REDESIGNING THE UNITED STATES DEFENSE ACQUISITION SYSTEM

By

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ACKNOWLEDGEMENTS

In December of 1985, I attended my first Interactive Management (IM) Workshop. Dr. Alexander N. Christakis, then Director of the Center for Interactive Management (CIM) at George Mason University had suggested holding Interactive Management sessions about Defense Acquisition System Problems to DSMC's Commandant and Provost. A 3 day workshop focused on the issue, "What are the problems with the Defense Acquisition Process?" Contrary to Christakis' advice to keep attendance below 15 people, the Commandant invited 21 members of DSMC's senior staff to participate in the workshop. The workshop achieved no consensus among participants either on what problems were or how they affected acquisition.

But two workshop participants, Paul J. McIlvaine (then Director of the Technical Management Department) and the author (then Professor of Engineering Management in that Department) thought the process could be used as a research tool. DSMC contracted with George Mason University to retain Professor John N. Warfield and Dr. Christakis to instruct DSMC faculty and staff in the theory and practice of Interactive Management. With McIlvaine's blessing, the author began use of Interactive Management as the singular instructional methodology for a one week course, "Technical Managers' Advanced Workshop". Later, a sequence of Under-Secretaries of Defense (Acquisition) used IM workshops to generate the redesigned acquisition process described in this document.

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DECLARATION

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ABSTRACT

In 1986, the Defense Systems Management College (DSMC) began to examine what defense program managers did as they developed new weapons for the Services. The aim was to determine the tasks program managers performed, how they performed those tasks, what their problems were in doing their work, and what might be done to help them improve their performance. The Interactive Management (IM) methodology developed by Dr. John N. Warfield was chosen as the vehicle for this work. As the workshops provided insights, that knowledge was disseminated throughout the defense acquisition community to provide immediate help to program managers.

In 1988, twelve Interactive Management workshops were sponsored by then incumbent Under-Secretaries of Defense, Acquisition (USD[A]) to help them understand acquisition problems and develop ameliorating actions which USD[A] could take to improve the efficiency and effectiveness of the Defense Acquisition System. In June 1991, a series of ten additional workshops began: the first workshop integrated knowledge accumulated from all of the prior workshops to define single set of problems which had been experienced during the process of acquiring defense systems; the second workshop attempted to devise a set of actions which could help resolve those problems.

But, by late 1991, it had become apparent that significant improvement in the then current acquisition process would require massive rethinking of the fundamental ideas incorporated within it. In February 1992 a series of workshops was initiated to address acquisition process redesign. These workshops focused on enunciating the specific functions/tasks necessary to develop advanced weapon systems efficiently, and designing a process to accomplish them efficiently and effectively.

The acquisition process which emerged from the workshops provided compressed weapon development cycles and reduced the numbers of mandatory oversight and management activities. In turn, those reductions provided the opportunity to incorporate near state of the art technology within newly developed weapons, while at the same time very significantly reducing development cost.

The redesigned acquisition process based on the 28 IM workshops was institutionalized by the U. S. Congress in the "Acquisition Streamlining Act of 1994" (Public Law 103-355).

The chapters which follow discuss the: (1) workshops, and insights gained from them; (2) redesigned acquisition process generated; and, potential for broader application of knowledge resulting from this work.

CHAPTER 1
INTRODUCTION

This chapter presents: (1) The objectives of this work, why it was undertaken and what end results were sought; (2) A brief description of the author's experience with the Defense Acquisition System (DAS) during 45 years of professional life to build credibility for the claim of expertise in the subject matter as the result of long and intimate association with the acquisition process; (3) An initial rationale which points to the need for a holistic approach to defense acquisition system re-design; and (4) An overview of the document's structure to the reader.

1.1 THE TWO OBJECTIVES OF THIS WORK

The examination of defense acquisition processes discussed here: (1) Extended over six years; (2) Was conducted by the author with the guidance, advice and assistance of Dr. John Warfield; and (3) Was supported by the various incumbent Under Secretaries of Defense, Acquisition. Two objectives defined this research:

- Provide a detailed functional description of the Defense Acquisition System (DAS) and use that understanding to develop a set of detailed suggestions for DAS redesign; and
- Determine how knowledge gained from the DAS analysis could be applied generally to other complex systems.

The first objective has been demonstrated by the incorporation of almost all of the changes suggested as the result of this work within the "Federal Acquisition Streamlining Act of 1994" [1], legislation enacted by the United States Congress in September 1994 and signed by the President on 14 October 1994. The nature of the DAS and the problems inherent in its use during the period between 1977 and 1993 are discussed in Chapters 5 through 8.

The second objective has become even more important over time. By 1989, it became apparent that the DAS had sufficient complexity to stand as exemplar for other extremely complex systems. The DAS:

- Is used to develop, produce, support and use highly complex devices.
- Interfaces with a great many government and Industrial institutional entities;
- Is in dynamic change at all times because it is owned by the Congress and the People whose views on defense change frequently in response to changing world

conditions;

If one could achieve a more complete understanding of the DAS, there would be enlightenment about how complex systems in general might behave. The DAS is interesting both because of its peculiar attributes and also because the system is "government crafted". In its attempt to maintain DAS efficiency and effectiveness, the government continuously modifies the system. The oversight is aimed at generating and sustaining an environment which supports design, development, production and field use of intricate technical systems. The breadth and scope of this dynamically changing system provides a unique opportunity to explore complex system dynamics. The methodology used to design the 1994 U.S. Health Care Reform legislation followed the traditional Congressional process: legislators who are generally unskilled or unknowledgeable about complex system design set about writing a set of detailed legislative proscriptions to create a unified and monolithic health care system. ***When the product of that methodology (the 1700 page legislative package) is compared with the DAS redesign work reported here, it may become quite clear that the DAS redesign process has much to offer as a model to all government system designers.***

1.2 THE AUTHOR'S EXPERIENCE WITHIN THE DEFENSE ACQUISITION PROCESS

In February 1949, the author began work as a Physicist-Mathematician at the Ballistic Research Laboratories. The Laboratories were part of the U. S. Army Ordnance Corps and were responsible to the Chief of Ordnance for design of new weapon projectiles. Initially involved in research within the broad area of compressible fluids, work soon became focused on learning about trans-sonic and super-sonic flow. That work led to later employment with the United States Air Force to build the first Intercontinental Ballistic Missile and membership in the Program Management Office of the first U. S. Air Force satellite program.

Through the years, (with the exception of the periods between 1956 and 1959, and between 1966 and 1978 when performing essentially commercial work in the United States and Europe) the author worked within the then-existing Defense Acquisition System both as a member of Government, and as an employee of one or another Defense contractor. Over the last 46 years, there has been much opportunity to experience and appreciate the complexity of the processes used for design, manufacture, test and distribution of military products, and the defense acquisition processes which place those products within the armed forces. There has also been considerable involvement with the continuous Government actions aimed at providing a process which adequately oversees that activity.

Since becoming a Faculty member at the Defense Systems Management College in 1983, the author has been a participant in the processes of change within the Department of Defense, and has proposed policy changes for Departmental and Congressional action. A number of those proposals have recently been enacted by the Congress.

In a very real sense, the author has lived intimately with change to the Defense Acquisition process and experienced the results of change first hand. The author was a party to the decision process by which those changes were crafted and implemented. ***As a result of living the history of Defense Acquisition growth and change, the author felt that a careful, well done study of the complex Defense Acquisition System could provide insight which would help in understanding large complex systems regardless of their purpose and origin.***

1.3 A SOCIETAL SYSTEM APPROACH TO DEFENSE ACQUISITION ANALYSIS

The examination of the origins of the Defense Acquisition System and the reasons for its complexity led to the search for a holistic approach to inquiry which did not foreclose the opportunity to include all of the complex dynamics seen as characteristic of the DAS.

Dr. John Warfield has studied complex processes for 25 years. He pioneered the methodology of relating events and outcomes which appears in his book Societal Systems [2] and his subsequent works [3][4]. The process of inquiry Warfield describes (and later defines) offered a logical approach to gain understanding of the acquisition process, not in terms of a traditional systems flow chart model, but rather as a multi-dimensional complex architectural entity.

Application of Dr. Warfield's methodology to complex problems requires a series of commitments from everyone involved.

- ***The complex process under study must be explored from multiple aspects and in considerable detail.*** The Defense Systems Management College (DSMC) spent six years exploring the DAS. As an arm of the UnderSecretary of Defense (Acquisition), those incumbents provided continuing investigative focus.
- ***The group of individual participants must be large enough to bring both breadth and depth of knowledge and experience.*** There needs to be assurance that sufficient numbers of people with requisite knowledge will be able to participate in intensive periods of deliberation. As the senior Defense Acquisition Executive, the UnderSecretary of Defense (Acquisition) can ensure sufficient and meaningful participation. 330 individuals were deeply involved in the work reported here. Participants included Program Managers from each Service, Program Manager staffs (military and civilian), Defense Departmental Staff, members of Defense Industrial Base support contractors, weapon designers and producers inside and outside the Government, and U. S. Senate Armed Services Committee staff members.
- ***The results of work performed need to be carefully studied, and accepted by the people who must implement the recommendations made.*** The mechanism for dissemination of final results should be built into the analytical process. DSMC, by conducting the investigation as a series of one week courses, provided for timely incorporation of the results within the many courses offered to the Defense Acquisition community; and the sponsorship of USD(A) and participation of Congressional staff in the workshops provided assurance that results would be viewed on their merit. Workshop findings were discussed with all participants and with Defense Senior staff members throughout the course of the investigation.

1.4 THE STRUCTURE OF THIS DOCUMENT

This work consists of 12 Chapters:

Chapter 1 sets the stage for the remaining discussion. It has discussed the two objectives of this work, the author's involvement with the Defense Acquisition process, the basis for use of a societal systems approach to Defense Acquisition System Analysis.

Chapter 2 discusses the evolution of the U. S. Defense Acquisition System, the Governmental activities involved in its exercise, the entities who have a stake in and influence the DAS and their approach to Defense Acquisition Analysis, and the elements considered in selecting an analytical methodology for the study.

Chapter 3 reviews the work of others involved directly with the defense acquisition system, more specifically the literature produced over the years which describes some aspect of the DAS and discussions with commercial equipment and component producers. In discussing the DAS, the kind of literature produced by DAS participants is related to DAS characteristics. Further, models of the DAS as it is constructed within the basic enabling documentation are presented, and details are provided about how agencies which influence DAS operations provide DAS inputs. The analysis points out differences between a dynamic system such as the DAS and other systems which are more stable over time.

Chapter 4 discusses analytical methodology and techniques available for complex system examination. It describes the way in which models of various types have been applied to the DAS and other complex systems and why the unique capabilities of the Interactive Management methodology were chosen. The particular attributes of IM are discussed with emphasis on their unique capacities for exploring complex systems.

Chapter 5: (1) Describes the context within which a series of Interactive Management workshops was undertaken; (2) Provides a chronology of the Interactive Management workshops conducted between June 1988 and August 1991 and indicates the purpose for which each workshop was held; (3) Groups workshops in accordance with the purpose for which they were undertaken; (4) Analyzes the workshop contributions within each workshop group; (5) Focuses on the knowledge gained; and (6) Presents relationships among defense acquisition system problems defined by workshop participants.

Chapter 6: (1) Establishes the framework within which a functional acquisition process was designed; (2) Describes the IM workshop activities which provided the basis for the new system design; (3) Describes the revised acquisition process design which resulted from the workshops; and (4) Discusses the differences between the way the established DAS performed and the way in which the new system was envisioned to perform.

Chapter 7: (1) Discusses the mechanism which participants used to determine skills required of individuals working within the functionally designed acquisition process; (2) Defines a skill set used to estimate the numbers and kinds of people required to perform the new process; (3) Reports the work done to derive the particular skills necessary to implement the process; (4) Presents the process and estimates savings in manpower which would result from implementing the suggested organizational changes.

Chapter 8: (1) Describes workshops which examined the question "Would the new Acquisition processes, if implemented, solve the problems experienced using the established system?"; (2) Defines the categories of problems which would remain; and (3) Discusses how the current U. S. cultural condition mitigates against an institutionalized set of solutions to those problems.

Chapter 9: (1) Describes the interfaces between society and the DAS; (2) Presents a perception of U. S. cultural characteristics; (3) Defines the entities which interact with the DAS at the interfaces; (4) Explains how the interactions create and maintain problems; and (5) Presents a concept of an interface set.

Chapter 10: (1) Discusses interactions between the DAS and other groups; (2) Describes the Congressional legislative mechanism and what was done to cause Congress to include many of the functionally designed processes derived in this work within the "Federal Acquisition Streamlining Act of 1994"; (3) Discusses problems addressed by present initiatives; and those which remain.

Chapter 11: (1) Discusses the lessons learned about working to improve DAS functional performance; (2) Discusses the difficulties inherent in use of public funds for complex system development programs; (3) Discusses what was learned about using Interactive Management methodology to design complex systems; (4) examines what was learned about understanding complex systems in general; and (5) details the authors contributions to the analysis process.

Chapter 12: Describes how objectives were met, the contribution made to knowledge and the plans for future work.

CHAPTER 2
THE DEFENSE ACQUISITION SYSTEM

This chapter: (1) Discusses how the U. S. Defense Acquisition System (DAS) evolved to its present state to show that over the past 14 years an accelerating pace of change to the system has created a remarkably complex system; (2) Discusses the major entities which affect the DAS and how each perceives it, their analytical methods, and the different points of view each has about how the system should perform; (3) Discusses reasons propounded to explain why the acquisition process continues to add to its complexity; and (4) Presents an initial rationale which points to the need for a holistic approach to defense acquisition system re-design.

2.1 THE EVOLVING UNITED STATES DEFENSE ACQUISITION SYSTEM (DAS) DEVELOPMENT

Obtaining weapons for the U. S. armed forces (first the Army, Navy and Marine Corps; and after World War II, the Air Force) has been of primary national concern since the nation was founded. Like many Federal government activities, defense procurement changed very little during the first 150 years of the 203-year history of the United States. But the protection and defense of the United States have become extremely complex since the time when the Minute Men took up their muskets, and George Washington paid the Continental Army troops under his command with his own (some say Martha's) money.

The discussion below is a chronology which explains how defense acquisition activity has evolved over the past 56 years and provides an appreciation for the increased rate of change to the system.

2.1.1 Prior to 1938 - Pre World War II

From 1776 until mid-1938, most purchases of military supplies and equipment were from commercial suppliers. In general, purchases were for fixed prices as negotiated by the buyers. Suppliers received their fair profit for risks taken. For products likely to have both military and commercial use, no special premium was charged when they were supplied to the military.

However Army and Navy weapons were not always bought commercially. Shortly after its establishment as an entity, the Army, believing that no suitable industrial capabilities existed within the society, built a set of "arsenals" to develop weapons. Over time arsenals specialized in design and production of particular military equipment. The arsenal in Harper's Ferry, West Virginia, produced gun powder and small arms; the arsenal in Springfield, Massachusetts, designed and produced rifles and ammunition for them; the arsenal in Watervliet, New York, produced artillery weapons (it still does to a limited extent); and Picitinny arsenal, New Jersey, specialized in ammunition design and production.

The Navy established a number of shipyards in strategic places along our coastlines which designed and constructed naval line vessels. The Navy also built its own gun factories to provide weapons for ships built in the naval shipyards. When the Navy's need for aircraft became apparent, Naval Aircraft factories for design and manufacture of naval aviation equipment were built.

Rather than establish its own aircraft factories the Army continued the practice begun when it purchased the first Army aircraft from the Wright Brothers: aircraft developed by commercial suppliers were "service tested" and, if they were suitable, they were purchased at a fixed price in definite quantities. The contract form used to procure the Wright Brothers aircraft continued in use until almost the eve of European mobilization for World War II.

2.1.2. **Between 1938 and 1941 - Armament Building for World War II**

In 1938, the United States Congress chartered the Defense Plant Corporation as an arm of Government to build and equip an industrial base specific to production of military arms. Congress recognized that there was a need to provide a much broader arms production capability. They also understood that little private capital was likely to be invested during the "depression" that lasted from 1929 until the beginning of World War II. When facilities were completed and equipped, a commercial organization experienced in producing the kinds of equipment to be built was selected to manage the facility under Government contract. Many Government-Owned, Contractor-Operated facilities still house today's defense contractors.

By 1940 it had become clear that the U.S. would need to mobilize and train more people for its expanded armed forces than would likely volunteer for such service. Congress created the Selective Service mechanism to oversee manpower resources and to allocate them to industry or military service as needed.

By 1941, Congress had recognized that engaging in truly global hostilities would require controlled distribution of raw and manufactured materials. The War Production Board and the Office of Price Administration were two of the numerous government entities established to regulate supplies of goods and non-manpower services such as energy and material distribution.

2.1.3 Between 1941 and 1946 - World War II Period

The various controls placed on almost every element of the U.S. economy by 1941 had made Government the *de facto* entrepreneur across almost all production and distribution functions. Certain businesses experienced government control of their raw materials and available labor; control which effectively limited quantities of their products. Energy rationing constrained distribution of the products they did produce.

In short Government had become the ultimate risk taker (whether that risk involved over-purchasing materials, over-hiring of workers, over-spending on production equipment, or producing a product unsuccessful in the market). Industrial managers were hired to run the Government's factories, and commercial operations were closely overseen by Government agencies.

Under such circumstances, Congress believed that payment for facilities management ought to be based on management services alone, rather than for risks normally taken by entrepreneurs. The "Cost-Plus-Fixed-Fee" contract form was created to provide a fair return on management skills under the kind of no-risk situation that existed subsequent to 1942.

But clearly, if "cost of operations" is the basis for profit computation, Government ought to be able to measure how tax-payer money was spent: that is, to ensure that public funds were expended in the best interests of the country, rather than to provide a basis management could use to justify larger profits. To assure that, Government claimed the right to perform detailed audits of exactly how management performed its business. A new kind of oversight hierarchy was established to insure that costs were reasonable and proper in accordance with the best production practices at the time. An auditing bureaucracy was established.

Use of private industrial organizations to envision, design, create, and manufacture weapon systems and other military equipment has increased over time. Today there are very few Government arsenals and naval shipyards that design and build combat equipment.

2.1.4. Between 1946 and 1950 - Post World War II - Pre Korean War

After celebrating the end of the World War II, the defense industrial base which had produced the weapons that won the war began to be dismantled. Because there were unfulfilled civilian needs to be met all over the world, converting weapon production lines to civil goods could proceed quickly as government contract terminations accelerated. Even when the Soviet Union initiated the "Berlin blockade", no additional weapon production was required because sufficient aircraft and munitions were already available in stockpiles. Thus, up until the invasion of South Korea by North Korea, the defense industrial base continued to convert its productive capacities to civilian goods which it had manufactured before the build up for World War II.

Institutional change, to the manner of equipping and servicing the armed forces, began just after 1949 as a part of the creation and organization of the Department of Defense (DoD). Until then, there were only three groups involved in Defense Acquisition: The Congress who appropriated monies through two Committees, Armed Forces and Appropriations; The Army and The Navy who spent the money to acquire their weapons and perform logistic and maintenance functions. Establishment of the Department of Defense (DoD) created a need for acquisition change. The former War Department and the Navy Department (within which was included the U.S. Marine Corps) were folded into DoD. As established, DoD included three (rather than two) primary war-fighting units: The Department of the Army, The Department of the Navy (still inclusive of the U.S. Marine Corps); and the new Department of the Air Force which was created by stripping the Army of what had been its aviation elements (the U.S. Army Air Corps) and elevating those activities to cabinet rank.

By establishing DoD, Congress sought to improve efficiency and effectiveness of the security forces through centralization of control and integration of functions. Congress also increased the number of its own Committees which had the authority to examine defense acquisition activity; Government Operations Committee and its Sub-Committees.

An immediate result was the burgeoning of newly created, centralized Defense Agencies and Offices which reported to DoD. Two organizational actions then taken came to have major effect on acquisition activities: creation of the Defense Comptroller's Office (OSD Comptroller), and establishing the Joint Chiefs of Staff (JCS) as a permanent activity reporting to the Secretary of Defense. OSD Comptroller became the single point of funds management for all Services; and the JCS became *de* *facto*, the armed forces integration focus. As time passed, defining requirements for equipment, (formerly a function of each individual Service and their fighting commands) became a major concern of the JCS; and decisions about allocation of funds among service weapon system requirements became centralized within OSD Comptroller. Creating DoD had provided Congress with a single focus of responsibility for two major defense issues. Because JCS assumed responsibility for validating requirements for weapons, and because all defense funds were concentrated within OSD (Comptroller), Congress was easily able to track the outcomes of its appropriation actions.

2.1.5 Between 1950 and 1960 - Cold War Arms Maintenance

The Korean War began a 40 year period of what was perceived to be a "cold war". The immediate effect of initial North Korean successes was to create an environment which supported a robust defense industrial base. Continuing improvements to weapon systems were perceived as essential to support U.S. international policies. Korean experience quickly demonstrated the obsolescence of military equipment used in World War II. The Soviet Union had continued to develop new and improved weapons which increasingly were seen as superior to U.S. aircraft and armor as World War II equipment was used against the North Korean forces. In these years,

- the defense industrial base expanded as increased emphasis was placed on research and development of new materials which could be used to improve weapons performance and better counter an expanded Communist threat;
- lessons learned in Korean combat were incorporated within developing military requirements, and industry responded with very rapid development of new concepts in weapon systems which used newly developed technology; and
- improvement in military operational capabilities was emphasized and new, improved equipment was placed into mass production as soon as it became available.

In 1956, Dr. Harold Hipsch, Chairman of the Department of Aeronautical Engineering at the Pennsylvania State University (PSU), began to develop a concept of total engineering for aircraft. Hipsch had designed military aircraft during World War II and had experienced great difficulty in integrating components within a single, well performing weapon system. He believed that considerable simplification would result if all components of a weapon system were designed initially for that entity. Hipsch referred to this concept as "System Engineering". The author worked with Professor Hipsch at PSU to formalize the concept. In 1958, Hipsch and the author presented papers at a meeting of the Operations Research Society of America (ORSA) describing the system engineering concept and its advantages. After their presentations, they were approached by Dr. Charles J. Hitch who was at that time a member of the Economics department at the University of California, Berkeley. Hitch discussed extending the "systems approach concept" to economics. Specifically, he envisioned accounting for cost as a series of increments which accrued over the lifetime of the equipment. In particular, the costs of an aircraft would include not only its purchase cost, but also its development cost, and its operating costs over the entire period of its utility. The concept later became known as "Life Cycle Costing" (LCC)[5].

2.1.6. **Between 1960 and 1978 - Active Military Involvements**

After the Korean cease-fire, another abortive attempt was made to turn the defense industrial base to production of civilian goods. Once more, military production contracts were canceled. But, as before, increasing Soviet aggressiveness; this time in Cuba, Latin America, Vietnam, Czechoslovakia and Africa, created a perceived need to institutionalize weapon development capabilities.

An event occurred early in the Kennedy Administration which changed the relationships between the armed Services, between the Congress and the Executive Branch, and between the Government and its Contractors. The event was appointment of Robert S. McNamara as Secretary of Defense. At that time, the Defense Department used a fairly simple accounting concept. Costs associated with military operations and with the maintenance of military bases and equipment were accounted within a category of costs labelled "Operating and Maintenance Costs" (O&M). Costs of procurement whether for new equipment or for replenishment and supply were accounted as "Purchasing Costs".

McNamara found those broad categories insufficient for the kind of quantitative analyses he felt necessary. Until McNamara's tenure, each Service had been responsible for justifying and procuring its own specific weapons. Early attempts to "unify and standardize" individual service actions within a strongly constituted central Defense Procurement Executive had been attempted, but had failed. The rationale was that after

World War II the complexity of the weapons purchased and the process used to purchase them had grown to the point where strong centrally integrated control was necessary. McNamara succeeded where others had failed because he understood better how to formulate and control complex activities using quantitative methodologies. McNamara's processes for transforming qualitative information (opinions, anecdotes, value judgements) into quantitative form were for the purpose of providing consistent and accurate data. He was a technological manager. McNamara's insistence on quantification has both permitted and pressed forward the rapid change in the DAS over the past 34 years.

McNamara appointed Hitch to be Comptroller of the Department of Defense and asked that he develop cost accounting methodology which would make it easier to project defense spending over longer periods of time, Hitch responded by institutionalizing the Life Cycle Cost concept within a newly established management system known as the "Programming, Planning, and Budgeting System" (PPBS)[6][7]. The PPBS made it mandatory to project all costs associated with the lifetime of weapons and to provide that information when the system was being considered for acquisition. Since weapons at that time were considered to have life cycles of 20 or more years, it became necessary to project costs that far into the future.

Two fundamental assumptions were built into the LCC and PPBS concepts:

- There would be no substantive change to any of the conditions which were directly involved in determining costs (e.g., technology, resource availability, force deployment and numbers); and
- The force utilization (e.g., potential hostile force structure and equipment) would not change sufficiently to make modification to the equipment necessary during the weapon's lifetime.

With the rapid development of the television industry, the media became a stronger influence on the ideas and activities of the Congress. During the Vietnam war, each evening's news would show combat events and casualties. It became possible to see people become casualties and the horrors of war were viewed daily. There was also heavy media coverage of protests against the war.

In the mid 1960's, it became obvious that warfare in Vietnam was different than the kind of conflict for which the U.S. armed force had been configured. The defense industrial base was directed not only to sustain production of strategic weaponry for full scale European warfare, but also to focus on developing weapons suitable for use in limited regional conflict. As it became clear that U.S. forces were unable to prevail in Vietnam despite superior arms and equipment, the defense industry was encouraged to refine its capabilities even further.

Throughout this time period, the U.S.S.R. continued to improve its own weapons and deploy them to client states. Even though the U.S. found its existing military capability unable properly to counter various hostile actions by the U.S.S.R., there was insufficient public support to maintain the defense sector at its late 1950's levels. Within the U.S., it was felt that social problems were of more fundamental importance than military issues; and that funding used for weapons would be better used to seek solutions to social problems.

