation is not a process reserved for a very few gifted individuals. It is a process we have seen begin to happen on a broad scale from the most junior up to the most senior personnel.

The physchological transformation simply amounts to this. If a programmer thinks that what is in his mind is essentially correct, but is subconsciously counting on debugging runs to iron out small errors in logic, then he loses concentration here and in the entire process, leading to small errors that later torment him and others in the debugging process. The critical matter is not simply for a programmer to *be able* to program correctly—he must *know* that he is able to program correctly. It is his knowledge that he knows how to program correctly that effects the psychological transformation and makes possible the concentration necessary to write correct programs. When a programmer knows that what is in his head is correct, it becomes more important to him to get it on paper in exactly that correct form, that he look up past data definitions to be sure they are precisely compatible, that he examine every special case with more care to make sure they treat the subject in exactly the right way. This psychology of precision applies to the understanding of his logical capability, clear through to the development of machine-readable material, however it is accomplished.

This difference between a programmer's being able to program correctly and knowing that he *can* is a distinction that is available to a programmer only on considerable education in questions of mathematics and logic. Such an education allows him to regard programming as a logical activity similar in form to a game such as tic tac toe, and differing only in the degree of complexity, not in any inherent requirement which transcends his human capabilities.

Programmers with this kind of psychological transformation will be disappointed indeed if their code is not read and if the reasoning that they formulate for their code is not appreciated.

Program Documentation

The question of documentation has plagued programming management for a long time. In the mathematical theory behind structured programming,

documentation turns out to have a natural home. The documentation of a program is synonymous with proof that it is correct. In fact, anything beyond that is superfluous. This proof of correctness may be at several levels; at the user level, the program language level, or even in some cases at the machine level. But the "correctness" problem gives a rationale and basis for judgment on the relevance and quality of documentation that we have not had before.

In the proofs of program correctness, documentation appears as an adjunct of the program itself. It is easy to point to cases where documentation attempts to replace the code. When this occurs, there is a danger that the code will be changed without the documentation being changed, with the result that documentation loses its currency. When programs are maintained in a visibly correct form, the standards of correctness are, themselves, standards for maintaining documentation in a current and relevant form. ‖

Correspondence

To the Editor:

Please extend our thanks to Dr. David N. Burt, Adjunct Professor of Acquisition Management at the Naval Postgraduate School, for his fine article, "Will Four-Step Solve the Problem?" published in your [Winter 1980] issue of the *Defense Systems Management Review*.

Dr. Burt is promoting the use of four-step to help solve many of our basic acquisition and contracting problems. We concur that the adoption of four-step by DOD is a sign that the Federal Government is indeed serious about trying to improve the acquisition of defense weapon systems. We would like to point out that the Air Force Systems Command has taken some additional initiatives to also help in the improvement of the acquisition process. Three examples follow:

a. The need for consulting with and obtaining industry feedback on the statement of work is being effectively accomplished by our use of a draft request for proposal (DRFP). This technique involves furnishing to industry a draft of the intended solicitation for their review and response. This technique also helps in overcoming a problem covered in the article—that of insufficient proposal preparation time. We strive to release the draft RFP at the same time we seek negotiation authority, which is normally at least 60 days ahead of the formal RFP release.

b. We are continuing our support for the non-disclosure of numerical weights in source selection. There is already too much leading of the offeror in proposing. Even Dr. Burt suggests in his article that there is a need for less mathematical equations of numerical assessments in proposal evaluation. The tendency to force a selection by such disciplined measures dilutes the customer's need to be free to pick the best possible source.

c. Finally, as to past performance not being used as a motivator, Systems Command researched, tested, developed, and is now using past performance as a source selection criterion on all competitive acquisitions. On 1 November 1979, definitive policy was issued which specifically requires the use of past performance as a selection criterion first or at least equal to all other criteria in importance.

Four-step can help solve problems, but most of our acquisition problems will only be solved by using all of the contracting techniques available plus a considerable amount of personal and forceful management attention.

Anthony J. Deluca
Deputy Director
Systems and Support Contracts
DCS/Contracting and Manufacturing
Headquarters Air Force Systems Command

*U.S. GOVERNMENT PRINTING OFFICE : 1980 0-628-889/2745