The Congress, while determined to support a robust defense industrial base, enacted legislation which insisted that public monies used for defense also further social goals. The "Small and Disadvantaged Business Act" was passed. The act required "setting aside" a percentage of defense contracts for businesses owned and operated by an ethnic minority; or by women. In effect, the act institutionalized a key social objective of that time: to distribute at least some government funding to help a target business population become more capable of competing for defense funds. Again, special oversight offices were established to insure compliance with the new legislation. By the beginning of 1975, the number of entities which affected defense acquisition had expanded to extend beyond Congress, the Department of Defense, and the Services. The Department of Energy, Department of Commerce, National Aeronautics and Space Agency, Federal Aviation Agency, and the Media were all deeply involved in defense acquisition.

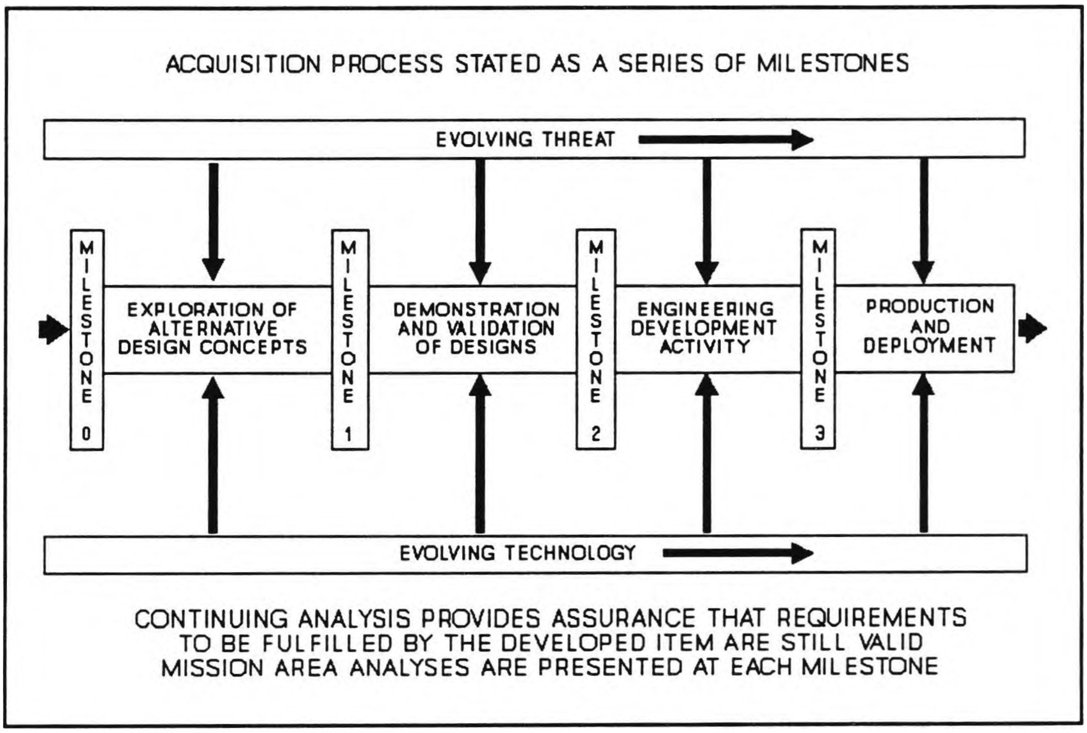
During the period 1969 - 1970 Defense procurement activity had a large national budget. The appearance of numerous media stories which talked about rumored abuse of authority by individuals engaged in procurement of weapon systems caused the subject to become a matter of national concern. That concern caused Congress to hold hearings on the subject to determine the extent of fraud, waste and abuse of authority within the Defense Acquisition community. While not sustaining accusations of large scale improper action by individuals responsible for development, purchase, and support of weapons; the hearing did indicate a need for some kind of educational institution to provide specialized education to individuals engaged in developing technically advanced systems. In 1970 the Defense Systems Management College (DSMC) was chartered as the educational arm of the Office of the Secretary of Defense (OSD); its charge was to become "The Academy of Management".

DSMC's purview included all aspects of acquisition: from conceiving new weapons through moving from ideas to practical, operationally-supportable devices. The work is intricate and change to weapon requirements, technology, and available resources continues all of the time that work is underway. As part of its responsibility, DSMC was asked to act as "honest broker" for DoD; specifically to examine sensitive issues and recommend systemic change to the acquisition process. Continuing investigation of acquisition process problems remains a major DSMC activity.

For various reasons, high levels of defense expenditure had continued during the period between 1950 and 1974. In its 1975 review of the budget, Congress became concerned that those expenditures had not provided the expected assurance of complete military superiority. The U.S. had been unable to prevail in Vietnam; and, even more disturbing, media stories began to appear (mainly on television) which questioned the claimed superior capability of U.S. aircraft in combat against Russian built fighters. In short, doubt had been cast on the capability of U.S. forces in general; and especially on the capacity to counter the kinds of Russian Surface to Air Missiles (SAMs) which had been emplaced around North Vietnamese strategic targets.

Between 1967 and 1975, there was an intense debate about improving the weapon acquisition process to achieve weapon superiority at much reduced cost. The first version of Department of Defense Directive 5000.1 (DoDD 5000.1) [8] was issued on January 18, 1977 in response to that debate. The PPBS had been introduced early in 1963; and the Life Cycle Cost concept is imbedded in the process. When issued, DoDD 5000.1 was mandated only for programs with anticipated costs of $75 million in Research, Development, Test, and Evaluation; or $300 million in production. But the Directive has become, *de facto*, the standard acquisition process tool for almost all programs undertaken by any element of DoD. Figure 2.1 represents the acquisition process established by DoDD 5000.1.

Figure 2-1 shows that both threat and technology evolve during the period of weapon system development. It also shows a process of development which begins with exploration of concepts applicable to a newly required system (ideation), the orderly progression to demonstration and validation of the design concept (proof of principle), the engineering development of a prototypical system (reduction to practice), and finally the production and deployment of some number of fully configured items. The process indicates a set of 4 "Milestones" which serve as points of program review. Milestone reviews are performed at meetings of what is now called the Defense Acquisition Board (DAB).



DoD ACQUISITION PROCESS
ESTABLISHED IN DoDD 5000.1

Figure 2-1

Today, DAB permanent membership includes the Under Secretary of Defense (Acquisition) who chairs the board, the Deputy Chief of the JCS, the DoD Comptroller, Other Defense Offices, Service Acquisition Executives and representatives of other interested parties. Reviews are made of:

- The threat as it currently exists. Threat changes are described and analyzed to insure that there is continuing need for the system proposed or being developed.

- Current technology "state of the art", especially change in technology areas incorporated within the developing weapons system. If technology change seems indicated, it is authorized.
- The current status of the program and whether the program plan requires change from the plan submitted at the previous review.
- The funds expended and those planned for expenditure during the course of the next program activity.

Department of Defense Instruction 5000.2 (DoDI 5000.2) [9] was issued to provide a procedural framework for system developers of weapon systems requiring application of the concepts within DoDD 5000.1. DoDI 5000.2 specifies the decision making framework and reporting requirements at milestones.

In one sense the process described in Figure 2-1 is a functional process: it specifies actions necessary to proceed from ideas to operational products. The functions are broadly enough stated so that they can be assumed to apply to all sorts of design, development, and production activities. That is, one might equally well produce automobiles, television sets, or any other complex products using those four functional blocks.

But the detail of functional performance within those blocks depends upon how the process is managed; the infrastructure within which the process is performed. It can be argued that just as automobile manufacturing is managed differently in Japan than it is in the U.S., the U.S. Defense Acquisition infrastructure is also unique. Therefore, the search for understanding of the DAS must come from analysis of the management statements which form the basis for the rules and regulations that govern DAS activities.

2.1.7. Between 1978 and 1992 - The DoDD 5000.1 Acquisition Process

The attacks on a Marine barracks in Lebanon and on the U.S. embassy in Teheran (with its subsequent imprisonment of the embassy staff as hostages) created a groundswell of public support in the U.S. for renewed emphasis on defense industrial capability. During that period not only were the armed forces re-equipped with the latest available new aircraft and bombardment devices (the so-called "smart bombs" and missiles), but large scale programs were undertaken to develop even more sophisticated new weapons with far-reaching implications (e.g., the "star-wars" ballistic missile defense system and the Patriot Anti-Ballistic-Missile forward area defense system). With this increased support for defense industry, Congress felt it necessary to enact more legislation directing Defense agencies to serve an expanded set of social objectives. The most important single enactment was entitled "The Competition in Contracting Act (CICA)". The law required announcement of all prospective contract awards prior to issuance of a formal tender request. All firms considering themselves capable of response could make one, and that tender would be seriously considered. Provision was made for exceptions: a special waiver which permitted less than "free and open" competition could be obtained from the Secretary of the particular Service. In practice, few responsible individuals availed themselves of the waiver provision. There had been adverse publicity about some of those who did: they were accused of prejudicial behavior, favoritism, and attempting to subvert the government's acquisition process. To oversee compliance with the law, Congress also mandated establishment of a "Competition Advocate" in each Service and in the Department of Defense. The effect of this single Congressional action was to increase the eight- to fifteen-month tender process by an estimated four months.

In 1991, both DoDD 5000.1 and DoDI 5000.2 were revised [10][11] to reflect legislative and organizational changes made since 1987 to the acquisition process defined within the original DoDD 5000.1. Two major changes in Defense organization had been mandated by the Congress:

- To assure more thorough weapon system testing, the position of Director of Operational Test And Evaluation [DOTE] was created. DOTE appointments required Senate confirmation. DOTE reported directly to the Congress; and
- To pay particular attention to survivability of personnel carrying weapons, the position of Director of Live Fire Testing [DLFT] was established. DLFT reported to the Secretary of Defense.

Another important element within the revised DoDI 5000.2 was the definition of the Defense Planning and Resources Board. The position of UnderSecretary of Defense (Acquisition) [USD(A)] was established specifically to oversee all Research, Development, Test, and Production activities involved with acquiring new weapon systems. In practice, the USD(A) became the acquisition "czar" and all offices involved in acquisition activities reported to USD(A). However, USD(A) was not given control of the resources required to pursue weapon development. The Defense Planning and Resources Board (DRB), chaired by the Deputy Secretary of Defense (DEPSECDEF), was created for that purpose. Permanent DRB membership included Secretaries of the Military Departments, Chairman of the Joint Chiefs of Staff, USD(A) and the UnderSecretary of Defense, Policy, The Assistant Secretary of Defense for Program Analysis and Evaluation and the OSD (Comptroller). Funding control was retained within OSD Comptroller.

In effect, although the DAB was responsible for acquisition decisions, the DRB made programmatic change to DAB actions through control of resources allocated to all Defense programs.

2.1.8. **Between 1992 and Now**

Two major events have influenced defense policy since 1992:

- U.S.S.R. restructuring: the restructuring of the U.S.S.R and its announced subsequent policy shift in policies has made it a less visible supplier of weapons used in "wars of liberation"; and
- Persian Gulf War: the outcome of the Persian Gulf war has led to public perception that U.S. military capability, as currently configured, can deal successfully with situations which might threaten U.S. interests anywhere in the world.

In turn, these events have led to wide acceptance of the idea that the defense industrial base can be significantly reduced. However, it has also been perceived that acceptance of public funds by the defense industrial community had indeed become a principal agent of societal change. Congress has also come to realize that significant unemployment will occur among well- educated and well-trained people if the planned defense expenditure reduction of 50% actually takes place. There is no civilian industrial expansion foreseen which will compensate for defense employment losses. In addition, employment gains achieved for minority and disadvantaged people through application of Congressionally mandated actions taken by defense industrial activities may well be lost. Thus reductions in the defense industrial base will affect the nation in many ways not specifically connected with defense.

A new Congressional thrust has also emerged during this period. Increasingly, organizations which engage in purely commercial transactions with Government have become subject to the defense acquisition rules and regulations. Specifically, the government will now request certification that all applicable laws and regulations have been met regardless of what is to be purchased.

As we shall see in later chapters, use of industry as an agent of social change has required oversight to insure compliance with the letter and the intent of the law; and additional oversight hierarchies continue to be established for those purposes. These actions have the effect of creating separate "government" and "commercial" acquisition processes. The activities and functions required for participation in each process are different.

In the end, use of a more complex "government acquisition" process must increase the cost of government by promoting creation of a separate production and supply sector which serves only government's needs. It is difficult to envision how such government-oriented industrial organizations could maintain world market competitiveness except in producing defense equipment, where technological superiority is the primary (if not the sole) concern.

The elements for confused management within the DoD were now in place. The Secretary of Defense and his Deputy Secretary made major policy decisions; JCS working with the Services established weapon system requirements; OSD Comptroller was responsible for and allocated funds appropriated by Congress; USD(A) was responsible for the acquisition activities throughout DoD. And Congress exercised oversight as and when it pleased.

2.2 PARTICIPANTS IN THE DAS: THEIR VARIOUS APPROACHES TO DEFENSE ACQUISITION ANALYSIS

2.2.1. Congress and Its Oversight Arms

The Congress performs continuous analysis of the defense acquisition process and the acquisition system which supports it. That analysis uses anecdotal evidence gathered through hearings, staff investigations, and research performed by Congressional agencies. In addition to the Congressional Committees on the Armed Forces, the Committees on Appropriations, and Government Operations Committees, three other Congressional activities work on defense acquisition and procurement issues:

- *General Accounting Office (GAO)*: This office can perform congressionally directed audits of any governmental activity. GAO considers both cost and performance effectiveness in its audit activity. A singular office has been organized to consider Defense acquisition and procurement audits. In general, its staff is oriented toward examination of "what happened" and comparison of those actions with "what could/should have happened". In general, the focus is on determining shortcomings and suggesting alternatives which would have prevented the problem. Many GAO reports have revealed systemic problems and have been very useful to both Congress and the Department of Defense (See Chapter 3).

- *Office of Technology Assessment (OTA)*: This office performs continuous review of technological capability and, when asked, evaluates the potential for technology application to particular problems or issues. In general, OTA will answer questions such as, "Can Parallel Computational Equipment Improve Government Data Processing Operations?" Because OTA works closely with Defense technology agencies, it is not generally asked to review the acquisition process directly. Rather it might be asked to provide opinions to Congress or to the GAO about whether some particular technology might improve weapon system performance.
- *The Library of Congress*: In addition to performing its library functions for Congress, a "Congressional Research Service" (CRS) has been established to provide special information summaries of interest to particular Members of Congress. The CRS will provide broad sketches of the states of economic sectors or provide listings of reported events together with summaries of the list content. CRS does not generally oversee defense acquisition; but might provide a listing of current articles about "fraud, waste, and abuse" and summaries of their content. It might also provide a list of suggested changes to the Acquisition process contained within the listed material.

2.2.2 The Defense Agencies and Individuals Who Perform Analysis and The Tools They Use

Those offices within DoD which focus directly on the DAS have continually subjected that system to searching analysis. Defense acquisition command line and general oversight has traditionally been divided among three general groups. Not surprisingly, each group has developed its own set of analytical tools.

- *Technologists*: this group includes the agencies and individuals within them who focus on technological aspects of weapons and seek improved weapon performance by introducing newly available technology or newly conceived applications of available technology. Analysis produced by this group generally suggests "building the next generation system": going well beyond current weapon performance by incorporating new "state of the art" capabilities within "newly designed" weapon systems "optimized" to achieve performance potentials so made available.

  Technologists have tended to develop "combat models" and to test them in "war-games" or "field-exercises". The best known infantry combat model was Lanchester's model of "one-on-one" engagement which treated two riflemen firing at each other until one of them became ineffective (either dead or wounded beyond combat capability). Lanchester posited sequential single shots each of which was assigned a "hit probability" (P_h), and a "kill probability given a hit" (P_{hk}). The number of rounds required to overcome an opponent was a function of weapon accuracy and lethality - both of which could be measured through test of ordnance and projectiles used with them. Lanchester's model is a "stochastic" or "probabilistic" model. Such models do not usually project effect from cause. Rather they compute probabilities of outcomes which result from occurrence of some particular sequences of events. Event sequences are derived from use of statistical information about how often sets of events will occur in the real world.

  Naval forces also developed stochastic combat models. The best known were "search" models which defined patterns most effective when seeking submarines preying on convoys. Once found, submarines were engaged using tactics resulting from exercise of models which specified laying down specific depth-charge patterns derived from exercise of area coverage models.

  Similarly constructed models were also developed for air force combat. Some of these models incorporated other weapons used for tactical and strategic bombardment as well (e.g., artillery, naval guns, or aerial bombs).

- *War-Fighters*: individuals whose responsibility is to engage in conflicts and see to their favorable outcome. From the Joint Chiefs of Staff to the individual Squad Leaders, Airmen, Coxswains, boat or ship captains, the major focus is creation and maintenance of efficient combat capability. These individuals are not only concerned with combat but also with the support of elements so engaged — the supply of combat expendables such as munitions and fuel, and other materiel necessary to sustain hostilities until the enemy force has been defeated. War-Fighters are also concerned with building capabilities which can conserve their own forces while those forces inflict damage on an enemy sufficient to compel surrender. War-Fighters are primarily interested in both the quantity and mix of force, and the quality and capability of munitions and equipment within the forces.

War-fighters also use models to test tactical ideas. During the period between 1950 and 1992 modelling activity extended stochastic constructs from "simple engagement models" to "force models" which use as force members notional force structures of thousands of troops, hundreds of naval vessels, and aircraft with various levels of capability. The models permit varied "rules" and "sequences" of engagement while holding "weapon effectiveness levels" constant; or effectiveness can be varied while holding rules and sequences of engagement constant. Changes in outcome are evaluated to select alternatives which provide most effective force structures. Within the Office of The Joint Chiefs of Staff, the Gaming and Analysis Division (GAD) of the Force Structure Resources Assessment Directorate (J-8) collects, develops, tests, and exercises force-level combat models for various hostility levels. They evaluate proposed force structure or composition changes, and changed capabilities which result from change to equipment used by those forces. The current Catalog of War Gaming and Model Simulation [12] lists models currently used to calculate force effectiveness and potential benefits which might be derived from improvement to force-component capability. It grown from one paper backed volume in 1982 to two volumes on a computer disk in 1994.

- *Managers*: individuals whose main concern is with funding the needs of the war-fighters through a proper mix of men and materiel. The classical statement of weapon acquisition management is: "Balance cost, schedule, and performance".

Managers usually seek balance between war-fighter generated requirements, technologist-proposed weapon capabilities, and resource availability. Their concern is with gaining the best military capability within the allocated resource levels. To purchase an effective force within reasonable cost has been described as "cost-effectiveness".

Managers, too, have developed a set of models. These models generally attempt to treat the over-arching question; "Which costs are associated with increased weapon performance capability; and if costs are higher, is the increased force effectiveness (sometimes called the "force-multiplier" to connote that improved technology might be substituted for increased force numbers) worth the additional expenditure?" The nature of the inquiry predisposes parametric constructs rather than stochastic models. For example: estimates of the time and cost involved to develop a new sequence of functional software are generally determined by looking at the number of lines of code to be written, and then finding the cost and time historically required for the code writing group to develop lines of code. Adjustments are made for statistical distribution of outcomes over the years and answers are presented as number values plus or minus some variance number. The confidence which can be placed in the number is also stated: an example might be "we are 75% confident that we will have the new system within 6 months at a cost of $1,248,000 ± 5% and 15% respectively". An alternative formulation would state, "There is a 75 percent chance the system will be delivered between 5½ and 6¼ months from now at a cost between $900,000 and $1,500,000".

2.3 SELECTING A METHOD FOR ANALYZING THE DAS

Successful performance of any system design or re-design requires tools of analysis which are suitable for the level of system complexity involved. Everyone involved with the present DAS has said that the system structure is quite complex. There is less agreement about exactly why. The author is not the first to look at the entire defense acquisition process. There have been 6 precedent investigations since 1957. The Defense Blue Ribbon Panel examined the system in 1963; The Packard Commission (headed by David Packard) did the same thing in 1969; The Grace Commission (headed by Peter Grace) performed its review in 1975; and the Second Packard Commission was convened in 1983. There was an abortive attempt by the National Academy of Science to form a group in 1991; and finally the Clinton administration performed a National Defense Review shortly after it took office in 1992. There is little difference between the conclusions reached by the six examining bodies. Each found that the DAS was too complex and required change. The second Packard Commission went further than simple recognition of the need for change. Their pointed language made clear their belief that the system was flawed since every group which had examined it had reached that conclusion. But they also asked why, in spite of all the recommendations for changes, no substantive changes had been made!

No Commission has provided an answer to that question. When performing the work reported here, four often stated hypotheses were considered.

2.3.1 Defense Systems are Complex, Therefore Acquisition of Those Products Is Also Complex

This hypothesis implies that defense weapons are themselves so complex that a complex oversight and management process is necessary to their successful development and production. If this were true, it would foreclose much desirable DAS change.

Although there are certainly some additional functions which must be performed to insure some measures of defense capability effectiveness, (e.g., maintaining essential communications between friendly forces when active counter-measures are taken; or providing for stresses which arise when military combat aircraft must perform maneuvers almost never required of commercial aircraft), there seems little basis to conclude that all defense products are more complex than similar commercial products. That argument has been extended to suggest that military aircraft require larger numbers of parts than do commercial aircraft because higher performance is demanded from them and as a consequence, they contain a larger number of sub-systems than commercial airplanes. There is actually little to show that the process by which military systems are provided to field forces is made more complex because of enhanced military performance requirements. The "greater military system complexity" argument may become much less credible if the complexity of products in daily use is carefully examined. Simply looking at the numbers of parts in some generic product lines can make the point dramatically:

- High-Fidelity commercially available stereo equipment contains on the order of hundreds of parts;
- Computers (including their internal drives and peripherals) have thousands of parts;
- Automobiles require tens of thousands of parts;
- Large civilian airplanes require millions of parts.

Military products can be at any of these levels of complexity. Even preliminary investigation will show that differences between Defense and civil procurement processes are not caused by increased defense product complexity. Purchases by Government for non-defense Government activities are more complex than are non-governmental purchases of the same exact equipment because government actions are constrained to follow the Federal Acquisition Regulations (FAR), and the FAR requires oversight and audit not generally required (or available) within the civil sector. In fact, the most recent procurement legislation, "The Acquisition Reform Act of 1994" mandates a single complex process for **all** Government procurement, defense and non-defense alike!

As can be seen from the discussion in 2.1 above, the reasons for differences between government and commercial acquisition processes appear to derive mainly from the way the defense procurement process evolved into its present state.

2.3.2 <u>The Defense Acquisition System is Complex Because Of The Need To Safeguard Public Funds</u>

This argument stipulates that although the process used to create a working system from an idea is the same whether that item is for military or civil use, acquisition complexity is introduced *because of the stringent requirement to safeguard public funds*.

There is considerable support for this contention. When individuals buy products they are usually concerned about product performance rather than with details of how performance was achieved in the design and manufacturing processes: Vacuum cleaner buyers will likely want to see how well a unit cleans rather than discuss its design or how it was built. Even for custom-made items, the conditions of product design and production are normally left to the purveyor. Only when an item fails to perform do we, as consumers, seek to understand why; and even then, our concern tends to be with ease of repair rather than details of construction.

But even if a customer were to inquire about how an item (or its components) was manufactured, customer requests for audits to determine how each component's cost elements were determined would be unusual. That kind of detailed cost analysis is seldom part of a consumer's decision process. Further; if, in the course of deciding whether to buy an item or which of similar available items to select, a prospective purchaser were to ask for sworn certification that the cost elements were accurate and that the producer's facilities had met all provisions of local and city ordinances and state and national laws, item producers and merchants would not be bound to accommodate such requests.

Although it can be postulated that product complexity might cause prospective purchasers to check closely into how the product was designed and the conditions under which it was produced, discussions with commercial aircraft producers and ship builders reveals such detailed probing forays are not usual in commercial markets. ***Rather, existence of the final product which performs as advertised and is offered at a price the purchaser considers "fair" are usually the elements of importance when purchasing even the most complex of commonly used commercial systems.***

For many years, military purchases have been made very differently from commercial norms. There is now a requirement to change; and the Secretary of Defense has issued instructions to do so. The work reported here has provided rationale and direction for taking such actions.

2.3.3 <u>The Speed With Which Perceptions Of the DAS Change</u>

The DAS is a publicly owned system devised in response to public perception about the best practices for use in Defense acquisition. Usually, exercising the legislative process requires some time to elapse between a Congressional perception that change is necessary and the enactment of change into law. In the case of the DAS however, enactment of restrictive or prescriptive law has occurred within days of the appearance of a media article reporting an incident which generates public outrage.

It is precisely because restrictive legislation so quickly follows a perception of need for more oversight that the DAS has become so complex. The normal analytical assumptions that, (1) the past gives some indication of how much change can occur in any given period of time, and (2) that there is some degree of stability in the process under examination for some reasonable period of time do not appear applicable to the DAS. Rather, the opposite situation might be the case: The DAS is under continuous change with the impetus for change coming from sources outside the control of those directly involved in exercising or overseeing the system!

2.3.4 The DAS Remains Complex Because There Are No Suitable Analysis Techniques Which Can Be Applied To Simplify It

A review of accepted models historically employed as analysis devices reveals that none are holistic. Each type of model uses templates resulting from particular sets of constructs. The focus of those constructs is usually on only one of the many aspects of the complex acquisition process. Not one of the models embraces that system's totality - from conceiving a new weapon to its ultimate delivery, use, and support in the field while it operates as part of overall force aggregate.

The acquisition process is not focused! It is rather a process which links technologists, war-fighters and managers together through complex interactive relationships. The dynamics of the acquisition process have not been captured within deterministic, stochastic, or parametric models. The simplifying assumptions necessary to compress the acquisition process complexity to enable it to fit within such boundaries is likely to make it quite difficult to construct a satisfactory holistic model with traditional modeling techniques. *By the time the necessary simplification has occurred, the intricacies of the process dynamics might well be compromised.* For this reason, a non-traditional modelling approach was necessary.

2.4 SUMMARY OF THIS CHAPTER

This chapter has presented a short history of how the U. S. Defense Acquisition System developed from the nation's birth to the present day. Events which were important in shaping the DAS process from 1938 until the present time are discussed to explain how the system developed into its present form. The Governmental and industrial entities embraced within the DAS are identified and their viewpoints described to explain the limitations of the current DAS process. Finally, arguments used in the past to justify retaining the DAS in its present configuration, with all of its inherent complexity are discussed to show their focus and to explain why a holistic approach to DAS re-design which aims at a functional Defense Acquisition System process has become so essential.

CHAPTER 3
OTHER APPLICABLE WORK

This chapter: (1) Discusses the major characteristics of defense acquisition which makes it a unique process; (2) Analyzes in detail, literature produced during the 15 year period between 1977 and 1993 by each entity involved with the unique defense acquisition process pertinent to the subject of Defense Acquisition System (DAS) re-design. The purposes of this analysis are (a) to develop information about acquisition problems which might be overcome by DAS re-design, (b) to demonstrate that although a great deal has been written about specific problems of defense acquisition, there is a paucity of writing which treats the system as an entity, and (c) to indicate the rapidity with which each entity's concern shifts from one portion of the system to another and the transient nature of the conclusions about the system drawn from that literature; (3) Suggests that conclusions drawn under such circumstances may have short lived validity: (4) Discusses other relevant information gathered through personal discussions with U. S. commercial equipment (ships, aircraft, automotive, and electronic) manufacturers; and (5) Reinforces the conjecture that a holistic system analytical approach is required.

3.1 UNIQUE FEATURES OF THE UNITED STATES DEFENSE ACQUISITION SYSTEM

During the course of this work, a great deal of literature was reviewed which discussed how commercial purchasing is done in the United States. A detailed review of that literature is not presented here. At first view, one might postulate that there are three major problems generic to acquiring (or purchasing) any item:

(1) The item failed to work as advertised;

(2) delivery was late, and

(3) item cost was greater than proposed.

Review of literature about purchasing showed that there are substantive differences between Defense acquisition and Industrial purchasing in the United States. That is because for defense

- The Government is the purchaser and *protecting the integrity of public funds* is of primary concern. While commercial purchasers also have need to protect corporate funds, there is no comparable detailed body of legislation in the commercial sector which dictates specific oversight requirements. Congress is also concerned with apportioning Federal funding to appropriate constituencies. While there may also be pressures to award commercial contracts in areas of high unemployment, those pressures do not usually take the form of legislation with severe penalties imposed for transgression. Congress authorizes and appropriates Defense monies yearly. Funding for commercial programs tends to be authorized over longer time periods and perhaps to permit achievement of specific product goals.

- Acquisition objectives may differ from those which apply to industrial purchasing. Military acquisition is designed to produce weapons and other equipment which supports combat. And although the new commercial product might be of equivalent complexity to a military vehicle, or may require development in a manner similar to a weapon development program, in general, commercial product development does not generally involve the kinds of political constraints which pervade defense acquisition: (e.g., contracts awarded to firms located within the constituency of a powerful member of Congress).
- Most defense acquisition process begins with "invention" or "incorporation" of new technology within a new (or refitted) product. Although non-defense industry also has the same kinds of concerns, commercial "purchasing" literature generally does not deal with how to "develop" items which will then be purchased in some quantity, but rather deals with supplying items for production processes within some established type of distribution system.

3.2 REVIEW OF LITERATURE SPECIFIC TO THE UNITED STATES DEFENSE ACQUISITION SYSTEM

Most of the literature with direct focus on Defense Acquisition is generated by entities directly involved with it. There were few general audience books or refereed technical publications (what have been referred to as "Archival Sources") which pertained directly to the Defense Acquisition System. Writings pertinent to the defense acquisition process, how it evolved, how it functions, and the problems it has were found in legislative documents, laws, regulations, military specifications, defense related study reports and memoranda, and other documents and articles generated by, or through sponsorship of:

- The Congress: Congressional material is found in (1) the U.S.Codex (Chapter 10 U.S.Code), (2) reports issued by those Committees who deal with Defense acquisition matters, (3) reports issued by Congressionally controlled entities such as the General Accounting Office, the Office of Technology Assessment, or the Congressional Research Service of the Library of Congress.

- Department of Defense agencies and offices, and the Services: Other Government Agency writings originate from offices within (1) DoD, (2) the Services, and (3) other government Departments. Such writing usually responds directly to Congressional concerns. Reports and memoranda may also be produced by special panels chartered by a government department or agency, to consider some aspect of the acquisition process or to review a particular program. Certain contractors on long term retainer from Federal government entities (Federal Contract Research Centers [FCRCs]) issue reports as the result of task orders placed by their sponsors.
- Special Interest Groups and Media: There have also been numerous studies and articles written by special interest groups (lobbyists). Special interest (lobbying) documents are provided to all involved as "specialized background or research material". The media publishes information in a number of forms: "Documentaries", News Reports, or Articles in popular publications

Many observers pay intensive attention to the DAS. It experiences continuing change because of that scrutiny. During the period of this work, the DAS configuration and rules of operation have changed significantly. Because of rapid change, specialized literature created over the years may be of little use today. Its validity might not long survive its issue. Moreover, the pertinence (or even the accuracy) of data included may also be overtaken by events. And finally, the restricted focus of the relevant literature may contribute little to understanding other highly complex systems which (1) are structured to serve different objectives, (2) involve organizations interactive with other than defense associated entities, (3) have different kinds of constraints, or (4) have longer "time constants of change" (that is, they resist responding rapidly to stimuli).

The discussion below reports on 93 separate documents felt to have great relevance to re-design of the Defense acquisition process. During the course of the work reported herein, the author has studied

- a major portion of the more than 150,000 pages of law, standards and regulations which provide legitimacy for the extant DAS.

- more than 150 special reports produced as the result of Congressional hearings or other investigations;
- over 125 reports produced by (1) DoD elements, (2) the Services, (3) the Federal Contract Research Centers (FCRC) who serve each military Service, and (4) the contractors who perform most of the actual work in conceiving, designing, producing, deploying and supporting the various weapon systems being developed or in active use;
- numerous articles, news items, press releases and other such documentation produced by other concerned entities

A selection of literature felt to be most relevant is listed in Table 3-1 and discussed below. Table 3-1 groups literature by the acquisition process participant who produced it to explain that participant's role over the past 14 years. This grouping helps the reader (1) track the changing concerns of particular entities, (2) see how the focus of an influential body (such as the Congress) can change rapidly, and (3) assess how changed positions can affect the DAS. The rapid change in perceptions about defense acquisition, and application of "cures" for perceived problems may largely explain the disjointed nature of defense acquisition which causes much waste and inefficiency.

3.2.1 LITERATURE PRODUCED BY THE CONGRESS, ITS COMMITTEES AND OTHER CONGRESSIONAL ENTITIES

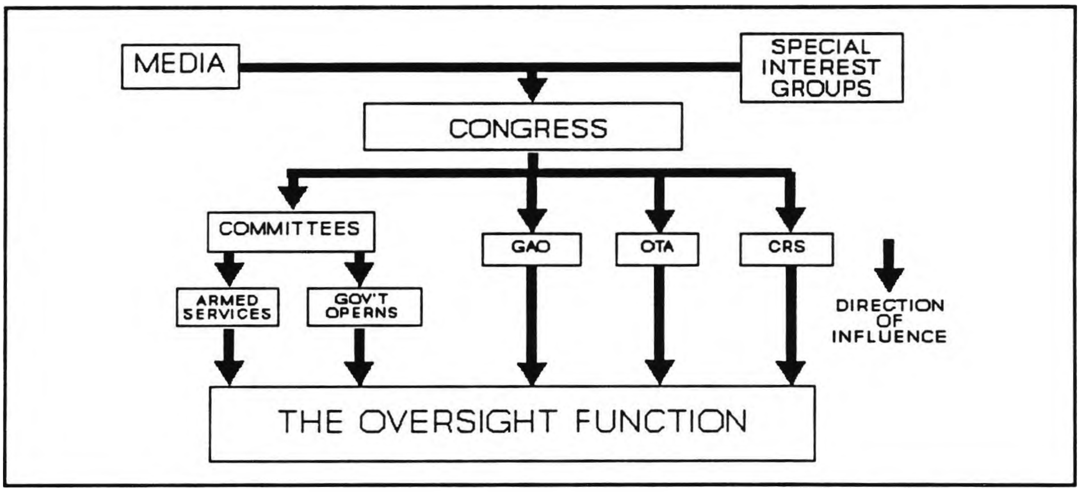
3.2.1.1 <u>The Congress As A Body</u>

Under the Constitution, the Congress has the responsibility to "provide for the common defense". It discharges that responsibility through its yearly appropriations of funds for the armed services. The Congress is organized into a number of Committees each of which deals with a particular activity of Government. Congressional committees which oversee the defense acquisition process are:

- <u>The Senate and House Armed Services Committees</u>. These groups are responsible for oversight of all military forces and evaluate the performance of those groups and the need for change to military force organization. The committees also authorize the strengths of each service and the kinds of equipment required to discharge the missions Congress approves. The bills which contain strength authorization numbers and the types and numbers of war-fighting equipment necessary are called "Authorization Bills". Also included is guidance to DoD and the Services. There is an Authorization Bill reported each year to the Senate and to the House by their respective Committees on the Armed Services. These bills may also contain specific direction on DoD organization.

- The Senate and House Government Operations Committees. These groups oversee operations of all Departments of Government including the Armed Services. Their concern is with whether the Departments are efficiently and effectively carrying out the direction of the Congress. The Committees hold hearings, and introduce legislation to make what they believe to be necessary change to department organization and operation.
- Other Committees such as Government Affairs, Small Business, Interstate Commerce, Finance and Banking, and Foreign Relations also hold hearings on aspects of military activities which concern them. The Congressional rules of organization give wide latitude of inquiry to most Congressional Committees.
- Congress is also supported by its own (1) library (the Library of Congress and its Congressional Research Service), (2) audit agency (the General Accounting Office), and (3) its own scientific advisory staff (the Office of Technology Assessment.

The Congressional oversight entities are shown in Figure 3-1.



ACQUISITION PROCESS CONGRESSIONAL INFLUENCES

Figure 3-1

3.2.1.2 Congressional Committee Reports

Since the revision of DoDD 5000.1 in 1987, 12 Congressional reports were influential in shaping change to the DAS. The contents of each report and its contribution to DAS actions taken by the Congress during the period 1988 through 1994 are indicated in the following discussion.

The Senate Armed Services Committee (SASC) issued two significant reports. They resulted from hearings before the SASC on two subjects: (1) The Defense Acquisition Process; and (2) Defense Build-Down and Inventory Management.

- In the first report [13], SASC examined the *state of the Defense Acquisition Process* as it had functioned prior to 1989. At the hearings, testimony was presented which suggested making organizational changes to foster Service Acquisition Executives (SAE) more timely interaction with the USD(A). The idea was to streamline (in order to improve) the "chain of command" for acquisition activities. Congress approved the actions.
- The second SASC report [14] was issued in 1992 when the likely extent of probable reduction to Defense activities under the new administration became apparent. Testimony was elicited about the *probable effects of reduced resources on the ability to manage critical defense inventory*. Ideas about logistic support organization and procedures were provided. Changes to the purview of the Defense Logistic Services were made.

The Senate Committee on Governmental Affairs (SCGA) issued three significant reports. They resulted from hearings before the SCGA on three separate aspects of contracting: (1) information release; (2) use of commercially available items; and, (3) subcontract management.

- The first Committee on Governmental Affairs hearing on oversight was conducted in 1989 [15]. Of concern were the reported *information leaks* regarding special requirements and contractor pricing information. There had been several instances of information leakage involving high level Defense Department employees (several went to jail for bribery and corruption) and the hearings explored these issues and the result of such practices on competition.
- The second 1989 oversight hearing [16] focused on attempts to promote *use of*

more commercial items in Defense procurement. Congress (and DoD) had been aggressively encouraging acquisition managers to seek the use of commercial, off-the-shelf (COTS) items in military weapon systems. Testimony provided views which encouraged that practice and views which did not. The main concern was risk of combat failure if significant amounts of COTS items were incorporated into combat systems. Although the issue was unresolved, there was considerable Congressional discussion about mandating increased use of COTS.

- The third SCGA oversight hearing [17] was held in 1992 in response to perceived problems with *effective sub-contractor management*. At issue were the mechanisms mandated for use by prime contractors in their management of sub-contractors; and whether rules and regulations aimed at insuring even-handedness were observed.

<u>The House of Representatives Armed Services Committee (HASC)</u> held five hearings in 1988 concerning the DAS: two by the Acquisition Policy Panel, and three by the Investigations Sub-Committee.

- The first ***Acquisition Policy Panel*** hearing [18] concerned the *leaks of information* treated by the SCGA (see above). Much of the same kind of information was developed and there was considerable question about the integrity of the acquisition process; specifically about whether or not the many consultants to DoD elements were safeguarding the information they obtained when retained to help Government do its work.
- The second ***Acquisition Policy Panel*** hearing [19] went to the question of whether *consultants* would need to be strictly regulated and if they, like those individuals engaged in influencing Government (e.g., lobbyists) should be registered.
- The first ***Investigation Sub-Committee*** hearing [20] examined the *qualifications of individuals* serving in the Acquisition work force. The hearings were specific to legislation creating a Defense Acquisition Corps (DAC) and specifying the training members of that Corps would be given. The result of the proposals led to the Defense Acquisition Work Force Improvement Act (DAWIA) which created the DAC and other, newly authorized Department of Defense department offices to implement that act.

- The second ***Investigation Sub-Committee*** hearing in 1990 [21] examined the issue of *tenure in Program Manager positions*. The observation was made that most weapon system Project Managers served between 18 and 24 months before reassignment. Given that the weapon development process normally exceeded 10 years, there was concern that such frequent shifts in management were detrimental to efficient and effective acquisition. Tours of duty for Military Program Managers were lengthened after the hearings. As a result, Program Managers currently serve until their program has had a DAB milestone review (usually programs are reviewed at intervals of between 38 and 50 months).
- The third ***Investigation Sub-Committee*** hearing in 1990 [22] had a number of sessions and it explored numerous other issues involved with acquisition. Among them were questions about *whether existing laws inhibited performing the functions of acquisition*. The hearings were one of a number of activities in Congress which lead to language in the appropriation bill that established the group (known as the "800 Panel") that later examined all of the legislation applicable to acquisition and made numerous recommendations to the Congress about *repeal of specific legislation*.

<u>The House of Representatives Committee on Small Business (SBC)</u> held one hearing [23] (two sessions) in 1993. Their objective was to solicit *views of small business on recommendations made by the Congressionally chartered panel (800 Panel)*. The panel had been established by language in the Fiscal Year 1992 Authorization Bill. Its task was to review all laws contained within Title 10 U.S.Code and any other U. S. Law which affected the DAS. The 800 panel was chaired by the Commandant, DSMC. At the time of the hearing, the Panel report [24] (and its 12 Appendices) had been given to Congress. The Congress was concerned about the adequacy of small business representation to the Panel discussions. A number of changes to the panel's recommendations were suggested.

- <u>A 1990 report, released under the imprimatur of the SASC</u>, written by former USD(A) Donald A. Hicks [25] also contained information which influenced 1993 SBC activity. The document, cited *legislative barriers to effective defense acquisition* mainly the prohibitions in law against open communication between

Government and prospective contractors. The report helped justify establishing the 800 Panel.

3.2.1.3 General Accounting Office (GAO)

The GAO responds to Congressional concerns about the integrity of public monies expended. There are a large number of inquiries each year from individual Members of Congress (i.e., both Congressmen and Senators) and from Congressional Committees about how agencies perform the direction of the Congress. GAO investigates and renders an opinion about the efficiency and effectiveness of the activities performed and the value purchased with them. The GAO issues reports about each investigation. The government activities involved are provided opportunity to comment on GAO's findings in advance of publication. Most agencies attempt to modify their activities in the manner GAO suggests although many Defense activities have difficulty making those adjustments. Because of the way in which GAO inquiries are initiated, most GAO reports respond to perceived problems and thus tend to be critical of an agency's management. The General Accounting Office is organized into a number of Divisions, each with its own particular purview. During the period between 1983 and 1993, 4 GAO divisions issued reports with impact on the DAS:

- ***The Procurement, Logistics, and Readiness Division (PLRD).*** When the PLRD issued its assessment of the Rickover recommendations in 1983, (see Table 3-1), it was concerned with all aspects of Procurement and Logistics. The division's functions have since been absorbed by other GAO Divisions.
- ***The General Government Division (GGD).*** The major concerns of this GAO element are with legal actions to remedy fraud, waste, and abuse.
- ***The Information Management and Technology Division (IMTEC).*** Issues of data processing and information handling (including intelligence information) are investigated by this GAO division.
- ***The National Security and International Affairs Division (NSIAD).*** Defense Acquisition, Acquisition Reform, Procurement and Defense Management are the concerns of this GAO division.

26 reports issued by these GAO divisions were felt to have affected the

acquisition process. The GAO has divided the reports into seven subject areas:

Acquisition Reform - *Acquisition reform* has been of continuing interest to the Congress. In its review of defense activities, it has consistently sought mechanisms which would increase cost effectiveness. In pursuit of that goal, it has created panels and commissions to review acquisition effectiveness, and it has looked to individuals whom it considered to be expert to provide insights into what might be done. One such individual was Admiral Hyman D. Rickover. Rickover's contribution was to conceive, design, build, and equip the Naval fleet with nuclear submarines. While doing that, Rickover kept expenditures within acceptable variances and consistently met schedule and performance requirements. When Rickover was forced to retire he wrote about his work and made suggestions about how to improve acquisition in general. In 1983, the PLR Division was requested to review one such report [26]. The Rickover report was divided into three parts: Resource utilization; Procurement contracting; and Resolution of Contractual Conflicts. In general, GAO agreed that there was *room to improve the efficiency of the contracting process* to achieve better resource utilization. GAO also concluded there was *need to create a codified mechanism to resolve contractual problems* - both in achieving a focused contract, and overseeing contractual relationships after formalization.

In 1990, in response to the request of the Chairman of the Senate Armed Services Committee, the NSIA Division reviewed the status of a selected set of 6 development programs and *evaluated DAS performance demonstrated by those programs' status* [27]. The 6 programs were designated because the DRB was scheduled to hold "milestone reviews" to assess their progress. In addition, for some of these programs, Congress had agreed to provide all requested funding increments for a five years period. The 6 programs were: (1) an Army Non-Line-Of-Sight Missile development program, (2) an new Army Light Helicopter, (3) the Navy's new torpedo development, (4) the Air Force sensor fuzed weapons program, (5) an Advanced Tactical Fighter program, and (6) a Joint Services Tactical Information Distribution System Class 2 Terminal). The GAO analyzed each program's status and concluded that the Services and DoD had been unable to hold operational requirements constant over a five year period, could not make cost *projections which matched actual expenditures, experienced technical difficulties in meeting anticipated performance goals*, and had therefore experienced considerable cost growth.

Defense Procurement Fraud - Because public funds expended for defense represent a large share of the Federal budget, the Congress has always been concerned about fraud, waste, and abuse in pursuit of weapon system development. During late 1985 and continuing into 1986, media reports of individuals who had received monies for assistance to government contractors created the impression of wide-spread problems with defense acquisition.

In 1986, the GGD Division was requested to *examine reported instances of fraud and how those reports were handled by the Department of Justice (DOJ) Defense Procurement Fraud Unit* [28]. Congress asked the GAO to examine "the number of cases [referred to DOJ], types of fraud involved, extent of top 100 defense contractor involvement, estimated dollar losses, and the status/disposition of the cases sent to" DOJ. GAO found that of 486 cases sent to DOJ from October 1982 to December 1985, 64 indictments were achieved and 45 individuals or companies either pleaded guilty or were convicted of various charges of fraud.

As a follow up, in 1988 Congress asked GAO to review DOJ's *management practices in handling fraud cases* [29]. GAO found DOJ's case management process did not provide timely tracking of cases referred to the department. GAO recommended Fraud and Corruption Tracking System (FACTS) be strengthened to improve DOJ's capability to oversee cases referred. Data had not been routinely provided and several reporting steps were recommended which GAO felt would help DOJ's ability to track cases referred to the department and insure their expeditious processing through the DOJ bureaus and the Courts.

In 1991 GAO was asked to review *plea bargains* accepted by DOJ and to report on the settlements of fraud cases [30]. The report, issued in September 1992 concluded that DOJ was still unable to identify all of the cases referred to it for prosecution. The incomplete data limited the scope of inquiry to cases of procurement fraud against the top 100 defense contractors. Of 38 cases where convictions were obtained, 35 pled guilty, 2 were convicted at trial, and one pled "nolo contendere". The data indicated that DOJ tended to accept reduced pleas as a mechanism of accelerating case resolution. Also, GAO indicated that although *settlements achieved substantial restitution* for the Government, there might be opportunities to improve.

Automatic Data Processing Procurement - Because electronic components (and data processing systems those components enable) develop at a rapid pace there has been considerable discussion about how best to plan systems which can easily accommodate technology development. The North American Air Defense (NORAD) complex was built to permit consolidation of all information required to obtain early warning of impending attack on Canada and the United States. NORAD's computer facility tracks, and plots intercepts of all aircraft flying toward Alaska, Canada and the United States. Some extremely complex and sophisticated equipment is involved in this activity. During the period between 1987 and 1988, the operations of the North American Air Defense Command and its command center in Colorado were examined by the IMTEC Division [31]. At issue were the reported *difficulties NORAD experienced in bringing its newly acquired Tactical Warning and Attack Assessment computational equipment to operationally effective levels.*

In its 1989 report, GAO suggested that the DAB had not been searching enough in its review of the Air Force's planned computer acquisition, and that sufficient technical difficulty had been experienced to warrant DAB intervention. It was thought that *DAB review might be able to focus on corrective actions which would improve NORAD's performance.*

Another report issued in 1990 [32] found that the *Air Force had prematurely recommended acquisition of new generation computers* in the hope of achieving improved detection and tracking capability. The problems arose because the need to incorporate new technology left insufficient time to define firm operational requirements against which to judge the precise technology needs. The problems discussed in this report deal generally with the difficulties which arise when operational requirements change and it becomes necessary to project (sometimes wrongly) the direction those requirements will take. The inability to be precise combines with the inability accurately to project technology advances to create situations where judgements are made prematurely.

Acquisition - Frank Carlucci took office as Secretary of Defense in 1986. While serving previously as Deputy Secretary of Defense, he had proposed 32 specific actions which, taken together, became known as the *Defense Acquisition Improvement Program (or the Carlucci Initiatives)*. Carlucci believed that a few very specific actions could markedly improve defense acquisition performance. The GAO had been asked review the status of the initiatives and to advise the Congress on progress in implementing them [32]. GAO reviewed the initiatives in one report, and evaluated DoD's progress in implementing them in another [33]. The two reports were issued in 1986.

In 1986, prior to issue of any reports of the President's Blue Ribbon Panel ("The Second Packard Commission") GAO was asked to assess the effectiveness of the Carlucci initiatives [34]. Using methodology developed in the late 1970's which compared cost and performance of weapon development undertaken in the 1960's with those undertaken in the 1970', the GAO analysis in this report *"suggests that DoD is generally coming closer to its planning estimated in the 1980's than it did in the 1970's"*. But there is a caveat that, *"we cannot link the results of our analysis exclusively to the improvement program because of the coincidence of several other factors which could have favorably affected the acquisition process."* Thus, although GAO concluded that things were better, they could not be sure that other factors did not contribute significantly to improved DAS performance. One of the factors considered was the economic inflation experienced during the 1970's. GAO said, "Inflation contributed significantly to the cost growth of the 1970's ..but less so in the 1980's". GAO estimated the 1970's cost growth due to inflation at about 100%, and the 1980's inflation cost growth at 55%. A decrease of 13% in non-inflation cost growth was estimated; at least some of which was attributable to the initiatives. The GAO report concludes that, *"Weapon systems being developed and acquired in the 1980's are, so far, experiencing less cost growth and schedule slippage than comparable systems did during the 1970's"*.

Defense Acquisition - Two reports were issued in 1990 which dealt with the elements of effective acquisition management as seen from GAO's perspective. The first report [35] identified *key elements which would make efficient management possible.* GAO concluded that, "The unprecedented peacetime buildup of defense during the past decade, coupled with disclosures of excessive prices paid for defense parts, followed by the procurement scandal and revelations of other fraud, waste, and abuse has magnified the problems with the acquisition process. The public and the Congress have seriously questioned DoD's ability to manage its acquisition programs effectively. Cost growth, extremely long acquisition times, and program stretch-outs resulting in inefficient production rates have been common. Many reforms are needed."

GAO indicates the areas of reform as: *Sustained Leadership, Work Force (attracting and keeping people); Organization (mirroring is strongly indicated), Information (free flow of "realistic" information), Internal Controls (strengthen control on acquisition and contracting), Affordability (realistic evaluation of fiscal constraints), Culture ("The cultures imbedded in DoD which are often opposed to change, are difficult to modify").* At the same time, GAO stated, "Some of the officials in the new acquisition chain lacked the authority and control of resources needed to make and implement the full range of acquisition management decisions. GAO concludes with the statement that, "The acquisition system has many checks and balances in place. So many, in fact, that some people felt that complying with all the administrative requirements slowed down acquisition and wasted money". However, GAO felt that DoD "must strike a balance between a rigorous set of checks and balances and the safety they provide in terms of guaranteeing appropriate expenditure of the public's funds, and the costs of compliance, in terms of delaying a program. We believe that in the public arena one should err on the side of safety to ensure that the government is satisfying the requirements of its position of public trust, compliance with a strong and complete set of checks and balances is necessary."

The second GAO report [36] considered the Navy's Fleet Ballistic Missile system and why it was perceived to be successful. GAO cited the Packard Commissions acquisition model which identified six features which could be used as exemplar for defense acquisition programs: *"(1) clear* *command channels, (2) stability, (3) limited reporting requirements, (4) small, high quality staffs, (5) communication with users, and (6) prototyping and testing."* GAO identified "five *interrelated major features* that contributed to the Fleet Ballistic Missile program's success. These features are *(1) funding and program stability, (2) program responsibility over the system's entire life cycle from development through operations support, (3) continuity of key personnel, (4) program office technical expertise, and (5) good management practices, such as open communications, independent internal evaluation, and on-site management representation at contractor plants."*

Most U.S. weapon development programs are financed completely within U.S. resources, there are few *multinational cooperative efforts*. One such effort was the Multiple Launch Rocket System (MLRS) Terminal Guidance Warhead (TGW) program. This "multinational cooperative development effort began under a 1983 Memorandum of Understanding signed by the United States, Germany, France, and the United Kingdom" is to "develop a target-sensing submunition and warhead for attacking armored targets at distances up to 30 kilometers or more." The U.S. contributes 40% of funding, the other partners contribute 20% each. As the result of a Congressionally directed competition between three weapon systems (One of which was the MLRS/TGW), the U.S. Army chose a competing system for continued development. One consequence of that choice was to *consider termination of the MLRS/TGW program*. Both the GAO [37] and the German Federal Court of Audit (DFCA) performed coordinated examinations of the program. In addition,"the Federal Court of Audit compared the MLRS/TGW with another target-sensing artillery round under development in Germany." *Both the GAO and the DFCA recommended the program's cancellation*. The program was affected both by the changes in anticipated combat utility, and the need to deal with reduced funding capability in the U.S. and in Germany. The report does not discuss reactions of either France or the UK to the proposed program cancellation.

In 1991, Congress enacted Public Law 99-145 which amended Title 10 U.S.Code to prohibit "*defense-related employment of individuals convicted of a felony rising out of a defense contract* for at least 5 years after conviction".

The GAO reviewed the situation in 1992 [38]. At issue was the need to establish formal listings of individuals debarred from participation in defense contracts. The argument devolves around the cost of establishing and maintaining the list. The DoD states, "that *the cost of establishing and maintaining a list of prohibited individuals would far exceed any potential benefit to the Government.*" The Department of Justice contended that, "it has neither the funding nor the mandate to produce needed data and...should not divert its limited resources to implement a system to be used by defense contractors for complying with" the law.

In 1992, *GAO reviewed Air Force activities to provide training capability to Special Operations Force air crews* [39]. There was concern that the prime contractor's software development activities were not subject to independent verification and validation by an agency independent of that contractor. GAO recommended that the Secretary of Defense direct the Secretary of the Air Force to *amend the contract to incorporate a requirement for independent software verification and validation.* The Air Force did not concur with the recommendation.

Defense Procurement *-* ***Acquisition*** *is the process through which ideas are developed into products and placed in operation.* ***Procurement*** *generally encompasses the process of buying things which are already developed.* A part for a Sea Wolf submarine would be "purchased" rather than "acquired". The ten reports dealt with the minutiae of procurement - how developed items ought to be purchased. There is a clear relationship between GAO recommendations about procurement and the mechanisms of acquisition: techniques suggested as improvements in purchasing often find their way into regulations which deal specifically with acquisition.

<u>The first report</u> [40] examined *accounting methods used to accrue "costs" to labor.* The Work Measurement Program was established in 1975 by the Air Force and was adopted by DoD in March 1983 with the issue of MIL-STD-1567A. Work measurement was mandatory for programs which cost more than $100 million. It establishes *a 4 step process: (1) "setting accurate labor standards (the number of hours it should take a qualified worker to perform a*

manufacturing task at normal pace using a prescribed method)"; (2) analyzing the costs actually experienced and comparing them with the "standard"; (3) establishing programs for improving manufacturing operations and reducing standard labor hours; and (4) using the work measurement data for pricing when providing cost estimates for other programs. GAO reviewed cost accumulation practices at four major defense contractor facilities and found a *low level of compliance with MIL-STD-1567A*. It recommended stricter enforcement of the standard. There was no discussion of how to set standards for work never before performed in advance of gaining experience through performing that work.

The second report [41] reviewed *procurement of services which provide daily support to government activities*. Some services purchased deal with maintenance of equipment used by active military elements (e.g., aircraft, submarines, tanks). The concern was that there was limited competition for many awards. The contention was that limits to competition were dictated by lack of familiarity with the equipment to be supported rather than by the desire to truncate numbers of prospective bidders. GAO examined the cost implication of the practice and found that it might result in higher cost of services. No estimate was made of cost of learning for organizations lacking knowledge sufficient to perform that service at the start of a contract.

The third report [42] examined the how *lack of detailed technical data packages* [TDPs] (information sufficient to enable production of an item by an organization which has never before had experience in its manufacture) *affected competitive bidding for parts*. When complete TDPs are unavailable, the Government usually limits competition. Even when competition is not limited, lack of full technical data causes agencies to use "part numbers" (the number by which the Government identifies the item(s) to be purchased) in lieu of providing a full set of data. GAO found the latter practice used in a large number of procurement actions. One reason was that TDPs were not required of the developing contractor. GAO discussed the price differences caused by lack of TDPs but did not examine the cost of producing them during a period when the system was under development. *GAO concluded that many procurement actions did not comply with the Congressionally mandated "Com-*

petition In Contracting Act (CICA)".

The Fourth report [43] examines *DoD compliance with Section 805 of Title VII of the Fiscal Year 1989 National Defense Authorization Act*. The act requires DoD "to use appropriate requirements for qualification and contractual quality when purchasing critical spare parts for aircraft and ships".The need for clarification of which parts are critical and the standards by which competing contractors will be judged qualified to submit offers to manufacture such parts stems from the Congressional desire to reduce costs of military activities. *DoD was found to be generally compliant with the requirements set forth in Section 805.*

The fifth report [44] dealt with DoD *purchase certain machine tools made by foreign companies*. When GAO began its work, U.S. machine tool manufacturers were experiencing continuing drops in orders and the survival of some of them was in doubt. The "Buy American Act" limited foreign purchases to equipment unavailable from U.S. sources, thus GAO examined the reasons for DoD action. GAO was told that *foreign purchases were necessitated by lack of comparable U.S. manufactured items*.

The sixth report [45] continued GAO's examination of spare parts procurement practices. *Once again, the objective was to determine whether cost could be reduced*. When a weapon system has been produced in some numbers, and when it has accumulated sufficient field use, the Government attempts to find contractors other than those associated with the initial weapon system development from whom spare parts can be purchased. The practice is called "Break-out". GAO examined 14 major weapon systems to determine whether program managers had purchased TDPs to permit break-out" of spare parts purchased. TDPs had been purchased in 11 cases. *GAO found it difficult to assess whether any cost reductions had been so achieved.*

The seventh report [46] dealt with the *Congressionally mandated (DoD implemented) practice of "Teaming"*: two or more contractors forming a team to develop a new weapon system. The idea was to have two of more sources ready to undertake production of the system after it had been tested and the initial quantity deployed and used in the field. It was thought that creating multiple sources would reduce production cost of the final system. *GAO found that even when two sources were created,* when Congressional or DoD actions reduced item quantity requirements, *the costs associated with such teaming could easily exceed the savings achieved.*

The eighth report [47] examined DoD's *management of Technical Data.* The issues were, (1) whether information within TDPs was maintained current, and (2) whether current information was routinely provided to procurement agencies. The objective was to reduce costs by foreclosing the potential supply of incorrect system components, spare or replacement parts. *GAO found lags between creation of technical data and its incorporation within procurement agency archives.*

The ninth report [48] examined *the mechanism by which Government recovers monies paid to contractors (usually as "progress payments") for items or services not provided.* The examination was triggered by cancellation of the A-12 aircraft program. When the contract was terminated $1.3 billion had been advanced as progress payments to the A-12 contractor for work to be done. But no product had been produced. Nor had requisite work been accomplished. Under contracting rules, a Contracting Officer can defer collection of such debt. When a contractor in such circumstance is "small or disadvantaged" grounds are normally found for deferral. GAO *found that in many cases, proper grounds for deferral had not been established in accordance with the Federal Acquisition Regulations (FAR), and that some deferrals had been granted to large contractors.* In 1991 an agency (Defense Finance and Accounting Service [DFAS]) was created to manage recovery of deferred debts to the Government.

The tenth report [49] examined the *effects of proposed legislative action to make mandatory DoD approval of FAA certified spare parts.* DoD contended that in many instances, DoD requirements are much more restrictive than those of commercial aviation. Further, both DoD and FAA indicated to GAO that, because of their mission, the approval mechanism for spare parts differs. Since, in certain cases, FAA had designated DoD representatives as approving officials for commercial aviation parts, *GAO believed it should be possible to designate FAA representatives as approving officials for DoD spare parts. Both FAA and*

DoD disagreed.

Defense Management - GAO is required by law to issue a yearly report of *progress in implementing the Defense Acquisition Workforce Improvement Act (DAWIA).* While the research reported here was ongoing, two reports were issued: one in 1992 [51], and one in 1993 [52]. In both reports a number of key items of DAWIA were scrutinized. As a condition of their appointment as Program Managers, designated individuals (1) would be required to attend the Program Managers Course at the Defense Systems Management College, (2) would be required to sign an agreement to remain as program manager "until completion of the first major milestone closest in time to the date they had served 4 years, and (3) have at least 8 years prior acquisition experience in a major defense program. Although the requirements could be waived for sufficient cause, *DoD had not appointed any program managers requiring such waiver during the time period included in GAO's examination.*

3.2.1.4 - <u>Office of Technology Assessment (OTA)</u>

As discussed in Chapter 2, the OTA responds to Congressional concerns about the state of technology and whether technology is available for inclusion in weapon systems. It also comments on issues of how technology may be affected by actions taken by the Congress. In reviewing defense issues, it provides the Congress with assessments of the experience of other nations in shaping policies which advance and preserve technology capability. Of the many reports issued by OTA during the period of this research, two documents were judged to be important in the context of how U. S. problems might arise in acquisition programs because of the way the U. S. might deal with its allies.

- The first document discusses international cooperation [52]. Coming prior to 1992, the report dealt with the *problems in continuing cooperation with allies.* U. S. public opinion polls clearly indicated that collaboration with Japan which resulted in building the F-16 aircraft abroad was strongly opposed. U. S. policies on armaments cooperation had originated with the cold war. But in the changed world, it was felt that change to those policies might be required. The issue of sharing technology with Japan had led to OTA's conclusion that *"loss of technological supremacy may be an unavoidable long-term cost of maintaining* *security alliances. It might also be the price of gaining access to foreign defense technology in the future."* OTA also concluded that *"political interests of the United States and its European NATO allies may diverge significantly...if economic integration in Europe proceeds smoothly."* OTA also concluded that in a time of decreasing defense funding in all quarters, "competition between U. S. and European defense companies will escalate as they seek to export sophisticated weaponry to maintain revenues and keep production facilities open in a declining market." In terms of effect on the DAS, OTA pointed out that, "One industry association has brought suit against DoD to force compliance with the 'Buy American Act'...". *The difficulties of having multiple acquisition process in different countries was seen as a deterrent to on-going cooperative defense efforts.* If Buy American provisions were strictly observed, many problems would arise when acquisition programs found U. S. companies could not supply required items.

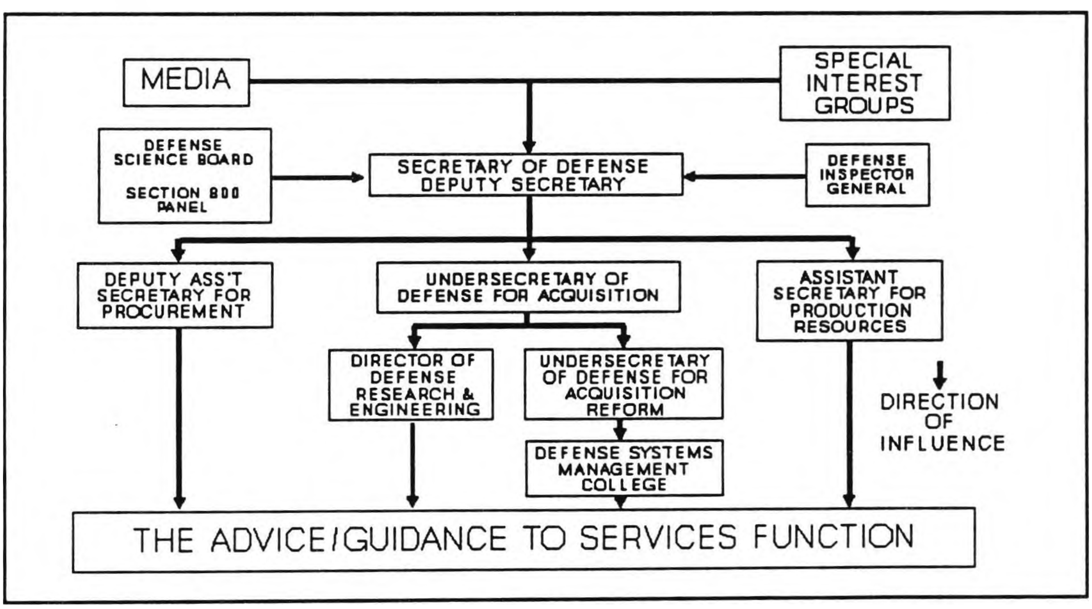
- The second document [53] *compared the U. S. Acquisition process and the U. S. Defense Industrial Base with the mechanisms used in France* to accomplish the same objectives. There was much discussion of the General Delegation for Armaments (DGA) as "a centralized procurement agency" pointing out that "nearly four-fifths of the French defense industry is controlled by the state and broadly managed by the government" and that "the French Parliament has much less power over defense decisions than does the U.S. Congress." The report went on to contrast the U. S. and French defense objectives. *OTA concluded that "France has managed defense R&D and procurement to preserve a broad-based industry for the future, but at some cost to its current military capabilities as evidenced by the shortcomings of French weapon systems during the Cold War."* OTA concluded that the U. S. has managed its assets to "maximize its current military capability, but at some cost to the future health of the defense-industrial base." The challenge OTA poses based on the French activity is for U. S. defense policy makers to "find an optimal balance between these two strategies" in treating DAS issues.

3.2.1.5 - **Congressional Research Service (CRS)**

As discussed in Chapter 2, the CRS responds to Congressional need for reviews of literature and periodicals on subject of particular interest. In performing their work, the CRS acts as a kind of "personal assistant" and "confidential source" for the individual Members of Congress. Summaries provided directly to Members are often used in debate as source material and attributed to the Member. CRS documents are rarely circulated outside Congressional Membership. During the period of this research there were many requests by Members for reviews of material written about the DAS. None were available to the author.

3.2.2 LITERATURE PRODUCED BY THE DEPARTMENT OF DEFENSE STAFF, OFFICES, AND OTHER SPECIALLY CONVENED GROUPS

The Department of Defense is charged with definition and maintenance of the Defense Acquisition System. In that role, it issues documentation which defines the acquisition processes, authorizes performance of studies to examine all aspects of DAS operations, issues specifications and standards which function as controls on process deviation for acquisition programs in excess of Congressionally stipulated limits. There are a number of entities within DoD which create and issue documents that affect the DAS. The specific offices are shown in Figure 3-2.



ACQUISITION PROCESS DoD INFLUENCES

Figure 3-2

The Secretary (SECDEF) and Deputy Secretary of Defense (DEPSECDEF) are the Chief Executive and Chief Operating Officers of DoD. They are the focus of all activity within the department. Fig 3-2 indicates two organizations as special staff elements of SECDEF: (1) the Defense Science Board (DSB) and (2) The Section 800 Panel. The DSB is a continuing body which provides information to SECDEF about the state of technology and its relationship to defense materiel and military operations. The Section 800 Panel was specifically created by the Congress in the Defense Authorization Bill of 1991. The panel was given two years to provide Congress and SECDEF with a set of actions which would simplify the acquisition process. The Defense Systems Management College was directed to establish and staff the panel. DSMC's Commandant was chairman of the panel. The third staff level activity shown in Figure 3-2 is the Department of Defense Inspector General (DoDIG). In some ways, the DoDIG acts similarly to the GAO. DoDIG examines Defense operations to see if they are compliant with established law, regulation, and practice. Results of DoDIG audits and investigations are used by SECDEF (and the Congress) as reference and rationale for actions taken in response to DoDIG findings. DoDIG sponsored several workshops which contributed information to the research reported here (see Chapter 5).

During the course of the work reported here, two line offices were involved with the acquisition process, (1) The Deputy Assistant Secretary of Defense for Procurement (DASD(P)), and (2) The Assistant Secretary of Defense for Production Resources (ASD(PR)). The DASD(P) is responsible for the Federal Acquisition Regulation (FAR) documentation. Revisions to the FAR and changes in procurement concept fall within the purview of the ASD(PR). The DASD(P) provided information as required for the workshops reported in Chapters 5 through 8 so that workshop participants might better understand the FAR and the constraints it places on the DAS. The ASD(PR) is responsible for industrial issues including issuance of a report to the Congress on the condition of the Defense Industrial Base (DIB). The ASD(PR) sponsored a number of the workshops reported in Chapter 5 and used workshop results to make industrial base policy and to substantiate his comments in reports issued to the Congress.

The Under Secretary of Defense for Acquisition (USD[A]) has charge of any activity which deals with the DAS and, in the role of Defense Acquisition Executive (DAE), is responsible for continuing review of the activities of all weapon system program development. USD(A) chairs the Defense Acquisition Board (DAB) and provides oversight for each Service Acquisition Executive (SAE), the individuals who are responsible for development activity within their respective Service. During the period of this research, USD(A) was the sponsor of many of the workshops reported in Chapter 5, and approved the work done for other elements of DoD. USD(A) oversees both the Director of Defense Research and Engineering (DDR&E) and the UnderSecretary of Defense for Acquisition Reform (USDA(AR)). DSMC reports to USD(AR). While this research was underway, DDR&E undertook intensive review of the process by which DoD provides sponsorship for basic and applied research. That review resulted in conceptual change to the kinds of research supported and to the mechanisms used to support research. The Technology Reinvestment Program (TRP) was developed by DDR&E. USD(A) worked with the Congress on the legislation introduced both in the Senate and the House of Representatives. The ideas for change which resulted from the workshops discussed here were imbedded within USD(AR)'s inputs to the Congress.

In discharge of its responsibilities to USD(AR), DSMC also provides timely guidance on how the DAS is implemented. Between 1977 and 1994, DSMC issued handbooks and notebooks for use by Program Managers (PMs) and their staffs. The handbooks help PM's implement policy within DoDD 5000.1 and explain the basis for the directives and regulations which govern acquisition activity.

3.2.2.1 - <u>DoD, Office of the Secretary of Defense</u>

The two appropriation acts referenced [54], [55] impacted directly on the DAS. The Defense Authorization Act of 1985 adopted changes with regard to implementing DAB production decisions that had been suggested by the Packard Commission changes. Until those changes were adopted, a program which had completed Engineering Development (i.e., had reached Milestone III in Figure 2-1), would see DAB approval to produce the required numbers of items. In some cases however, the initial product configuration had to be changed as the results of field use began to be studied. When that happened, products provided at the beginning of a production run were considerably different than those provided at the mid-point of production. The suggestion was made that the DAB might defer full scale production until a few units had been produced and tested. Adopting that suggestion resulted in splitting Milestone III into two phases: (1) a DAB was held to authorize Low Rate Initial Production (LRIP) of the system (Milestone III-A), and (2) a second DAB was held after the production items had been tested and proven to be satisfactory (Milestone III-B).

In addition, the Appropriations Act of 1986 directed establishment of the office of Director of Live Fire Testing (DLFT) to respond to public perception that newly developed weapon systems would have difficulty surviving even less than intense combat. The specific case cited was the Army's replacement Armored Personnel Carrier (BRADLEY Fighting Vehicle). BRADLEY was unable to survive fire directed on it by heavy armored vehicles. DLFT was directed to provide for routine live fire test of all combat equipment which carried troops on the battlefield.

Reference [55] re-issues the Federal Acquisition Regulations to incorporate all Congressional and Defense generated FAR changes. The FAR provides structure for all U. S. Federal procurement. However there are sufficient special conditions which apply to defense that an additional supplements (DFARs) are issued to codify them. References [57], [58], and [59] are three of those supplements which complete codification of the FAR.

Reference [60] is the special Legislative Review Panel Report (the 800 Panel product). The document studied all Federal legislation which affects acquisition activities and recommended a great many legislative changes. Suggested changes ranged from repeal of specific laws, to repeal of some provisions within laws, through modification to a singular legislative provision. The 800 panel report contained considerable material derived from the workshops reported here, and was used by the Congress to draft acquisition reform legislation which was passed in October 1994.

3.2.2.2 - **DoD, Office of the Inspector General**: Internal Evaluations

Documents listed within this heading illustrate the broad charter of the DoDIG. Reference [61] comments on DoD attempts to make use of already developed items of equipment in new system designs. If a component already in the military equipment inventory could be used in a new weapon system, there would be fewer different system components and the logistic cost of stocking spare parts would be reduced. An additional benefit would come in reduced system cost. There would be no need to re-qualify the components, there would be no component test and certification expense. *The IG found few examples of successful use of such kinds of items in new systems.*

DoDIG examined the performance of the DAB in terms of its effectiveness in revealing potential difficulties of systems under development which might cause increased system development costs [62]. It was found that in the case of the F/A-18 aircraft program, the review process was only marginally effective as a cost reduction mechanism.

DoDIG also examined how special acquisition funding received in Fiscal Year 1992 was actually expended [63]. The report found no problems.

An examination of the concept of Low Rate Initial Production (LRIP) [64] found that the practice had not kept system production costs from inflating. Although LRIP might permit early discovery of production process difficulties, there were considerable cost accumulations which resulted from prolonging the production process to accommodate reduced budgets.

Not surprisingly, an audit of the impact of DoD programs on the environment [65] found evidence that DoD had contributed significantly to environmental problems. Media stories had fixed on the damage at many installations even before the audit was performed. Recommendations were made for actions that would significantly reduce the problem.

One concept for reducing cost of major weapon system acquisition involved analyzing advantages of making use of every available source [66]. An especially useful opportunity was presented at DAB reviews. Although comparison of source capability and cost during Milestone reviews might well reveal ways to reduce costs, DoDIG indicated little use was made of them.

An audit was performed of the effectiveness of logistic support provided to weapon system development [67] which, because of lower estimated development cost, was exempted from use the acquisition process described in DoDD 5000.1. Problems were revealed in achieving adequate support because the planning required by DoDD 5000.1 was not accomplished.

3.2.2.3 - Defense Science Board: Lack of a System Approach

In 1992, the Defense Science Board (DSB) met to consider changes required in the acquisition process [68]. A part of the DSB input consisted of that knowledge about problems with the existing system which had been developed by DSMC's workshops. The DSB agreed with the problem statements and suggested some remedial actions which would aim at "solving the problems which exist with the acquisition process". The difficulty with the DSB report was that it was quickly overtaken by events. DSMC's re-design work treated the DAS as a complex entity and sought problem solution through system re-design. The DSB took a fragmented rather than a systems approach.

3.2.2.4 - Defense Systems Management College: Aggressive Educational Role

There is no fixed schedule for DSMC issue of reports and guidance documents. Normally, when problems are either foreseen or experienced, one or more DSMC faculty will provide writings for distribution to DSMC graduates and current students. The 17 documents listed as references [69] through [85] are a portion of the total number produced during the period between 1977 and 1994. They are included to illustrate two points:

- DSMC's attention to acquisition reform and to providing Program Management Office staff with mechanisms for improving their own acquisition activities has continued for more than 15 years. During that time, DSMC has carefully examined issues of concern to PMs. DSMC strives for currency in the guidance provided.

Beginning in 1980, DSMC undertook close scrutiny of the acquisition process, the problems experienced in its use, and potential solutions to those problems. The issue of the Defense Systems Management Review (a journal of DSMC) provided an excellent snapshot in the year 1980. When the Carlucci initiatives were introduced within DoD, DSMC provided its own analysis of how PMs could use those initiatives to improve their programs. The guidance given on how best to establish competition among alternative industrial sources was an outgrowth of acquisition process changes resulting from DoD and Congressional actions. In 1985, DSMC provided PMs and their staffs with a comprehensive set of actions which would help in solving problems. For reference, contacts with special knowledge in acquisition process areas was provided. The PM Notebook was brought current yearly. A companion set to the PM Notebook were the publications, "Introduction to DoD Program Management", and "Glossary of Defense Acquisition Acronyms and Terms".

As the changes in world power structure proceeded, concern for the future of the defense industrial base heightened. USD(A) directed DSMC to perform the "Defense Procurement Industrial Base Study". How commercial industry operated became of major importance and "Using Commercial Practices in DoD Acquisition" was published in 1990. The events scheduled in Europe became a subject of scrutiny both in the U.S. and Canada. DSMC published "Europe 1992: Catalyst for Change in Defense Acquisition" in 1990 to provide assistance to PMs in helping their industrial partners to become more competitive internationally. The thrust of the argument was that since Europe was to become considerably more integrated in its treatment of industrial capability, it would be necessary for DoD to help industry in its search for international markets as well as to ameliorate practices which resulted in added cost to industrial products. Europe's shifting paradigm was considered to demand a similar response from U.S. industry and DoD was required to help in developing and implementing better industrial competitiveness. DSMC also provided information about the effect of Congressional activities on PMs in the book, "Congressional Relations: A Guide for DoD Acquisition Managers". And in 1992, "Commercial Practices for Defense Acquisition Guidebook" explained how to apply commercial principles to the DAS.

- This work was the first DSMC activity which looked at the whole DAS. All other DSMC publications focused on a part of the DAS, or on some specific problem or activity perceived to generate problems.

3.2.2.5 - Office of the Secretary of Defense: Non-comprehensive System Approach

In 1981, two individuals attached to the Office of the Assistant Secretary of Defense for Research and Engineering provided a systemic review of defense acquisition [86]. The document is of interest because, (1) it is a "systems" approach to analysis, and (2) it assumes that "cost" is the only item which can be used to measure system effectiveness. The problem is that if cost is used as the surrogate measure for goodness, then one must carry the cost analysis through the complete lifetime of the system activity. Doing that requires costing intangibles and making guesses about the course of future events which cannot help but be flawed. In this exposition, the system considered in 1981 has so remarkably changed that the analysis cannot be applied to the present DAS.

3.2.2.6 - Office of the Deputy Undersecretary of Defense (Director of Defense Research & Engineering): Seeking Career Path Definition

In 1984 Nicholas Mavroulis, Congressman from Massachusetts began to seek creation of a U. S. Defense Acquisition Corps. Mr. Mavroulis asked for a comprehensive study of education and training (including career sketches) of personnel who had spent their careers in defense or service acquisition or procurement. Two reports were provided to him [87], and [88]. It was found that acquisition personnel had not generally been able to participate in the various courses established by DSMC and other Service schools. Recognizing that time would be required to provide training, it was felt that the DAS might be changed in ways which would improve personnel performance and Mr. Mavroulis began to draft legislation which would meet the twin objectives of "DAS simplification" and "improved personnel training". Mr. Mavroulis later sponsored the Defense Workforce Improvement Act".

3.2.2.7 - Office of the UnderSecretary of Defense (Acquisition) USD(A): Concern for the Industrial Base

In 1988, the then USD(A) produced a document which assessed the health of the Defense Industrial Base, and projected its future [89]. USD(A) became so concerned about those findings that DSMC was asked to examine the problem in detail. Five of the workshops reported in Chapter 5 were the direct result of the USD(A)'s work on "Bolstering Defense Industrial Competitiveness:Preserving Heritage: The Industrial Base: Securing Our Future". The USD(A) was also responsible for Congressionally mandated action to receive a yearly report on the state of industrial base health. The reports issued in 1990 [90] and 1992 [91] contained information developed in DSMC workshops reported here.

3.2.2.8 - Office of Federal Procurement Policy (OFPP): Broad Powers May Be Invoked

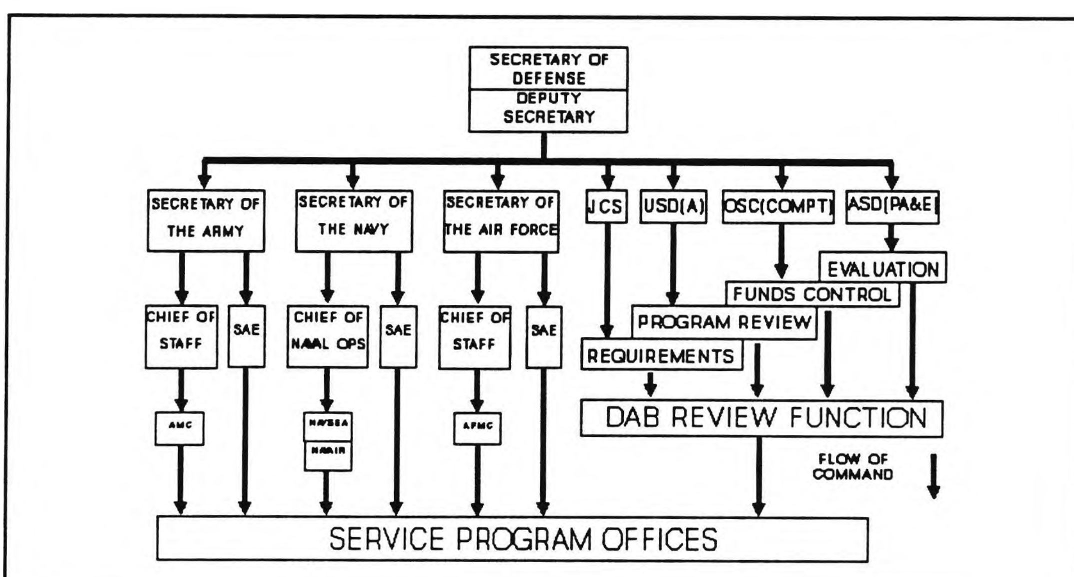
The Office of Federal Procurement Policy was established as an arm of the Office of the President, Office of Management and Budget (OMB) to act in matters concerning the Federal Acquisition Regulation. One of the first policy issues considered was the cost of spare parts and the procurement practices which lead to those cost accruals [92]. OMB has the power to change Executive Department procurement policy in any way which does not contravene Federal law. At issue in this report are the current Federal Acquisition Regulations (FAR) and the procurement practices the FAR institutionalizes. The report may already be overtaken by events since the Congressional Acquisition Reform Act of 1994 exempts spare parts procurement in amounts of less than $100,000.00 from the FAR.

3.2.3 LITERATURE PRODUCED BY THE INDIVIDUAL SERVICES

In general, the Army, Navy and Air Force have been the responsible agents for developing, producing, deploying, and supporting weapon systems. Each service has a Service Acquisition Executive (SAE) who reports both to the Service Secretary (e.g., Secretary of the Air Force) and to the Defense Acquisition Executive, the USD(A).

Service Commands are actually responsible for weapon development, and each service has established its own command structure to discharge those responsibilities. In the Army and Air Force, the responsible development command is headed by a full General Officer (4 stars). The Army Materiel Command and the Air Force Material Command are responsible for weapon system development procurement and support for the complete weapon life cycle.

The Navy accomplishes these functions as a part of the work of two major commands headed by a Vice Admiral (3 stars); (1) The Naval Sea Systems Command (NAVSEA), and (2) The Naval Aeronautical Systems Command (NAVAIR). The Commands are directly subordinate to their respective service's chief of staff (the Chiefs of Staff of the Army and Air Force, the Chief of Naval Operations). The major commands establish Program Management Offices (PMOs) headed by a Program Manager (PM) to perform acquisition functions. For major weapon programs the Program Manager is usually a serving officer with the rank of Colonel (although for programs like the B-2 or the Space Defense Initiative, the PM was a General Officer). The PM usually has a civilian (civil service) deputy (DPM) of equal rank (civil service professional ranks run from General Service (GS) level 1 through 15; a GS-15 has of "equivalent rank" of Colonel. If the PM is a General Officer, the DPM will usually be a member of the Senior Executive Service). All program management personnel are necessarily members of the Acquisition Corps (Either the DoD or Service units). Each of the services has established a mechanism for PM reporting. Usually, the PMs have reporting responsibility to their own Command and also to the SAE. The PMs usually interact directly with the DoD staff officers; and the PMs are responsible for all DAB related activity. Figure 3-3 shows the acquisition command line; the reporting and oversight managers of major programs experience.



ACQUISITION PROCESS COMMAND LINE

Figure 3-3

The Congress only rarely asks the PM directly for documentation about a program. Program managers usually respond only to such requests when they are made by some element of the command line. However, when PM's do respond, the focus of their documents is sharp and addresses immediate questions and needed actions. Each service operates one or more higher educational facilities. Students working to earn degrees at those institutions sometimes look at the acquisition process as an area of special study. In the search for archival literature, the author reviewed documentation specific to acquisition produced by the Army War College and Army Logistics Management Academy, The Naval War College and Naval Post Graduate School, The Air University, and the Air Force Institute of Technology.

3.2.3.1 - Department Of The Army: Philosophy and Practice are Inconsistent

In the search for relevant material originating from within the Army, little was found which treated the Acquisition process as defined herein. There was considerable literature written by students at the Army Logistic Management College which dealt with the practice of logistics in the sense of maintaining force readiness and operational capability but little which dealt even with portions of acquisition in the DAS context. The Army War College requires its students to perform research into what are perceived to be problems for the Army. Much of the literature originating within the Army War College concerned strategic and tactical planning and war fighting. Only one publication was found which dealt specifically with the DAS. Tirone [93] focused on dichotomies within the Acquisition process as practiced within the Army. While the Army's stated position required the process to permit rapid response to change, the checks and balances placed on program managers by that system so impeded such response as to almost prohibit the practice. In fact, Tirone states that the process philosophy is at odds with its practice. The check and balance provided by attempting to satisfy all oversight entities is opposed to the practical nature of what must be done by those who execute programs. Tirone states that it is nearly impossible to conform to the letter of regulation which required flexibility and rapid response. Tirone therefore concludes that the system (as implemented) is schizophrenic, and that there is no efficiency or effectiveness possible when working within such a system.

3.2.3.2 - Department Of The Navy: Quality Concerns

Four reports of interest were produced within the student body at the Naval Post Graduate School (NPS).

- Rannenberg [94] examined the way in which defense acquisitions were made subject to special warranty provisions introduced in an appropriation act. The author attempted to model the life cycle cost of warranties to determine whether they were a cost saving to the government. His conclusion was that an analytical model would be too difficult to construct even if a great many simplifying assumptions were made about the variables of importance and the values they could take on.
- Konetski [95] reviewed attempts to use commercially accepted standards in place of government developed standards. The issue of decentralized commercial standard setting was a major deterrent to program managers adopting market warranty practices.
- Brown [96] discussed barriers to DoD implementation of Dr. W. Edwards Deming's "Total Quality Management" (TQM) system. The research attempted to define barriers in terms of whether they were, "linked to Government laws, regulations, or internal DoD policies." The author recognized that TQM was a cultural concept, which in manufacturing was implemented using a combination of statistical and social science mechanisms. The report concludes that the *six major barrier categories are: (1) Congressionally imposed competition rules; (2) single year resource allocation; (3) Congressional oversight (micro-management); (4) the way DoD accepts and inspects work in progress and delivered materiel; (5) the rapidity of change in DoD management; and (6) management unwillingness to change practices*. There were a number of examples cited within each of the six barrier categories. The principal recommendation was for sweeping change to the then current DAS.
- Lumb [97] discussed the skills required by Acquisition Corps and relates those skills to educational opportunities offered to Army personnel. During the course of this research, the document was mainly of assistance in designing instructional material derived from the on-going workshops which examined DAS

problems and re-design.

The Navy Personnel Research and Development Center had the responsibility to determine needs for education and training of naval forces. Suarez [98] provided a plan for training Acquisition Corps members in principles of Total Quality Management (TQM). A most interesting aspect of the report was its failure to deal with those cultural barriers enunciated in the Naval Post Graduate School report discussed above.

3.2.3.3 - Department Of The Air Force: Military Sales and DAS Modeling

The Air University performs studies which have impact on Air Force policy. A study by Walsh [99] treats difficulties in establishing contracts with foreign sources. The Congress stated a policy in 1975 which encouraged DoD to expand its co-operative activities with foreign suppliers. In attempting to follow the congressional mandate, a number of difficulties were experienced. This study suggested change to overseas contracting procedures to make contracts easier to initiate, maintain, and administer. The Air Force Institute of Technology (USAFIT) is the technical education institution for the Air Force. It grants Masters degrees on its own accreditation, and in conjunction with other institutions can grant Doctoral degrees in technical subject areas. It also does limited research for the Air Force Materiel Command a major portion of which is co-located at the Wright-Paterson Air Force Base. Four documents issued by USAFIT were of interest in the course of the work reported here.

- McChesney [100] considered the impact that foreign military sales programs had on defense policies. The origin of changes made to regulations which governed the DAS in the period prior to issue of DoDD 5000.1 and DoDI 5000.2 is explained in this report.
- Burgess [101], Burgess and Clark [102] and Spanier [103] all report on work which attempted to structure the DAS as a System Dynamic model which could be manipulated to determine how change to the system will affect outcomes. What is particularly interesting is the divergence in conclusion between these authors and Rannenberg [94] when attempting to construct a structural dynamic model simply for the warranty provisions within the DAS. These reports will

be discussed in detail in Chapter 4 when rationale is presented for selection of the Interactive Management methodology to perform this research.

3.2.4 OTHER LITERATURE

There is considerable literature produced by Federal Contract Research Centers such as The Rand Corporation (contractor to the Air Force), the Logistics Management Institute (contractor to the Army), the MITRE Corporation (contractor to DoD, the Services and a number of other Government entities such as the Federal Aviation Agency, National Aeronautics and Space Agency, Department of Commerce and the intelligence community), and other technology companies. A sample of the reports produced under sponsorship of these organizations is listed as references [104] through [116]. They were the only reports which listed "Defense Acquisition Process" or "Defense Acquisition System" as the key words which most applied to them. Review of the reports revealed them to be concerned with particulars of defense acquisition rather than the entire DAS.

3.2.5 SUMMARY OF THE LITERATURE SURVEY RESULTS

Table 3-1 provides an overview of the literature discussed above.

The literature study provided much useful information. The perception of the DAS by each entity involved with it provided a series of snapshots about problems being experienced at the time the document was produced as seen by that entity. In performing the research described in this document, that information was presented to the workshop participants as background and contextual information. Some of the reports were referred to as justification for suggestions made during the DAS re-design process. ***But one of the most striking characteristics of the literature was its failure to treat the DAS as a complex system.*** The requirement to understand the "whole" when attempting to deal with specific problems has, in the case of the DAS, lead to imposition of a number of constraints which cause much difficulty. It is clear that legislative and regulative actions taken in the past without regard to the DAS in its entirety have burdened the system and made it much less efficient than it might be.

Another striking result of the literature survey is the observation that "the problem of the week" tends to be the focus of concern about the DAS. Emphasis shifts quickly from one aspect of DAS performance to another. Because the observations and perceptions of what is reported change quickly, applicability and long term validity of the reports is questionable. Some of the problems reported in 1985 are no longer of concern. Other statements made in 1988 are no longer true. ***Because the investigations fail to deal with the entire DAS as an entity, there has been little fundamental understanding of complex systems generated in them.***

3.3 INFORMATION GATHERED FROM INDUSTRIAL ORGANIZATIONS

During the course of this research, the author also served as DSMC's point of contact for DoD's Electronic Commerce activities (then being carried out under DoD's Computer Aided Life-Cycle Support [CALS] program). The purpose of this work was to examine the changes to corporate activities made possible by full implementation of electronic data collection, storage, retrieval, and dissemination.

In addition, during the period from April 1993 through October 1993, the author was a member of a special panel convened by the Defense Advanced Research Projects Agency (DARPA) to study commercial and military aircraft acquisition practices. The Affordable Aircraft Acquisition panel task was to recommend mechanisms which would reduce the cost of military aircraft by 50%. In the course of both of these activities, briefings were given to the author, and visits were made to a number of industrial facilities producing commercial and military products. During the course of the briefings and visits, each company's methodology for product design, development, manufacture, test, distribution and support was thoroughly discussed. The result of this data gathering activity is presented below.

3.3.1 GENERAL ELECTRIC HEAVY ELECTRICAL GENERATION EQUIPMENT DEPARTMENT, Schnectady, New York [117].

General Electric (GE) had purchased existing commercial software from IBM and used it to create a single electronic data base (EDB) for all Departmental information. All information about product design and manufacture was kept current

Agency	Subject	Year	Title
U.S.SENATE COMMITTEE ON THE ARMED SERVICES	Defense Acquisition Process	1989	[13] Hearings, 100th Congress, 2nd Session, July 11,12,27, August 4, 1988 (Published 1989)
	Defense Build-Down and Inventory Management in the Department of Defense	1992	[14] Hearings, 102nd Congress, 2nd Session, 26,27,28 February 1992; S-102-848
U.S.SENATE COMMITTEE ON GOVERNMENTAL AFFAIRS	Oversight	1989	[15] Oversight of DoD's Management Of Inside Information: Hearing before the Sub-Committee on Oversight of Government Management, 101st Congress, 1st Session, 24 February 1989
		1989	[16] Oversight of DoD's Inadequate Use of Off-The-Shelf Items, Hearings before the Sub-Committee on Oversight of Government Management, 101st Congress, 1st Session, 30 May and 1 June 1989
		1992	[17] Subcontract Management In The Department of Defense, 102nd Congress, 1st Session, 22 May 1992
U.S.HOUSE OF REPRESENTATIVES COMMITTEE ON THE ARMED SERVICES	Acquisition Policy Panel	1988	[18] Integrity of Department of Defense Acquisition System and Its Impact on National Security: Hearings Held Before The Full Committee and the Acquisition Policy Panel, 100th Congress, 2nd Session, 29 June, 6,8,26 July, 10 August, 16,28,29 September, and 13 October 1988
		1988	[19] Registration of Consultants: Hearing Held Before The Acquisition Policy Panel, 100th Congress, 2nd Session, 23 September 1988

LITERATURE SURVEY OVERVIEW - CONGRESSIONAL COMMITTEE REPORTS

Table 3-1

Agency	Subject	Year	Title
U.S.HOUSE OF REPRESENTATIVES COMMITTEE ON THE ARMED SERVICES	The Quality And Professionalism of the Acquisition Workforce	1989	[20] Report of the Investigations Sub-Committee of the Committee on Armed Services, 101st Congress, 2nd Session 1989
	Life Is Too Short	1990	[21] Report of the Investigations Sub-Committee of the Committee on Armed Services: A review of the Brief Periods Managers of Major Defense Acquisition Programs Stay On The Job, 101st Congress, 2nd Session
	Acquisition Issues	1990	[22] Hearings Before The Investigations Sub-Committee, 101st Congress, 2nd Session, Hearings held 15 and 29 March 1990
U.S.HOUSE OF REPRESENTATIVES COMMITTEE ON SMALL BUSINESS	Small Business Concerns with Panel 800 Recommendations on Department of Defense Acquisition Reform	1993	[23] Hearing Before The Sub-Committee on Procurement, Taxation, and Tourism, 103rd Congress, 1st Session, 22 January 1993
SPECIAL REPORT OF SENATE ARMED SERVICES COMMITTEE	Legislative Barriers	1990	[24] "Legislative Barriers to Communication in the Defense Acquisition Process"; Hicks, Donald A.; A Report to the Senate Armed Services Committee by a Former Under Secretary of Defense (Acquisition)

LITERATURE SURVEY OVERVIEW - CONGRESSIONAL COMMITTEE REPORTS

Table 3-1 (Continued)

Subject	Agency	Yr	Report Title
Acquisition Reform	GAO/PLRD	1983	[25] Assessment of Admiral Rickover's Recommendations to Improve the Department of
	GAO/NSIAD	1990	[26] Status of Selected Programs
Defense Procurement Fraud	GAO/GGD	1986	[27] Cases Sent To The Department of Justice's Defense Procurement Fraud Unit
	GAO/GGD	1988	[28] Justice's Overall Management Can Be Enhanced
	GAO/GGD	1992	[29] Information on Plea Agreements and Settlements
ADP Procurement	GAO/IMTEC	1989	[30] Defense Acquisition Board Should Address NORAD's Computer Deficiencies
	GAO/IMTEC	1990	[31] Air Force Prematurely Recommends ADP Acquisitions
Acquisition	GAO/NSIAD	1986	[32] DoD's Defense Acquisition Program (Carlucci's 33 Initiatives)
	GAO/NSIAD	1986	[33] Status of the Defense Acquisition Improvement Program's 33 initiatives
Defense Acquisition	GAO/NSIAD	1990	[34] Perspectives on Key Elements for Efficient Management
	GAO/NSIAD	1990	[35] Fleet Ballistic Missile Program Offers Lessons For A Successful Program
	GAO/NSIAD	1992	[36] U.S.-German Examinations of the MLRS Terminal Guidance Warhead Program
	GAO/NSIAD	1992	[37] More Information Needed of Individuals Convicted of Procurement Related Crime
	GAO/NSIAD	1992	[38] The Special Operations Forces Aircrew Training System at One Year
Defense Procurement	GAO/NSIAD	1988	[39] Work Measurement Programs at Selected Contractor Locations
	GSO/NSIAD	1990	[40] Solicitation for Contract Support Services Under Limited Competition
	GAO/NSIAD	1991	[41] Not Providing Technical Data May Limit Defense Logistic Agency Competition
	GAO/NSIAD	1991	[42] Qualification and Quality Requirements Purchases of Critical Spare Parts
	GAO/NSIAD	1991	[43] DoD Purchase of Foreign-Made Machine Tools
	GAO/NSIAD	1991	[44] Acquiring Technical Data for Spare Parts Re-Procurement
	GAO/NSIAD	1992	[45] DoD Should Assess Cost Impact of Contracting Teaming Arrangements
	GAO/NSIAD	1992	[46] Improvement Needed in Technical Data Management
	GAO/NSIAD	1992	[47] Need to Improve Internal Controls On Deferred Contractor Debts
	GAO/NSIAD	1992	[48] DoD Concerns Regarding Acceptance of Spare Parts Approvals
Defense Management	GAO/NSIAD	1992	[49] Implementation of the Defense Acquisition Workforce Improvement Act
	GAO/NSIAD	1993	[50] Implementation of the Defense Acquisition Workforce Improvement Act

LITERATURE OVERVIEW - GAO SPECIAL REPORTS

Table 3-1 (Continued)

Agency	DOCUMENT NO	Year	Title
DEPARTMENT OF DEFENSE AND OFFICE OF THE SECRETARY	2.110: 98-525	1985	[53] **DoD Issue of** Department of Defense Authorization Act, 1985: An Act to Authorize Appropriation for Military Functions of the Department of Defense and to Prescribe Military Personnel Levels for the Department of Defense for Fiscal Year 1985, Revise and Improve Defense Procurement, Compensation, and Management Programs ...
	AE 2.110: 99-661	1986	[54] **DoD Issue of** National Defense Appropriation Act for Fiscal Year 1987: An Act to Authorize Appropriations for Fiscal Year 1987 for Military Activities of the Department of Defense, for Military Construction, and for Defense Activities of the Department of Energy, to Prescribe Personnel Strengths for Such Fiscal Year for the Armed Forces, to Improve the Defense Acquisition Process, and for other purposes.
	KF844. F33X	1988	[55] U. S. Department of Defense, Federal Acquisition Regulation as of 1 June 1988
	KF844. F34X	1988	[56] U. S. Department of Defense, Federal Acquisition Regulation Supplement
	KF844. U55	1988	[57] U. S. Department of Defense, Federal Acquisition Regulation Supplement
	KF844. D44	1991	[58] U. S. Department of Defense, Federal Acquisition Regulation Supplement
	KF852.A3 U53	1993	[59] Streamlining Defense Acquisition Laws; Report of the Acquisition Law Advisory Panel to the United States Congress
DEPARTMENT OF DEFENSE, OFFICE OF THE INSPECTOR GENERAL	Audit Report DoD IG 92-107	1992	[60] Effectiveness of DoD Use of Non Developmental Items In Major Defense Acquisition Programs
	Audit Report DOD IG 92-097	1992	[61] F/A-18 Program As A Part Of The Audit Of The Effectiveness Of The Defense Acquisition Board Review Process - FY 1992
	Audit Report DoD IG 93-121	1993	[62] Special Defense Acquisition Fund Financial Statements for Fiscal Year 1992
	Audit Report DOD IG 94-014	1993	[63] Low Rate Initial Production In Major Defense Acquisition Programs
	Audit Report DOD IG 94-020	1993	[64] Environmental Consequence Analysis Of Major Defense Acquisition Programs
	Audit Report DOD IG 93-087	1993	[65] Review Of The All Source Analysis System As A Part Of The Analysis of The Effectiveness Of The Defense Acquisition Board Review Process Fiscal Year 1993
	Audit Report DOD IG 93-089	1993	[66] Integrated Logistics Support For Non Major Defense Acquisition Programs

LITERATURE OVERVIEW - DEPARTMENT OF DEFENSE REPORTS

Table 3-1 (Continued)

Agency	Co-Author	Year	Title
DEFENSE SCIENCE BOARD	U. S. Defense Science Board Task Force on Defense Acquisition Reform	1993	[67] Report Of The Defense Science Board Task Force On Defense Acquisition Reform
DEPARTMENT OF DEFENSE, DEFENSE SYSTEMS MANAGEMENT COLLEGE	Goodman, Stuart N.	1977	[68] Management Information Systems and the Computer in the Defense Acquisition Program Office
	Various	1979	[69] Defense Systems Management Review. Volume 2, No 4: Defense Acquisition, The Process And The Problems
	Various	1980	[70] Defense Systems Management Review. Volume 3, No 1: Defense Acquisition, Issues and Answers
	Columbia Research Co	1983	[71] Defense Acquisition Improvement Program: DoDAIP
	Acker, David D.	1983	[72] Evaluation Of The Effectiveness of the Defense Systems Acquisition Review Council (DSARC)
	ANADAC Inc.	1984	[73] Etablishing Competitive Production Sources, A Handbook for Program Managers
	N/A		[74] The Program Manager's Notebook: Glossary of Acquisition Management Acronyms and Terms; Fact Sheets
	Behavioral Sciences Assoc	1985	[75] Introduction to DOD Program Management
	Jones, Wilbur D.	1986	[76] Introduction To Defense Acquisition Management
	Jones, Wilbur D.	1989	[77] Glossary of Defense Acquisition Acronyms and Terms
	Center for Acquisition Policy	1989	[78] Outcomes, Principles, and Criteria: A Framework for Assessing Changes to The Defense Acquisition System
	DSMC Staff	1989	[79] Defense Procurement Industrial Base Study
	Sweeny, Perkins, Spencer	1990	[80] Using Commercial Practices in DoD Acquisition: A Page From Industry's Play Book
	Cole, Hochberg, Therrien	1990	[81] Europe 1992: Catalyst for Change in Defense Acquisition: Report of Research Fellows
	Cochrane, C.B.	1991	[82] Glossary: Defense Acquisition Acronyms and Terms
	Jones, Wilbur D.	1992	[83] Congressional Involvement and Relations: A Guide for DoD Acquisition Managers
	Rhodes, Dean I.	1992	[84] Commercial Practices for Defense Acquisition Guidebook

LITERATURE OVERVIEW - DEPARTMENT OF DEFENSE REPORTS

Table 3-1 (Continued)

Agency	DOCUMENT NO	Year	Title
OFFICE OF THE SECRETARY OF DEFENSE	Puritano, Vincent and Berenson, Paul J.	1981	[85] Improving The Defense Acquisition System And Reducing System Costs
OFFICE OF THE DEPUTY UNDER SECRETARY OF DEFENSE RESEARCH AND ENGINEERING	Laurence, M.T.	1984 1984	[86] Defense Financial and Investment Review, Appendix 4. Part 1: Survey Of Defense Procurement Personnel Results and Findings [87] Defense Financial and Investment Review, Appendix 4. Part 2: Survey Of Defense Procurement Personnel Narrative Comments
OFFICE OF THE UNDERSECRETARY OF DEFENSE (ACQUISITION)		1988 1990 1991	[88] Bolstering Defense Industrial Competitiveness: Preserving heritage: The Industrial Base: Securing Our Future [89] Report To Congress on The Defense Industrial Base (ASD P&L) [90] Report To Congress on The Defense Industrial Base (ASD P&L)
OFFICE OF FEDERAL PROCUREMENT POLICY	Policy Report From the Office of Management And Budget	1984	[91] Review of the Spare Parts Procurement Practices Of The Department of Defense

LITERATURE OVERVIEW - DEPARTMENT OF DEFENSE REPORTS

Table 3-1 (Continued)

Service	Agency	Year	Title
DEPARTMENT OF THE ARMY	Army War College, Carlisle Barracks, Pa	1988	[92] The Schizophrenic Conscience Of Defense Acquisition by Joseph M. Tirone
DEPARTMENT OF THE NAVY	U. S. Naval PostGraduate School, Monterey, Ca	1984	[93] Warranties In Defense Acquisition: The Concept, The Context, And The Congress by J. E. Rannenberg
		1986	[94] The Role Of Specifications And Standards In The Department Of Defense Acquisition Process by Mark L. Konetski
		1990	[95] A Study Of The Barriers To Institutionalization Of Total Quality Management (TQM) In The Department Of Defense Acquisition Process by William A. Brown
		1991	[96] An Examination Of The Skills, Experience, Training and Education Requirements Needed As A Functional Area by 97 Officers in the Army Acquisition Corps by Mark D. Lumb
	Navy Personnel Research & Development Center, San Diego, Ca	1989	[97] Strategy For Educating The Department Of Defense Acquisition Work Force In Total Quality Management by Gerald Suarez
DEPARTMENT OF THE AIR FORCE	Air University, Air Power Research Institute, Maxwell Air Force Base, Alabama	1976	[98] Improving International Defense Acquisition: A Study Of Problems In Initiating Overseas Contracts by Brian Walsh
	Air Force Institute Of Technology, Wright Patterson Air Force Base, Ohio	1976	[99] The Evolution Of The Foreign Military Sales Program And Its Impact On Defense Policies And Procedures by Jack Lester McChesney
		1988	[100] A Management Analysis And Systems Model Of Department Of Defense Acquisition Structure And Policy by Gregg M. Burgess
		1988	[101] Management Analysis & Structural Model of The Defense Acquisition System by Gregg M. Burgess & Thomas D. Clark
		1989	[102] Theoretical Framework for Defense Acquisition Analysis by Lee J. Spanier

LITERATURE OVERVIEW - SERVICES - DEPARTMENTAL REPORTS

Table 3-1 (Continued)

FCRC	Accession #	Year	Title
LOGISTICS MANAGEMENT INSTITUTE	ADA 025278	1969	[103] Briefings on Defense Procurement Policy And Weapon System Acquisition
	ADA 107142	1979	[104] Joining The Defense Directives and Defense Acquisition Regulatory Systems; Platt, Alvin W. and Conrad, David M.
	ADA 095371	1980	[105] Small Business Guide to The Defense Acquisition Regulation; Young, Robert S. and O'Hearn, Thomas H. Jr.
	LMIAQ801R 1	1989	[106] Information Resource Management Planning In The Office Of The Under Secretary of Defense (Acquisition)
	U168L642H 35	1991	[107] DoD Implementation Guidelines for Electronic Data Interchange
INSTITUTE FOR DEFENSE ANALYSIS	ADA 205728	1988	[108] Observations Two Years After The Packard Commission; Graham David R., Bicksler, Barbara A., Hilton, Robert P., Hoyler, Marshall, Kanter, Herschel
	ADA 206858	1988	[109] The CINCS (Commanders-In-Chief) And The Acquisition Process; Kanter, Herschel, Wainstein, Leonard, Kaganoff, Rachel, Pavel, Barry
	ADA 236753	1989	[110] Observations Two Years After The Packard Commission; Volume II,Background Papers; Bicksler, Barbara A., Fox, J. R., Gilligan, Michael, Hilton, Robert P., and Transue, John R.
THE RAND CORPORATION	RAND	1989	[111] NATO And 1992: Defense Acquisition and Free Markets; Webb, Simon
SAIC	N/A	1985	[112] Cost Realism Handbook For Assuring More Realistic Contractor Cost Proposals: A Handbook For Program Management And Source Selection Personnel; For The U.S.Naval Material Command; Trapp, Donald L.
ICAF	ADB165843	1991	[113] Defense Acquisition Strategy For The 1990's; Shelkey, Ronald G.
NSIA	UB212.C655 1991	1991	[114] Commercial Off-The-Shelf/Non-Developmental Items Study (COTS/NDI); National Security Industrial Association National Headquarters
	KF844.S79 1993	1993	[115] A Study Of The Applicability Of FAR Clauses To Subcontracts Under Prime Defense Contracts: Including Defense FAR Supplement; National Security Industrial Association

LITERATURE OVERVIEW - FEDERAL CONTRACT RESEARCH CENTERS AND OTHERS

Table 3-1 (Concluded)

so that any questions about those issues could be answered immediately. A log was also maintained within the EDB which iterated changes and the dates they were made. Status information about orders in process of fulfillment (work in progress) was also maintained current so that customers could access that information directly when they had questions about delivery dates. Inventory levels of materiel and purchased parts were also maintained current on the EDB so that GE suppliers could access the information and decide when stock levels required replenishment. When that was necessary, the supplier would simply ship appropriate materiel to GE and enter that information on the EDB accounts payable files. When the materiel was received at GE, that information was entered into the EDB and a check was issued directly to the supplier. Security levels had been provided for accessing the EDB. ***The GE EDB system had been in operation for two and one half years at the time of the visit and had reduced GE cost so remarkably that the Department had been able not only to stem previous losses, but to become profitable and force Japanese competitors to withdraw from the Japanese market. GE was the supplier of generating equipment to Tokyo Electric Company!***

3.3.2 MOTOROLA, Tucson, Arizona [118]

Motorola had also installed an integrated electronic data base. While it had not permitted outside access by customers and suppliers, it did allow access (on a security level basis) for internal use and had experienced significant cost savings as a result.

3.3.3. TEXAS INSTRUMENTS (TI), Dallas Texas [119]

Alarmed about the percentage of its product rejected for failure to meet specifications, initiated a manufacturing process improvement program which it called the "Six Sigma Program". The objective was to reduce rejection rates to fewer than one item per 1,000,000 through use of statistical process control techniques. It had succeeded so well that Motorola had established a separate entity (American Supplier Institute) to help other commercial sector organizations apply TI's process control methodology. The major element of TI's program was the use of integrated product teams (IPT) throughout all stages of product development from conception to manufacture. Because the development process integrated skills of individuals skilled in design, production, marketing and logistic support throughout the product development process, designs could be modified to avoid manufacturing process difficulties and make it easier to support products during initial distribution and during use in customer equipment.

3.3.4. MCDONNELL DOUGLAS, St. Louis, Missouri [120]

McDonnell Aircraft (MACAIR) has a long history of production of fighter aircraft for the U. S. Navy and Air Force. At the time of these discussions, MACAIR's major effort was to develop new materials whose physical characteristics would permit revising the methodology used to manufacture major aircraft sections. As a result of that work, materials had been developed which permitted manufacture of multiple quantities of product without the requirement to develop typical production tooling. Additional benefit had been realized because the methodology provided means directly and continuously to measure critical physical dimensions using special emplaced materials embedded within the new structural material. Extremely accurate form, fit, and function were achieved and considerable cost reduction and time savings were realized during fabrication.

3.3.5. LOCKHEED AERONAUTICAL SYSTEMS, Marietta, Georgia [121]

At the time of this visit, Lockheed was lead contractor in development of a new fighter aircraft. A consortium consisting of McDonnell Douglas (St. Louis), Boeing Military and Space Systems (Renton, Washington), and Lockheed Aircraft Corporation had been formed to create and produce the new aircraft. The use of Integrated Product Teams was a major element in the teams approach as was the use of a common electronic data base within which all design, production, financial, and materiel data was collected and maintained current. Both time and cost savings were reported as the result of the new processes institutionalized by all consortium members. The consortium had formed a program office staffed with individuals from all consortium members. Most program office members were co-located at Marietta.

3.3.6. BOEING AIRCRAFT COMPANY, Seattle and Everett, Washington [122]

When this visit was made, Boeing was just completing initial manufacture of its new 777 commercial aircraft. The major thrust of the new process Boeing had developed was to create a complete facility which enabled construction and test of a "virtual aircraft". The facility provided means to examine performance of all aircraft system elements by creating a complete set of interfaces within which all aircraft and support components could be gathered to simulate the total aircraft system. Interfaces between pilots and maintenance personnel were also provided so that the "virtual" system would be capable of testing the new aircraft concept and expected performance. While facility construction was a very significant capital investment, large cost savings resulted from its use: no 777 "mock-up" was built - all of the requirements which had previously required mock-ups had been fulfilled using the virtual aircraft facility. Integrated product teams and singular electronic data bases were primary requirements within the virtual aircraft development concept. The first 777 was produced and delivered to the customer ahead of schedule.

3.3.7. LOCKHEED ADVANCED DEVELOPMENT COMPANY, Palmdale, California, [123]

This Lockheed component (nicknamed "The Skunk Works") was renowned for its capability to produce new, advanced aircraft quickly and it had continued to seek new and innovative ways to perform the functions required quickly to move ideas into useful end products. It had produced the U-2 and RB-22 reconnaissance aircraft. The nature of the product provided and the kinds of missions performed had permitted reconnaissance aircraft development outside of normal acquisition system constraints: thus the Skunk Works had a long established common internal data base and IPT policy internally (within its own facilities). The conditions under which work was done had not yet extended those applications to consortia as other organizations had.

3.3.8. SCALED COMPOSITES INCORPORATED, Mojave, California, [124]

Scaled Composites (SCI) is best known because of its President's (Burt Rutan) provocative discussion style. Rutan pioneered new manufacturing technology utilizing newly developed synthetic materials. Discussions with him revealed an additional factor embedded within his activities - an extremely small, multi-skilled integrated product team who essentially created, controlled, and used a single electronic data base. Indeed, the company's facilities had been tailored to the integrated work of multi-skilled individuals using simple, inexpensive tooling to create aircraft made of advanced non-metallic materials. Because the cost of tooling was so inexpensive and the individuals involved were capable of performing almost all of the tasks involved in the production process, simultaneous production of multiple aircraft units could be achieved. A major cost and time reduction had resulted by applying Rutan's concepts.

3.3.9. CHRYSLER MOTOR COMPANY, Detroit, Michigan, [125]

At the time of these discussions, Chrysler had just completed development of its new "Viper": a moderately priced vehicle aimed at capture of a portion of the U. S. $50,000.00 and up sport car market. The design concept required: (1) modification of an existing component (Chrysler's RAM truck engine); and (2) development of a new windshield manufacturing process which permitted more severe windshield contours than were previously available.

The new Viper engine was provided by adding two additional cylinders to the standard 6 cylinder truck engine. This was accomplished using production devices then in inventory avoiding the cost and time required to build new jigs and fixtures.

The windshield was developed external to Chrysler by an independent company which had been promised a long term production contract if it could deliver what Chrysler specified in accordance with an agreed upon schedule and at the specified unit price. Chrysler also established product quality criteria which the manufacturer would meet. The investment in windshield development was made attractive because it was not only required for Viper, but was also a primary element in the new Chrysler "Cab Forward" design. The quantities ultimately required would more than recover the initial cost and would provide a continuing market for the supplier's product.

3.3.10 SUMMARY OF THE RESULTS OF INTERVIEWS AND VISITS

It was clear from this group of interviews and facility visits that industrial acquisition organizations faced many of the same kinds of development problems reported in the all of the literature surveyed. The difficulties of balancing cost, schedule and performance were pervasive. However, it also became clear that although industry was successfully using integrated product teams and free information exchange as tools to achieve higher productivity at less cost, many of those same mechanisms could not be institutionalized by DoD within the then web of law and regulation which had resulted from non-holistic analysis of the DAS. Specifically, competition requirements mitigated against close continuing association between the purchasing organization and its supplier, and the requirements for protection of tax-payer funds made it difficult to implement the kind of procedures and data exchanges employed routinely by General Electric. The point will be discussed in greater detail in Chapter 11.

CHAPTER 4
THE CHOICE OF INVESTIGATIVE METHODOLOGY

This chapter: (1) States assumptions about the nature of inquiry into complex systems. The purpose is to set ground rules for discussion of alternative inquiry methodologies; (2) Discusses methodologies generally used to gain understanding and control of complex systems. The purpose is to indicate their characteristic strengths and weaknesses; (3) Presents a rationale for selecting the methodology the author used to perform the work reported here. The purpose is to show that the methodology selected is the most useful one for the purpose of system re-design.

4.1 ASSUMPTIONS

The discussions in Chapters 1, 2, and 3 support the contention that the DAS has been studied many times during its evolution from simplicity to complexity. In the course of that work many inquiry methodologies have been used and many analytical tools applied. Many of the reports about DAS analyses fail to state clearly the assumptions which created the context within which the attempt to represent the DAS structure was constructed. The assumptions on which this investigation was based are:

4.1.1 Investigators bring their preconceptions and biases into their analysis.

The review of previous work indicates that the way in which the DAS was regarded by those making the inquiry heavily influenced the structure which resulted from the investigation. The fundamental issue involves interactions between investigators and the systems they investigate. Support for this assumption comes from a number of sources.

Gareth Morgan [126] argues that examination of social systems is an engagement between the researcher and the system. He invokes Heisenberg's "uncertainty principle" [127] to argue that; just as it is not [yet] possible to know all things about an observed entity, individual researchers' biases and limitations form an environment within which their work is embedded. Another way to say that is to assume that perceptions and prejudices carry forward throughout the research. Warfield has said that "data presentation is an art form through which meaningful communications of content are provided to the user". Extending that idea might lead to a conjecture that artists (and perhaps researchers) express the same content differently. Perhaps the best statements about prejudicial perceptions of systems have can be found Immanuel Kant's work [128] which discussed the nature of *à priori* knowledge. That discussion supports the view that one sees what one expects to see in the context of one's life experience. As a result of the assumption that individual perception has influence on how data is presented, when one seeks to present complexity simply, individual researchers may believe some data presentation forms to be much better than others and they will tend to use them.

The discussion of the various groups concerned with providing oversight, command, and guidance to the DAS and the model structures they created and used can shed light on how those groups perform and perceive analytical thinking. If systems are perceived as representable by: (1) deterministic models (sets of equations which have singular sets of values that vary in a pre-determinable manner); (2) stochastic models (in which outcomes are decided statistically through selection of sets of random numbers which exercise probabilistic equations); or, (3) engineering constructs (a group of physical items which operate together and are represented by sets of equations in a network), then information resulting from singular (non-reproducible) events, anecdotal information (provided by sources which cannot be evaluated against any standard), in fact any information (data) derived by methods less rigorous than standard "scientific measurement" might be discounted.

The acquisition process functional model presented in Figure 2-1 and institutionalized in directives DoDD 5000.1 and DoDI 5000.2 will not be easily changed. It will necessarily be a beginning point for the research reported here. The perception of problems experienced and ideas for system re-design derive from experience within that construct. Another reason for using the functional model as a starting point is that although it claims only to represent the process used for converting technology ideas into military equipment, it is applicable as well to civil sector development. The model is at a high level of aggregation. Defining problems experienced in turning ideas into hardware using the specified DAS process is a good beginning point, but understanding the details of what must be done to improve the situation will require developing a much finer structure.

4.1.2 Only unchanging data from the past can be used to extrapolate into the future.

It has been said that science develops explanations of the past from past data. Implicit in that statement is an assumption of data invariance over time and space. In fact, scientific methodology is used in analysis to derive knowledge which, *because of its invariance over time and space*, can be labelled "fact". In theory, one has no need to keep investigating scientific data over and over again. Information gleaned from research about the DAS must be carefully considered to establish the length of time for which it will be invariant! For the DAS, perception of "truth" is extremely transient. Projection of futures from past observations is particularly risky if new knowledge is assimilated into the system structure at an accelerating pace. When crafting system reform, great care is necessary to be sure suggested legislative changes are likely to retain their utility for a reasonable period of time. That time period can only begin ***after the legislation has been enacted***. This point will be discussed again below in another context.

4.1.3 **Even invariant data can lead to erroneous conclusions.**

Use of scientific methodology does not protect against error. To Dalton [129], the atom was indivisible (Dalton's Atomic Theory). To physicists in the early 1940,s it was impossible to travel faster than the speed of sound (the so-called sonic barrier). Einstein's two basic principles of relativity [130] hold that it is impossible to travel faster than the speed of light. Simply because some result of a set of actions taken at some particular time can be reproduced across space and time does not guarantee its immutability. Limitations of experimental technique and methodology also reproduce across space and time. This is especially true when examining social system "invariance". The passage of even a day might make those reporting the data perceive it differently; researchers' ideas and perceptions used in the analysis might change. In short, the immutability of some ideas lasts only as long as the knowledge base upon which they rest does not change in ways that place their credibility in doubt. As a focus on this point: Milton Munitz [131] collected together "theories of the universe" in a kind of handbook of cosmological speculation. Concepts from Babylon through 1955 were placed on a time line for review. It was clear from that review that as more information became available over time, the cosmological theoretic changed considerably. The conclusion is that cosmological theories are snapshots on the time line of perception. Similarly, the "modern" theories of the universe in the 1950's are now only way-stations on the way to better understanding. Munitz's book shows that when information and knowledge are being rapidly developed, data immutability might not last long, and the truth which results from its use is transient!

4.1.4 **The situation which gave rise to the previous data no longer exists.** As shown in Chapters 1, 2, and 3 the environment within which the DAS functions has changed substantively and rapidly over the past very few years. It is axiomatic that rapid change will continue as the United States develops a new role for the Department of Defense. The need for generational change to entire weapon systems is increasingly questioned: the mechanisms meant to encourage research and technical development are in flux; and the relationships between the United States and other nations are under review. Therefore, in addition to the peculiarities brought to the research by the researcher, the data which provides underpinning to the science may no longer be reproducible! One reason for treating the genesis and history of the DAS in detail in Chapter 2 was to provide a time line of DAS change which would enable readers to understand difficulties which might inhibit significant deviation from the present DAS configuration. Indeed, the many questions about why sweeping change to the DAS had not occurred in spite of the many suggestions made by groups convened to study DAS problems might be answered by simply looking at the DAS history. Tomorrow's DAS environment will very likely be different than today's. It becomes even more important then that the methodology used to gain knowledge of complex systems should have a relatively long horizon of use. Just as a meter bar is an accepted universal constant of linear measure, so the analysis methodology used here ought to provide data accepted as valid regardless of time or place of use or whether there is change to the environment within which the system functions.

4.1.5 **Interfaces between systems and their environment, and between the system component subsystems are of primary importance in system analysis and redesign.**

Complex systems are aggregations of sub-systems, components, and parts all of which function as an integrated whole. The determination of exactly what elements of a whole will be divided into smaller units is a primary function of system design. Specifying exactly how elements of the whole fit together, and providing limits within which the components must operate is fundamental to achieving a system "entity" which operates as advertised. There are a large number of dimensions involved with interface specification. This point will be discussed further below.

4.2 METHODOLOGY INSTITUTIONALIZED WITHIN DoD

Some analysis methodology has been formally "institutionalized" within DoD. In fact, it is mandated that the Work Breakdown Structure (WBS), and the Integrated Computer-Aided Manufacturing Definition (IDEF) Model methodologies be used throughout the DAS for certain defined activities.

4.2.1. The Work Breakdown Structure Methodology

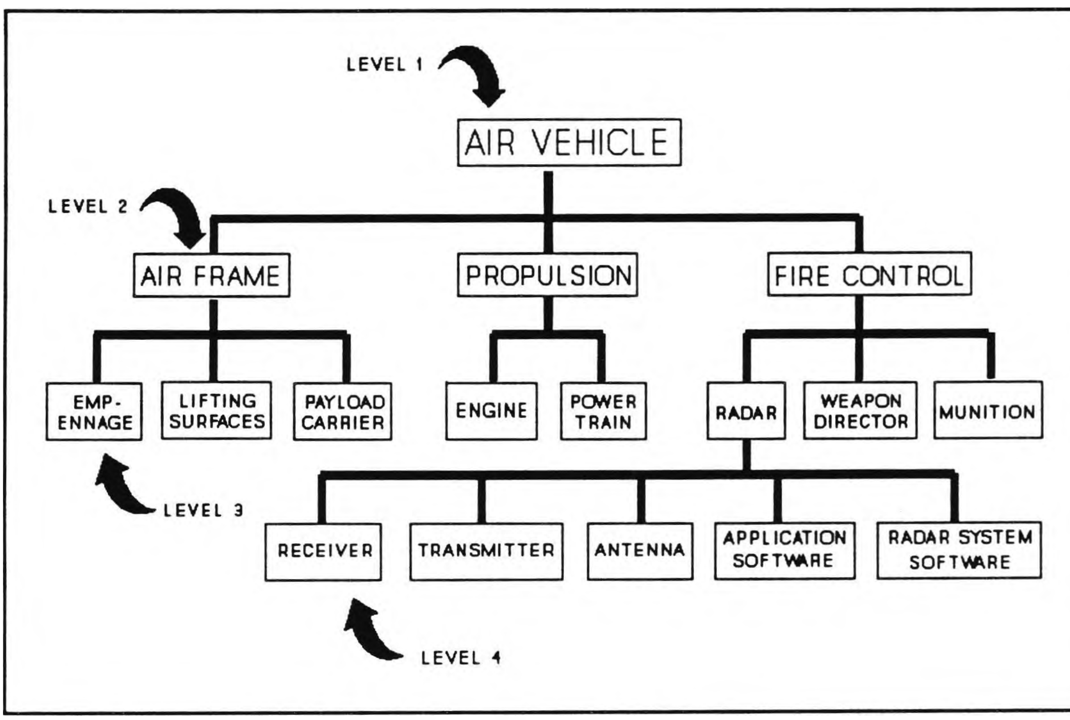
One methodology used over the years to identify subordinate structures which aggregate to form larger entities is the methodology of "decomposition": analyzing the meta-structure to define component parts and the relationships between them which create a higher level entity. Those who would perform decomposition must be mindful of Ackoff's injunction [132]: One does not gain system understanding by decomposing it to define its parts and then seeing how the parts function. System understanding comes from observing how parts function within the system. Within the DoD (and therefore within its supporting industry) the acceptable functional decomposition process has been institutionalized. A system is decomposed in steps by defining the components within it using a system representation called a "***Work Breakdown Structure***" (WBS). The technique is described in detail in two Military Standards: MIL-STD 499B [133], "Systems Engineering"; and MIL-STD 881 [134], "Work Breakdown Structure". The reasons why a WBS is mandated are stated in Department of Defense Instruction (DoDI) 5000.2 as follows:

"The WBS Shall:

- Display and define the product or service to be developed;
- Relate the elements of work to be accomplished to each other and to the end product;
- Be displayed as a product oriented family tree composed of hardware, software, services, data and facilities which defines the total program (MIL-STD 881B);
- Be developed for each program and each individual contract within the program."

The basic purposes for providing a WBS are: to provide a road map for managing the program in a sensible manner; and to generate a structure which permits creating and assigning multi-disciplinary product teams. In one sense, a good WBS provides a product tree for technical efforts. The tree is useful for establishing "system component" type interfaces between system elements, for assessing risk if interface requirements are not met, and for conducting technical reviews of progress. The methodology which generates work breakdown structures is multi-purpose: it can be used to detail a large weapon system such as an aircraft, and it can provide a useful framework which can help visualize how performance of many functions included within a system must be structured in order to perform a complex function.

Figure 4-1 (adapted from MIL-STD 881) is a work breakdown structure for an aircraft weapon system showing the various sub-systems of which it is comprised.



WORK BREAKDOWN STRUCTURE

(Adapted from MIL-STD 881 [15])

Figure 4-1

In Figure 4-1, the term "Level 1" refers to the total aircraft weapon system. Figure 4-1 shows a generalized air vehicle system having three components: the airframe, a propulsion system, and a fire control system. Each of these subordinate, component systems is considered to be at "Level 2". Further, each subordinate system can be decomposed into its component subsystems; each defined to be at "Level 3". The fire control radar subsystem is decomposed into 5 component elements which are at "Level 4". Many additional levels of detail can be accommodated by continuing decomposition until ultimately, an individual part of a sub-system (for instance an individual screw or bolt) ends the structure.

The WBS process shown in Figure 4-1 is a linear analytical process which decomposes major systems into their subordinate components until eventually, the smallest elements which make up the system have been accounted for. Work Breakdown Structures provide one-dimensional system visualization by defining relationships between the whole and its structure of subordinate parts. In Chapter 7, those functions involved in performing each of the large aggregate functional blocks set forth in Figure 2-1 will be derived using the WBS methodology.

The WBS presentation defines work packages and provides a management tool to generate information for currently used accounting practices. But WBS presentations do not: (1) make clear (or visible) the multitude of interface functional relationships between system components; (2) help us visualize or understand interactions among sub-systems which must work together in order for the complete system to function; (3) help us understand how change to individual system components can affect total system performance. Many more dimensions must be added to a WBS methodology to achieve those objectives.

The WBS structure is a point of departure for defining interfaces between elements (both major and subordinate level) of a complete system. Lacking the knowledge of which system components interface with each other forecloses the definition of interface characteristics essential to successful complex system design. The concept of interfaces and their role in system design and analysis will be discussed in detail in 4.2.4. below.

4.2.2 Enterprise Modeling using The "Industrial Dynamics" Type Methodology

Jay Forrester's book "Industrial Dynamics" [135] presented a set of concepts which stimulated a break with modeling tradition. Forrester traced model structures from those of "work simplification" developed by Frederick W. Taylor [136] to put "scientific management" in place; through "statistical process control" models pioneered by Juran [137] and others, and emplaced in Japan by W. Edwards Deming [138]; to "operations research' models developed (if not fathered) by Churchman and Ackoff [139]. But Forrester was critical of them because he said "trying only for an optimum solution often results in simplifying the problem until it is devoid of practical interest".

Forrester conceived of models which focused on processes. Models which would not provide exact solutions but would rather act as laboratories for investigating the dynamic system characteristics. "Look less for predictions of ***specific actions*** and more for enhancing our ***understanding of the inherent characteristics*** of the system. To construct such a "dynamic model" one must understand the organizational structure, the policies and practices which govern the functions within the system, and the delays in decisions and actions which occur.

According to Forrester's concept, the object is to model the enterprise. To design an enterprise requires (1) understanding the enterprise goal, (2) describing the situation, (3) devising a mathematical model, (4) using the model to simulate enterprise operation, (5) interpreting observations of its response, (6) revising the system, and (7) continuing, repeated experimentation. Achieving those objectives requires the model to incorporate within its structure (or otherwise account for) everything which might influence the model behavior: technical, legal, management, economic, psychological, organizational, monetary and historical factor information. Facets of verbal description which make the situations understandable should also be included.

Forrester has some caveats: he warns that (1) systems are constructed internally in such a way that they create for themselves many of the troubles that are often attributable to outside or independent sources; (2) measures for all variables should be in the same units as real variables; e.g., flows of goods (units) should be measured as units ***not as equivalent dollars*** because dollars do not capture the whole within which things are embedded (e.g., capture psychology of thinking about goods flowing into warehouses rather than dollars flowing into cash registers); (3) one needs to know what causes information distortion which can affect the system. Some causes he posits are prejudice, past history, integrity, hope and internal political environment. Error, random noise, unknown external perturbations (exogenous events) also play a part.

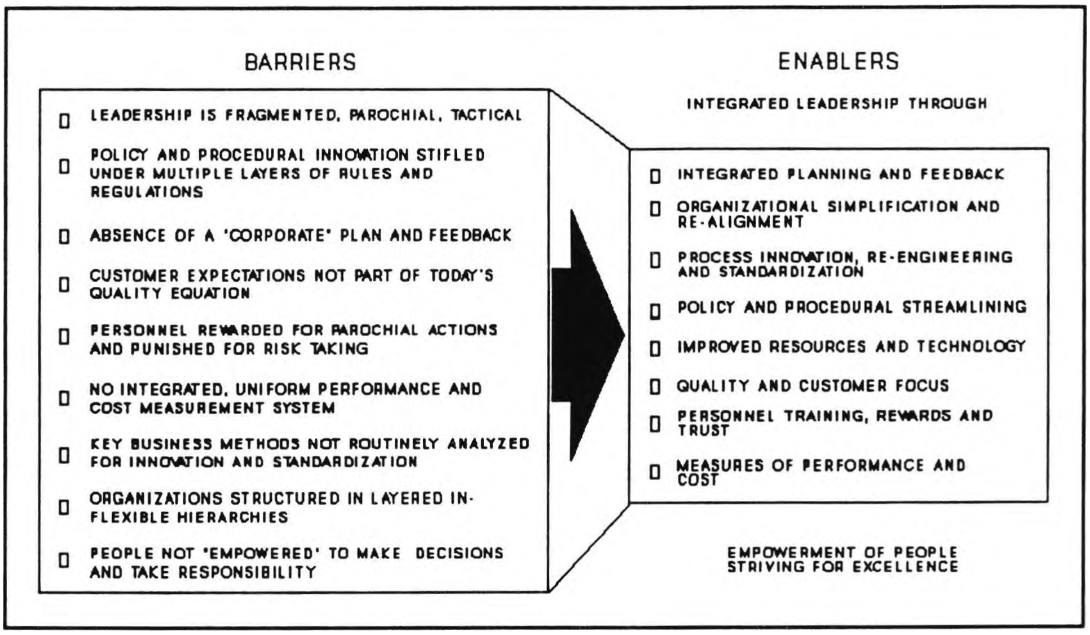
Clearly, information is the fundamental building block of dynamic system modeling. Just as clearly, the information generated within the Department of Defense about acquisition undertaken for defense is a basic resource to conceive, formulate, build, utilize and refine useful representations of the DAS. The Deputy Secretary of Defense in the Bush administration (Donald J. Atwood) had come to government service from industry. While an executive of the General Motors Corporation, Mr. Atwood had presided over the institutionalization of an information generating and distribution system. The General Motors' ***Corporate Information Management*** system (CIM) was credited with helping General Motors' management re-structure that corporation successfully. One of Atwood's first actions upon becoming Deputy Secretary was to promote establishment of a Defense Corporate Information Management system within the Department of Defense [140]. Atwood also began to use the term "Enterprise Model" to describe the kind of analysis he required of defense executives. Atwood was attempting to change the DoD management paradigm.

During the course of Atwood's tenure, a major reorganization was completed within the Department of Defense and the position of Deputy Assistant Secretary of Defense for Information Management was established within the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence.

Steven Kelman [141] has said "public officials cannot use common sense and good judgement in ways that would promote better...performance". When the Clinton administration took office, it immediately increased emphasis on orchestrating a paradigm shift which would act to broaden opportunities for defense officials to be innovative. The enterprise modeling technique would be used to re-engineer government to promote that end. The desired objective was to "remove barriers and enhance enablers" to achieve outstanding individual performance. The key barriers to and enablers of change shown in Figure 4-2 are adapted from the DoD Enterprise Model Volume I [142].

To devise mechanisms which would permit removal of barriers and creation of enablers, the DoD management created an analytical tool called the "DoD Enterprise Model". DoD's enterprise model regards each activity within DoD (an "enterprise") as a process capable of improvement through functional analysis. A guide to using the technique has been issued and is in current use. The guide will help guide decomposition of all defense activity into a set of singular process representations. The concept is:

- The CIM provides a mechanism for: (1) "Top Down" management of defense improvement; (2) cross functional integration of process, data, and information systems, (3) standardization of processes and practices across the Department,



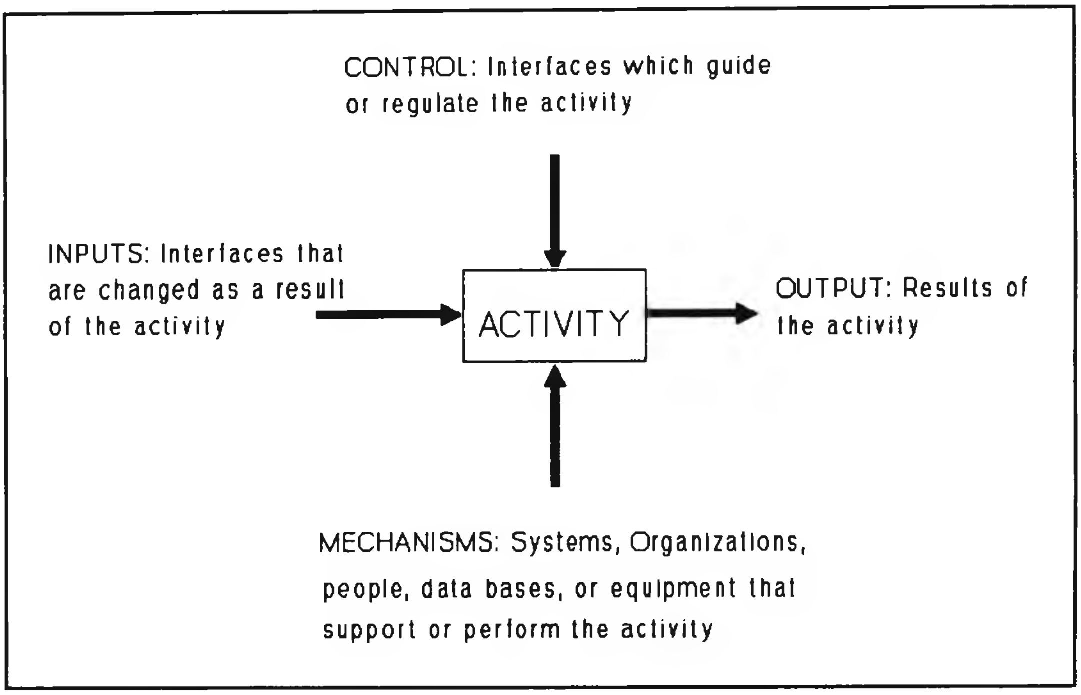
KEY BARRIERS TO AND ENABLERS OF CHANGE
(Adapted from DoD Enterprise Model Volume 1 [142, 19])

Figure 4-2

(4) application of process re-engineering and functional process improvement, (5) central guidance and direction of information systems development and services using a standard DoD system architecture, data element set, method and tools.

- The Enterprise model is a guiding framework for all functions. It provides a common understanding of all defense activities and data for all DoD leaders and managers which enables them to integrate processes, data, and system. Implicit in the Enterprise model are four activities which contribute to all the processes: (1) Establish Direction - provide strategic vision, goals, objectives, policies, strategies, requirements, plans and programmed resources; (2) Acquire Assets - obtain products, services and people needed for the process; (3) Provide Capabilities - integrate assets into the organizations and units which are then developed into ready process capabilities; (4) Use the Process - use the process to perform its functions.

Enterprise modelling very closely follows Forrester's techniques. It also integrates an approach derived from computer aided manufacturing methodologies. The resulting model structure is recognizable as basic Forrester but with an automated set of algo-



AN IDEF ACTIVITY MODEL
[Reproduced From [142] DoD Enterprise Model]
Figure 4-3

rithms which enables model construction automatically once answers are provided to a set of relational questions. The following excerpt from the DoD Enterprise Model [142], Volume 1 Page A-2 explains:

> "The enterprise model was developed using the Integrated Computer-Aided Manufacturing Definition modeling approach (IDEF)." Figure 4-3 (shown on Page A-3 of [142] as Fig A-1) shows basic IDEF activity model elements. "The activity itself is 'what is done'. Its interfaces are depicted as arrows entering or leaving the activity box. As in other modeling methods, <u>inputs</u> enter from the left and <u>outputs leave from the right of the box</u>; the activity transforms inputs into outputs. Arrows entering at the top are <u>controls</u> they provide direction and constraints. Typical controls in the DoD are policy and guidance. Arrows entering from the bottom are <u>mechanisms</u>. Mechanisms represent the means used to perform the activity. For example, an information system is a mechanisms.
>
> "From the basic construct" of Figure 4-3, "an activity model of an enterprise

is developed through a top-down process of decomposition. The fundamental mission of the enterprise is established as the first activity. This activity is decomposed into subordinate activities, whose interfaces must be consistent with those in the parent entity. Successive levels in the model are developed in the same way, until it is judged to be sufficiently detailed to allow for identification and analysis of potential areas for improvement.

"An activity model is developed within a context and from a particular point of view. These help establish the boundaries for analysis."

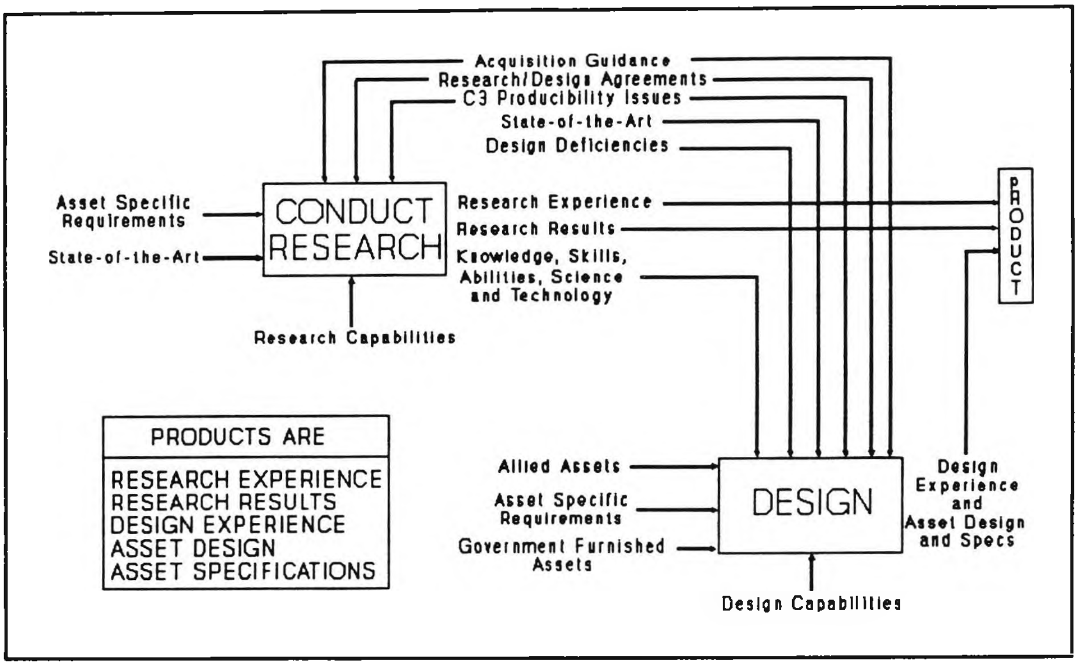
An example of how the enterprise model is to be used will help understand how barriers affect the specific activity and how enablers can be devised which will overcome the barriers. The discussion below is for the processes of research and design, two of functional groupings within the first step of the DoDD 5000.1 acquisition process shown in Figure 2-1.

Figure 4-4 (adapted from Page A-3 [142]) shows the IDEF model for research and design. In this context, research is defined as ranging: "from basic research to advance scientific knowledge to demonstration/validation efforts to prove the value of system technology". Design is defined as "the iterative process of developing designs that specify the form, fit, and function of assets".

As stated, the product of this particular model is at a very high level of ***abstraction rather than aggregation***. The abstraction results from provision of input, controls, mechanisms and outputs from "on-high"; derived from conceptualization rather than operational experience. To be accurate representations of the process, the model would need to be operated using aggregated data drawn from the experiences and knowledge base of those who must make the process operate.

It is the assumption of "top-down" direction which has led to much criticism of Forrester's work. To achieve benefit from this kind of dynamic model requires more expertise, breadth and depth of knowledge than is likely to reside within a single individual.

Several previous attempts were made to model the DAS using the IDEF type dynamic modeling concepts. In 1979, the U. S. Air Force Institute of Technology (USAFIT) encouraged two Master of Science degree students, Kaffenberger and Martin [143] to explore use of dynamic modeling "to assist DoD managers in understanding



ACTIVITY MODEL FOR RESEARCH AND DESIGN
[Adapted from Figure 3-4, Page a-3 [142])

Figure 4-4

the complex nature of the system and to identify the most important areas that are sensitive to changes in either structure or policy". Having built the structure, they concluded that (1) many variables outside the normal DAS structure (such as international political activity) influenced the system; (2) there were no quantitative relationships between many variables; (3) the amount of data required to operate the mathematical model was very large and much of the needed data was not obtained; and (4) that those in policy and decision positions did not analyze available alternatives in detail because they were occupied with other functions which were considered by their superiors to be more important.

Previous experience notwithstanding, during the period between 1987 and 1990, USAFIT again suggested that a dynamic model be used as a structuring methodology for a number of students pursuing advanced degrees. The underlying reason was the remark by the second Packard report about lack of progress in reform in spite of many recommendations which might achieve it. The conclusions of the previous work, that many variables outside the strictly defined boundaries of the DAS were inhibiting, suggested a further effort to define interactions between the DAS and its environment.

At that time, Forrester's methodology had reasonable credibility, and its application to the DAS by multiple individuals working separately might provide mechanisms to overcome stalled DAS reform efforts. Three documents referenced above ([101], [102], and [103] are attempts to invoke the dynamic modeling process to devise some practical policy changes which could facilitate DAS reform.

Work reported in [101] and [102] represents one body of research. Burgess and Clark [102] defined four sectors within the DAS: (1) a Defense sector, (2) an Industrial sector, (3) a National Sector, and (4) a Threat sector. A set of structures within these 4 areas was identified as having major influence on DAS activity. One structure involved Soviet defense expenditures, Soviet military capability, Soviet intelligence, Soviet gross domestic product, Soviet aggressive political behavior, and perceived Soviet military capability differential. A Basic U. S. National Sector involved spending and investment, savings and money supply; and other structures were evolved as well. In the end, 15 structures were identified as being embedded within the DAS. The second document by Burgess [102] reported detailed research to build the structure posited. The idea was to "(1) determine the nature of the decision process and information structure in the DAS; (2) develop a conceptual model of the system; (3) develop a computer based, policy-evaluation model; and (4) demonstrate the value of the models as policy analysis tools." In fact, the conceptual model could be understood only with difficulty and those interviewed about their reaction to the model tended to want a simpler kind of representation. Models should be simple enough to track what is happening. The parametric model which was exercised to draw conclusions about the effects of changed policy on the on each of the many variables included within the model provided outputs as time series values. Costs of producing a generic "weapon system" were the major element of concern. Although the claim is made that the model was validated, so many changes have occurred to each of the four major structural sectors between that time and now that whatever data was used is very likely to need change.

Spanier [103] attempts to integrate concepts drawn from "conflict science, organization theory, negotiation, social science, open systems theory, and transaction theory. The focus is on the processes that involve integration of interests...through transaction." Viewing lag in design schedules of system elements as a difficulty in resolving issues that arise while considering trade-offs between cost and performance and form, fit, and function provides a valuable perspective. Application of dynamic modeling in this case was expository rather than explanatory: there was no parametric construction nor was quantitative data required. The expository form permitted its use to examine a wide range of areas which have historically experienced difficulty during the acquisition process. Its major contribution was to reiterate the need to draw knowledge from many individuals within the DAS, and requirement to take sufficient time to understand their perceptions. The utility of Spanier's work lies in its suggestion that modeling complex systems should use methodology which encourages participants to arrive at common understanding of the objectives and mechanisms to achieve them thus ameliorating conflict arising from participants' differing perceptions, values, and individual objectives.

4.3 NON-INSTITUTIONALIZED METHODOLOGY OF PARTICULAR VALUE FOR DAS RE-DESIGN.

Two methodological approaches useful to understanding and managing complex systems are discussed: (1) the Interactive Management (IM) process developed by Warfield, and (2) the interface management concept developed by the author in separate publications.

4.3.1 Interactive Management: Aspects of importance to this work

Over the past twenty five years, Warfield's Interactive Management process has been presented in many publications: Warfield has published two annotated bibliographies of his papers ([144] and [145]), and he lists within those documents many other references in his Self-Study program development guides [146]. At the core of the process is the argument that the wisdom of more than one individual (at appropriate levels of capability) must contribute to the knowledge base to gain understanding of complex systems. As discussed in Section 3.1, understanding complex entities requires individuals having various perceptions of the system to interact: (1) individuals working internal to the system, (2) individuals who work within systems that interface with the system under examination, (3) individuals who are involved with multiple systems (including the one under examination), and (4) individuals who, while not directly involved, either exert influence on the system or exercise control over other systems which interact with it. To achieve the diversity of contribution, a group investigating a system is formed. It is composed of between eight and up to 15 individuals (in special cases) within one or more of the enumerated categories.

Once assembled, the group is brought to focus on a particular system aspect. Great care is taken to ensure that everyone in the group understands the focus and why that focus is appropriate: *the context of the investigation*. Because initial, and continuing agreement about the group objectives and how the group will focus on the problem is necessary to productive group activity, it is usual for a group to discuss, and possibly alter, the group focus based on their aggregate experience and understanding of what the system represents and how it works in practice. Changes to focus are acceptable if they: (1) enhance agreement about group objectives, (2) eliminate mis-understandings about the environment within which the system under study operates, and (3) increase group assurance that the issues to be addressed are crucial to the work's success.

The IM mechanism includes many of the elements embedded within conflict resolution theory. The way IM elicits contributions from each participant promotes formation of group wisdom. The IM practice of eliciting one contribution from each participant *seriatim* and ensuring that all contributions are recorded without critical comment prevents initial discord caused by lack of understanding. The IM practice of clarifying each contribution's meaning to insure that every participant understands what is meant can defuse most potential conflicts. The opportunity afforded all participants to "keep talking" until everyone understands completely is fundamental to success in focusing on issues rather than personalities.

Applying IM methodology facilitates: (1) deriving system structure and structural characteristics and problems, and (2) defining potential problem solutions in terms of actions to be taken and their sequence. Voting to determine the relative importance of each contribution to achieve group objectives provides for breadth of content by encouraging selection of ideas felt most necessary to determining system structure. Voting also tends to limit conflict opportunity: the result is clearly a group result. Thus an agreed upon set of contributions can be brought forward and other contributions can be aggregated appropriately within that set. When the process has been completed, participants recognize that their contribution has been fairly considered, has been grouped with contributions having similarity of meaning and intent, and is thus included within the group understanding. *Participants perceive their contributions as meaningful.*

The IM structure-building methodology, *Interpretive Structural Modeling (ISM)*, also provides opportunity for discussion; a continuing process of clarifying the meaning of contributions, and for examining potential relationships between elements of a structure. The process ensures that all individual judgements are consolidated within the group and that a consensus is reached about any relationships developed among contribution groupings.

Using the IM processes emphasizes achieving participant agreement. Agreement is crucial to validate the group work. Because of the nature of the work undertaken within DoD, and because the mind-sets of individuals who do the group work represent the spectrum of perspectives described in Chapter 2, consensus is taken very seriously at DSMC.

Four "levels of group agreement" are defined: (1) ***unanimity*** is reached when 97% to 99% of the participants are in agreement about a relationship; (2) ***consensus*** is reached when 67% to 97% agree; (3) ***majority*** is defined as 50% plus one vote, and, (4) ***fractionation*** has occurred if less than 50% of the participants vote for each of the available alternatives.

Participants are told that achieving high level consensus or unanimity is necessary. Generally, discussion continues until that happens. The minimum acceptable level of consensus is defined by group size. Generally when more than two individuals dissent on any issue, it is flagged for continued work. At the end of the group sessions, no issue is left unresolved, even if the resolution is an agreement for some to disagree with the consensus. Chapter 8 contains a more complete discussion of the levels of consensus in the context of cultural effects on system perceptions.

A great deal of IM's value lies in its ability to apply a consistent methodology to numerous aspects of relational modeling. The same process is used to determine whether: (1) one suggestion, if implemented will help to implement another; (2) one action should be completed prior to, concomitant with, or subsequent to another; and (3) individual contributions or aggregated groups of contributions should be combined into a single entity.

In many respects, Warfield's IM methodology has important points of analogy to the "standard meter bar":

- Like meter bar, *the analysis technique is unchanged across time and space*. The methodological approach is consistent regardless of the characteristics of the complex system under review.
- *Relational structures* which emerge from IM activities have been *derived in accordance with a set of invariant mechanisms and validated by participants*.
- Because *methodology is consistent*, changes observed in system elements or relationships derived in subsequent IM activity about the same system are likely to result from change to system operating environment or system characteristics.

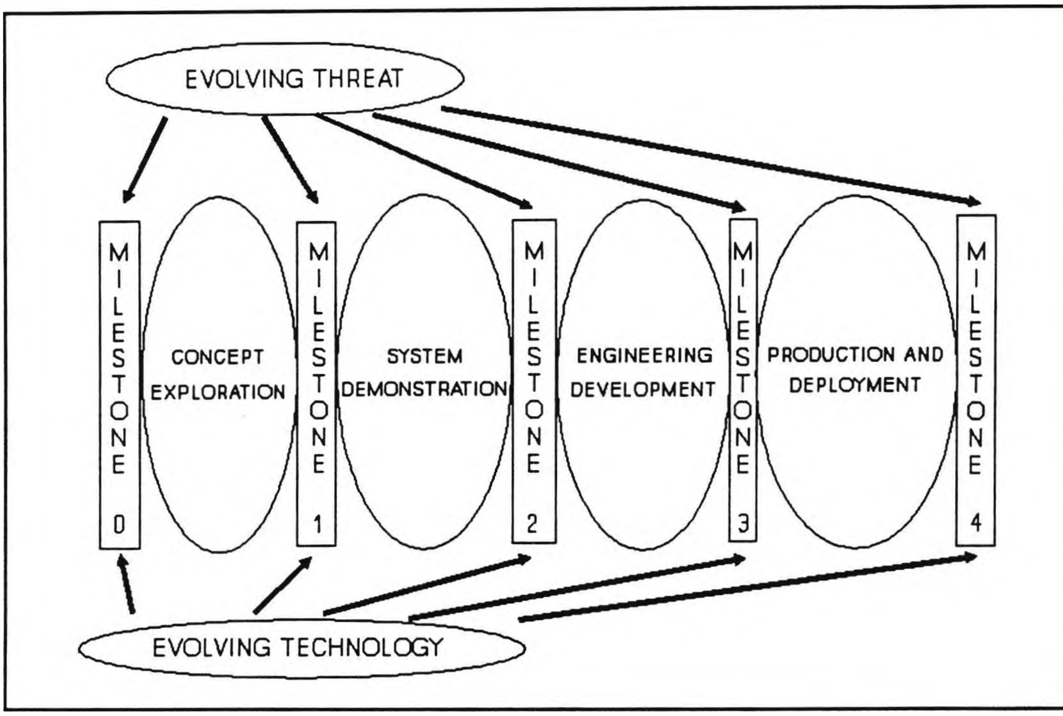
There are corollary benefits to use of IM which have parallel in use of standard measuring tools in general. *IM Practitioners need not have expertise in the system under study per se*. They need only develop expertise in application of the IM methodology. Additional capability to understand relational structures and to sense when a derived structure is improbable representation of a system is helpful, but not mandatory. *The environment within which the practitioner works can be defined to achieve best possible outcome with least possible participant discomfort*.

The IM methodology has been developed to exploit human characteristics and capacities. Because the methodology interfaces well with human beings, *IM promotes understanding of complex systems rather than driving to suggested quick-fix problem solutions which are not based on such understanding*. Because IM methodology is designed to be consistent with well-documented, relatively stable knowledge about human capabilities, and because it can be applied in a consistent manner across many problem foci, it seems likely that IM will continue to provide a useful investigative methodology for complex systems over a relatively long period of time.

4.3.2 System architecture and interface management

Warfield has embedded a methodology within the IM process for representing functional relationships which characterize complex systems. That capability is most important to DAS re-design.

One point of general agreement among everyone who has studied complex systems is the need to define, in detail, appropriate interfaces between the entities which integrate to form a system; and between the environment within which the system operates and the system itself. Figure 4-5 is a modified view of the weapon development process showing both internal and external interfaces. Figure 4-5 shows a number of major interfaces:



INTERFACES BETWEEN DEVELOPING WEAPON SYSTEM AND ITS ENVIRONMENT

Figure 4-5

(1) Milestone 0 is the interface which considers: the military need to perform some set of military activities, the state of technology; and potential system designs which will use the technology to provide a system with the required performance. If the proposed systems do not appear capable of meeting required system performance, there is no approval to explore any concept further.

(2) Milestone 1 is the interface which considers the concepts which have been explored and re-evaluates them against the continually changing threat. A judgement is also made about the state of technology which has become available. Milestone 1 is the interface which indicates whether change to system concepts is warranted.

(3) Milestone 2 provides for demonstration and preliminary testing of alternative systems which have been developed to prove different system concepts. There is another review of military needs and technology states-of-the-art. The purpose of this interface is to demonstrate that a system design has been (or can be) ach-

ieved that, with further engineering, can be made suitable for production at reasonable cost.

(4) Milestone 3 is the interface at which the production-engineered system is evaluated for full production (manufacture) in medium or large quantity; and for deployment to forces in the field. Once more, both the threat and the technology are reviewed in light of the system which will be produced and deployed to ensure that no changes are indicated to the existing system design and production planning.

(5) Milestone 4 is the interface at which performance of the deployed system is compared with the state of the threat and with the state of technology to determine whether the system needs improvement or replacement. Usually, limits of improved system performance to the existing configuration are compared with estimated performance of new kinds of systems which might be developed to judge the economic value of a new development.

Moving beyond interfaces requires demonstration that going further is desirable. The most obvious kind of measure is derived from carefully structured system test goals. For example, showing that an item should be produced in quantity and deployed to the forces usually requires the test item to have performed to a set of measurable standards over a pre-determined length of time while experiencing not more than some previously established number of problems that precluded its operation as specified.

Unlike the mechanisms in place which permit evaluation of contemplated future actions to be taken during new weapon system development, there is no existing mechanism which permits test of suggested changes to the DAS in advance of making the change. The purpose of dynamic modeling was to generate models which might permit those kinds of evaluation. But because of the problems stated by Kaffenberger and Martin (see page 79) the process of building such models becomes an indirect linkage due to the requirement to guess about the effect that change will have on quantitative parameters. A potential mechanism to permit estimating the likely result of making a change is to structure the system to be accepting of change within some reasonable limits. Systems such as aircraft, ships, and other kinds of weapon platforms usually permit some change to the weapons they carry without the necessity for system re-design and re-engineering. The means to achieve tolerance for variability in interface parameters is to employ a system architecture which clearly specifies interface values of form, fit, and function. Used here, *Form, Fit, and Function* are defined by Webster's Ninth New Collegiate Dictionary as:

Form - the shape or structure of something. (P. 485);

Fit, - adapted to an end design. (P. 467); and

Function - the action for which a thing is specially fitted or used. (P. 498).

In engineering, it is relatively straightforward to determine interface specifics.

- The WBS is used to define major system components at level 2 and below until a clear set of hierarchic representations has been derived for all system elements;
- System components would be appropriately placed within a system boundary so that the system package geometry can be carefully defined;
- A functional system model would be constructed so that the relationships between system element characteristics at the interfaces become clear; and finally
- The information needed to control the values of *form, fit, and function* at the interfaces would be developed to permit definition of the protocols and formats involved and the information refreshment rates necessary to manage the complex system within a changing environment.

Together, these differently defined, but complementary views of a complex system can provide the insight necessary to construct a system design, development, and management mechanism. The key is to establish clear functional relationships. Great care must be taken in aggregating all the information: a successful complex system development requires an integrated approach in creating, developing, and managing system activities. Simply getting the information required will not suffice.

To follow the example of the Aircraft system, Figure 4-1 indicates that the Radar portion of the fire control system at level 3, is composed of 5 component elements: (1) A receiver unit; (2) A transmitter unit; (3) An antenna which broadcasts the transmitter unit signals and receives echoed signal returns from targets; (4) A set of software which operates on the radar signals whose products are signals which drive the settings of the weapons produced by the (5) application software. All of these component units interact with each other. The actual set of relationships has to do with:

(1) signal strengths provided to the antenna by the transmitter for transmission in search of targets; (2) strength of signals arriving from targets at the antenna for processing by the radar system software; (3) signal strengths and repetition rates fed to the transmitter from the radar system software; (4) signal characteristic returns as compared with transmitted signals by the application software and used by that software to direct weapon settings, target lock-on and weapon guidance, and to generate aircraft flight vectoring information. A matrix can be constructed which indicates the relationships between the signal levels of all of the radar system components showing sets of values which must be achieved if the radar is to operate properly. Table 4-1 shows such a matrix.

RADAR SYSTEM COMPONENT	RANGE #1	RANGE #2	RANGE #3	RANGE #4
RECEIVER	x_{111}-x_{112}	x_{121}-x_{122}	x_{131}-x_{132}	x_{141}-x_{142}
TRANSMITTER	x_{211}-x_{212}	x_{221}-x_{222}	x_{231}-x_{232}	x_{241}-x_{242}
ANTENNA	x_{311}-x_{312}	x_{321}-x_{322}	x_{331}-x_{332}	x_{341}-x_{342}
WEAPON SOFTWARE	x_{411}-x_{412}	x_{421}-x_{422}	x_{431}-x_{432}	x_{441}-x_{442}
RADAR SOFTWARE	x_{511}-x_{512}	x_{521}-x_{522}	x_{531}-x_{532}	x_{541}-x_{542}

RADAR SYSTEM COMPONENT PERFORMANCE BANDS PERMITTING REQUISITE RADAR SYSTEM OPERATION

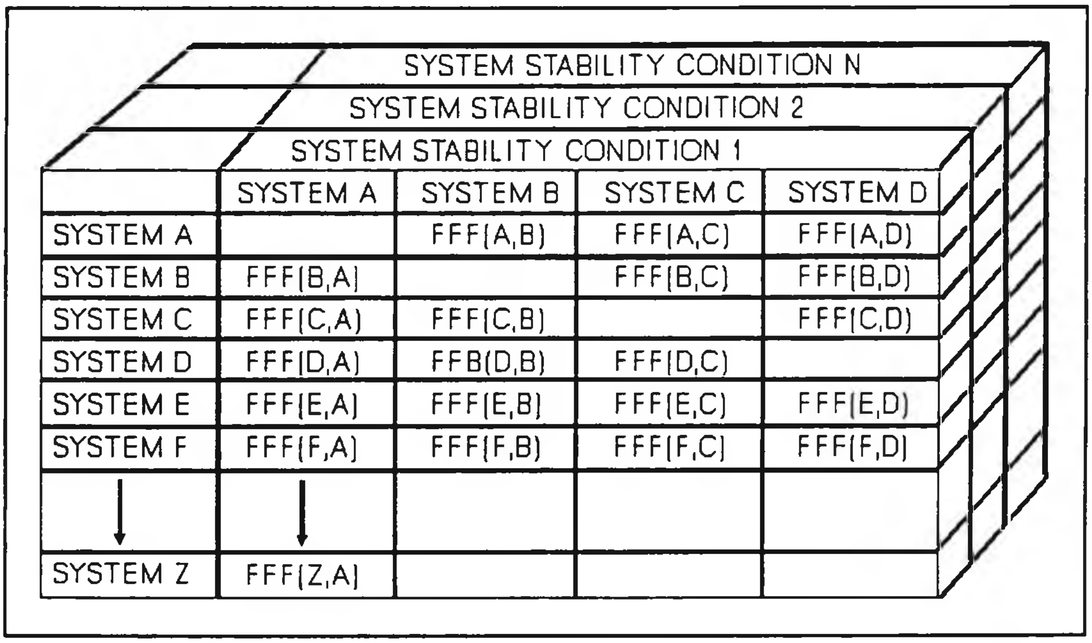
Table 4-1

In Table 4-1, all subsystem interfaces are described by bounds for operating values which change as other subsystem's interface values change. There is a range of values for each subsystem which, when achieved, will permit the system to perform at the desired operational level. That is, the total system will operate within its desired performance envelope if the Receiver operates within the boundary values x_{111}-x_{112}, the Transmitter operates within the bounds x_{211}-x_{212}, the Antenna performs within the range x_{311}-x_{312}, the Weapon software maintains its operating values between x_{411}-x_{412}, and the Radar software operational values stay within the band x_{511}-x_{512}. Another way to say this is to invoke the venerable concept of apportioning acceptable variances in system operating capability among all subordinate systems. The values required of each subsystem depend on the values required of all other sub-systems. The sets of common values which provide system operational stability vary: there are a number of value sets which can achieve it. Table 4-1 indicates 4 sets of ranges (Range #1, Range #2, Range #3, and Range #4) which if achieved will permit acceptable system operation. If any subsystem's operating values fall outside the range of acceptable performance, overall system performance will also fall outside acceptable limits. Table 4-1 indicates only one set of interface values (signal level). In Table 4-1, all subsystem interfaces are described by bounds of operating values which change as other subsystem's interface values change. If any subsystem's operating values fall outside the range of acceptable performance, overall system performance will also fall outside acceptable limits. There are, of course, three sets of values at each interface: Form, Fit, and Function. Further, each subsystem may interface with a different set of subsystems depending upon the operating conditions experienced. Therefore, a complete interface presentation would require definition of: (1) Sets of sub-system interfaces for each operating condition; and (2) values for form, fit, and function on each side of each interface.

If one were to generate the complete set of conditions which permitted system stability, they would represent the operating envelope of system integrity.

Figure 4-6 is a notional presentation of such an interface set. It indicates that there can be a multiple number of relationships between all sub-system form, fit, and function (FFF) interface values; and that the system can operate satisfactorily provided those values are achieved simultaneously. There is likely to be great difficulty in defining numerical values for each of member of the set, and maintaining them current as situations on either side of the interfaces change over time. As can be seen from Figure 4-6, the relationships between system components may also change over time. Truly, the problem of determining numerical values which accurately represent cause and effect relationships within a complex web of interfaces can be extremely difficult. It is perhaps for that reason that many predictive performance models used in Defense acquisition management do not attempt to define interfaces or derive ranges of values. Rather, what Forrester cautions against doing, is done: relationships are found between measurable surrogate entities and previous outcomes.

Proponents of system dynamic modeling recognize the need to vary system parameters. But parameters in that instance refers to changed numeric values for ranges



INTERFACE FORM, FIT, FUNCTION MATRIX

Figure 4-6

which variables can take on, or change in the frequency of occurrence of some value within the boundary of a range. ***As a consequence, the result of a change in functional structure must first be translated into a change in numerical values which the model uses to evaluate the result of those changes to the system as a whole. Any error introduced during conversion of structural change into numerical entries may affect the accuracy of model results.*** This problem will be exacerbated when all of the elements in an interface matrix are considered.

Two examples of this kind of management modeling are: (1) estimating cost to develop software; and (2) estimating the cost of building a new aircraft.

It was noted by software managers that the cost of developing software appeared to depend on the number of lines of code written. Both cost and lines of code were "measurable". A number of organizations developed models which permitted entry of the estimated lines of code to be produced and produced an estimated cost associated with that activity. The most frequently used model during the period 1991 through 1993 was the "Cost Constructive Model" (COCOMO) model developed by Boehm [147]. A version of "COCOMO" is available for free use on personal computing machinery (486SX, 2MB RAM configuration).

During the summer of 1993, the author worked with the Defense Advanced Research Projects Agency (DARPA) in an attempt to define both engineering and management practices which would reduce the cost of aircraft development by 50% (see 3.3 above). In connection with that effort, the Office of the Comptroller, U. S. Navy, reviewed the cost of developing Naval aircraft weapon systems for the period between 1972 and 1991 [148]. It was found that the cost of aircraft was related to aircraft weight. A major difficulty is achieving that goal centered about the wide credibility given to the "weight-cost" relationship model. Focus on cost reductions fixed on weight reductions quite early on. Unfortunately, it quickly became apparent that weight reductions would require use of rather costly materials. Thus the apparent cost savings from weight reductions indicated by the model were more than offset by material cost increases. Notwithstanding, the model was still in use to estimate cost of ongoing development activity as late as October, 1994. The model is run on Navy personal computing equipment (386, 486SX, 1MB RAM configurations).

A problem with using parametric relationships to attempt understanding of trade-off possibilities is that detailed knowledge of particular causes and effects are not normally derivable from such models; nor are any routinely used for management purposes. Mechanisms use form, fit, and function information to produce ranges of acceptable values for each sub-system, component, and part at any interface being examined.

One major problem in determining the total set of system interfaces and the form, fit, and function values required of the sub-system elements which intersect there is involved with time. In most cases, it will take longer to develop a complex system than it will for change to occur to one or more system elements or to the environment within which the system is developed and to the environment within which it must later function. Specifically, what happens if, under changed conditions, one or more interface condition(s) cannot be met? For instance, if the requirements for overall system performance envelopes are incompletely defined at the time development begins (the perception of the enemy changes)? Or suppose that there is a rapid technological change which affects the way in which Defense activities are performed (electronic communications are used for all program transactions and integrated computer data bases are required)? One can postulate a number of situations which might create difficulty for system designers, developers, or managers when a system takes a long time to modify, and its use must last over a long time period that is characterized by rapid change to elements of the system itself, or to the environment within which the system functions.

In the process of redesigning DoD's acquisition system, a methodology for dealing with interface change was developed. It is embodied within a process that was entitled "Evolutionary Acquisition". As a first step those particular elements (of the system and its operational environment) were defined which were thought to have strongest affect on the acquisition decisions program managers normally make. The listing below is taken from that work, but is made specific to the current discussion. It is not meant to be exhaustive: rather it is only a beginning on the path to development of a more complete set of circumstances under which interface management activities can become quite difficult. There appear to be three situations which should alert system designers that their careful attention is required. When any of these situations occurs, there is very likely to be difficulty in devising a system which will fulfill the expectations stated as design goals. Specifically;

(1) When required system boundaries (operating envelopes) are so vaguely defined that a complete set of detailed interface specifications cannot be developed.

It is often impossible to specify a complete range of interface specifications which define limits for satisfactory system operation for every interface contained within the system. This is particularly true when the definition of satisfactory performance is vaguely stated, or is stated in terms of a surrogate variable (such as dollars expended per acquisition end product as opposed to time limits to complete the entire acquisition process).

(2) When decision sequences are complex and cannot be defined well enough to establish interface specifications.

This situation is most often experienced when system operation will require intricate logical analyses to define a series of events, decisions, or actions. Obvious examples are system elements (1) which interface with each other using software, (2) which rely on timely data collection and interpretation activities, or (3) are computationally intensive (serial decision systems often require completion of chains of steps involving several events before a necessary decision can be made). Making action choices can often depend upon the ability to project probable outcomes associated with them. When new operational envelopes are imposed which significantly change current systemics, hypothetical outcomes might have to be developed in considerable detail to select decision chains before performance sequences can be established.

(3) ***When necessary technology must be invented.***

Designing an electronic commerce (EC) based system to generate requests for tender and to receive proposals in response may not be within easy technical availability for many small business suppliers. Similarly, it is debatable whether current technology will support maintaining a totally electronic data base for all program data. Managing interfaces and keeping careful watch on changes to all system elements is a necessity to understanding the complexity which has been designed into any system. And just as it is often necessary to include points of measurement within a system to ensure that important information is produced routinely, it is very likely necessary to make data-reporting networks an integral part of the management system design structure. This is not often even considered when designing a management system.

4.4 REASONS TO SELECT THE INVESTIGATIVE METHODOLOGY USED IN THIS WORK

The methodology used to inquire into the DAS structure and dynamic behavior is required to accommodate three fundamental system attributes:

- **Multiple levels of aggregation.** As with almost all systems, the DAS has many levels of aggregation within its structure. The level of aggregation can range from that presented in Fig 2-1 to the detailed level of decomposition necessary to generate interfaces for the work breakdown structure that describes an air filter for the central air inlet duct of a DC-10 airliner (level 11 of Figure 4-1).
- **Multiple sets of system interfaces.** A set of interfaces between system component elements (items, functions, shapes, continuity) is present at every aggregative level. The basic interface structural descriptors of form, fit, and function need to be defined for each interface set. Once again, the methodology used should be capable of deriving the interfaces no matter the aggregative level
- **Rapid change to the system structure.** As public and Congressional percep-

tions of the DAS change, legislative and departmental actions are taken in an attempt to satisfy concerns which have come to the attention of the oversight and command elements. The Congressional enactment of many of the changes suggested as the result of work reported later in this document was the result of a coordinated effort. Although it was complex, the enacted legislation was a systemic approach to DAS reform. However, there is real concern that Congress will return to its traditional approach to oversight reform: i.e., will enact fragmented change, aimed at solving particular problems, without examining the effect of the change on the total DAS. Each legislated or directed change made to the body of rules and regulations which apply to the DAS has the potential to change both the system component entities which aggregate together and the interfaces between them. The methodology should be capable of exercise to determine "what happens if" any kind of change is enacted. The major concern here is with DAS changes "required" to maintain acquisition integrity under the changed set of circumstances, rules, and regulations.

How can responsible DoD officials advise Congress on the potential effects of change before that change is proposed? Ideally, the inquiry methodology used here should be capable of generating system understanding at whatever level of aggregation is appropriate. Similarly, the need to define and structure interfaces is common at any aggregative level. In performing the work reported here, the idea of using different mechanisms for different levels of aggregation was rejected. Rather it was felt that commonality of investigative methodology was essential if insights which resulted from the examination were to be credible. The need for commonality was reinforced by the need to maintain knowledge current during rapid change.

The Work Breakdown Structure methodology is useful mainly for managing physical system development. The decomposition approach generally permits defining what has been aggregated to form a particular entity. The Forrester-IDEF modeling technique is useful when relationships between entities can be quantified and continuity of relationships between the entities is maintained for periods long enough to define, construct, test, and iterate the model structure which results from this type of investigation.

Warfield's methodology of Interactive Management has some characteristics which are uniquely suitable for use in this examination. The methodology is flexible because it can seek understanding at any level of system aggregation; from the highest conceptual level, to the lowest level of equipment component design. Moreover, although those who participate in the inquiry are required to involve themselves deeply with the system, the time period of that involvement is short enough to permit frequent re-examination when change to the system or the environment within which it operates makes that necessary. IM contains elements of both the WBS methodology and the IDEF methodology. In fact, the fundaments of both methods of inquiry are integrated within IM. In addition, IM can define sets of conditions which must occur at interfaces between elements.

But even more important, Warfield's methodology is pertinent specifically to the process of complex system design. In defining and refining the IM process as a part of the "Science of Generic Design", Warfield focused on the problems of complex system design and sought to create mechanisms which would ameliorate them. Just as barriers and enablers to efficient Defense operations were enumerated for the DoD Enterprise as a whole in Figure 4-2, Warfield enumerated elements which inhibit design of complex systems and discussed characteristics within the Interactive Management process which would enhance the design process and overcome the inhibitors. The four groups of inhibiting mechanisms defined were:

- <u>Situational Escalation</u> [3,139]: "Situational escalation occurs because of the following factors, among others: (a) varying perceptions among members of the problem-solving team, (b) difficulty in managing group problem-solving efforts, (c) the presence of organizational or cultural constraints that suppress useful contributions to problem-solving, (d) difficulty of communicating solutions to implementers, (e) change in the problem situation with time, (f) lack of actors to fill new, needed roles, and (g) the difficulty of dealing coherently with some or all of the foregoing when they appear in combination."
- <u>Personal Cognitive Burden</u> [3,139]: "The individual may be thrown into a position requiring that the individual provide opinions and decisions for which the individual is not cognitively prepared. The common incidence of this situation and the expectation of performance even though appropriate bases for performance have never been developed in the individual, are part of the evi-

dence of mismanagement of complexity."

- Situational Detractors [3,140]: "There are...situational factors that are frequently present which detract from problem solving or design activity...and there are other factors that are absent in the situation which, if present, would enhance problem-solving or design activity."
- Personal Enhancers: [3,140] "Make available suitable conditions or objects or entities or other means or mechanisms for enhancing the capacity of the individual to be effective in a problem solving situation." The potential enhancements are listed as: (1) Effective group process, (2) Computer assistance to the individual mind, (3) Computer assistance to the group, (3) Display of unstructured information, (4) Display of structured information, (5) Storage of unstructured information for recall, (6) Storage of structured information for recall, (7) Capacity to structure information effectively, and (8) Organized dialogue.

In short, because IM is precisely designed: (1) to overcome the detractors and help system designers understand the problems and processes involved in any design, and (2) to develop alternative systems which will overcome difficulties and inefficiencies identified with the current system,

> ***Interactive Management methodology provides an integrated mechanism to derive system entities, their composite subordinate elements, and the characteristics of interfaces between elements. Further IM can help determine interfaces between the system and its environment. The IM mechanism can perform all aspects of inquiry required to re-design the DAS.***

But there was one significant difficulty: until the usage reported herein, IM had been mainly used either: (1) to address single issues in single sessions; or (2) to address issues in closely spaced sets of sessions. The author anticipated that the DAS re-design activity would: (1) extend over a long time period; (2) require that many different sets of participants be involved; and (3) involve individuals with fundamentally different perceptions of reality. Thus, the author believed, the IM methodology might have to be extended to accommodate the DAS re-design activity. In truth, the process was modified and expanded in order to permit accomplishment of the work reported here. The newly expanded process proved to be a most effective way of exploring concepts proposed for DAS re-design. Since its introduction, the new methodology has become the inquiry methodology of choice in many DoD and Service activity areas.

4.5 CONCLUSIONS REGARDING THE CHOICE OF INVESTIGATIVE METHODOLOGY

As was shown in Chapter 3, attempts to correct problems with the Defense Acquisition System have focused on fragments of the process. That focus made possible the use of investigative methodology unsuitable for complex system research. The discussion in this Chapter has examined four methodologies which have been used in managing complex systems or in looking holistically at the structure of complex systems.

- Two methodologies institutionalized within the Department of Defense were considered: (1) The Work Breakdown Structure methodology - a technique which decomposes complex systems into components and manages their development through configuration control; and (2) a variant of Jay Forrester's Industrial Dynamic methodology, (IDEF Modeling) which treats the system as a process and attempts to define structures and interfaces.

  Neither methodology had integrated within it a methodology for providing a holistic overview of complex systems in a disciplined way.
- Two holistic system analysis and design mechanisms were examined: (1) The Interactive Management methodology (developed by Warfield); and (2) A concept of Interface Management based on adapting to continuous change in system components and the environment within which the system must function (developed by the author).

It was clear that determination of relationships among system elements, and specifically the condition of each element at a myriad of system interfaces might only be possible by use of Warfield's Interactive Management methodology. Thus, the IM methodology was selected for use throughout this research effort.

However, it was also recognized that considerable time would be necessary adequately to explore the details of how the U. S. Defense Acquisition process interfaced with, and was affected by, the environment in which it operates. To use Interactive Management, three issues would need to be addressed: (1) how to select appropriate participants and provide for their involvement in the on-going work; (2) how to build an integrated data base from information derived in a series of workshops each of which examined one facet of a complex issue at a different point in time; and (3) how to integrate change to the highly politicized environment within which the DAS functioned (and was embedded) within the body of workshop knowledge developed.

Of specific interest in this regard: (1) Chapter 9 will discuss how the political environment and the perceptions of the Congress define the problems which continue to be associated with the DAS; and (2) Chapter 11 will summarize the extensions made to the IM process described in Warfield's own work and detail how the author resolved the problems of applying the IM methodology to the process of devising a redesigned DAS which better meets U. S. weapon acquisition needs.

CHAPTER 5
THE WORKSHOPS AND WHAT WAS LEARNED FROM THEM

This chapter: (1) Describes the context within which a series of Interactive Management workshops was undertaken; (2) Provides a chronology of the Interactive Management workshops conducted between June 1988 and August 1991 and indicates the purpose for which each workshop was held; (3) Groups workshops in accordance with the purpose for which they were undertaken; (4) Analyzes the workshop contributions within each workshop group; (5) Focuses on the knowledge gained; and (6) Presents relationships among defense acquisition system problems defined by workshop participants.

5.1 CONTEXT WITHIN WHICH THE WORKSHOPS WERE CONDUCTED

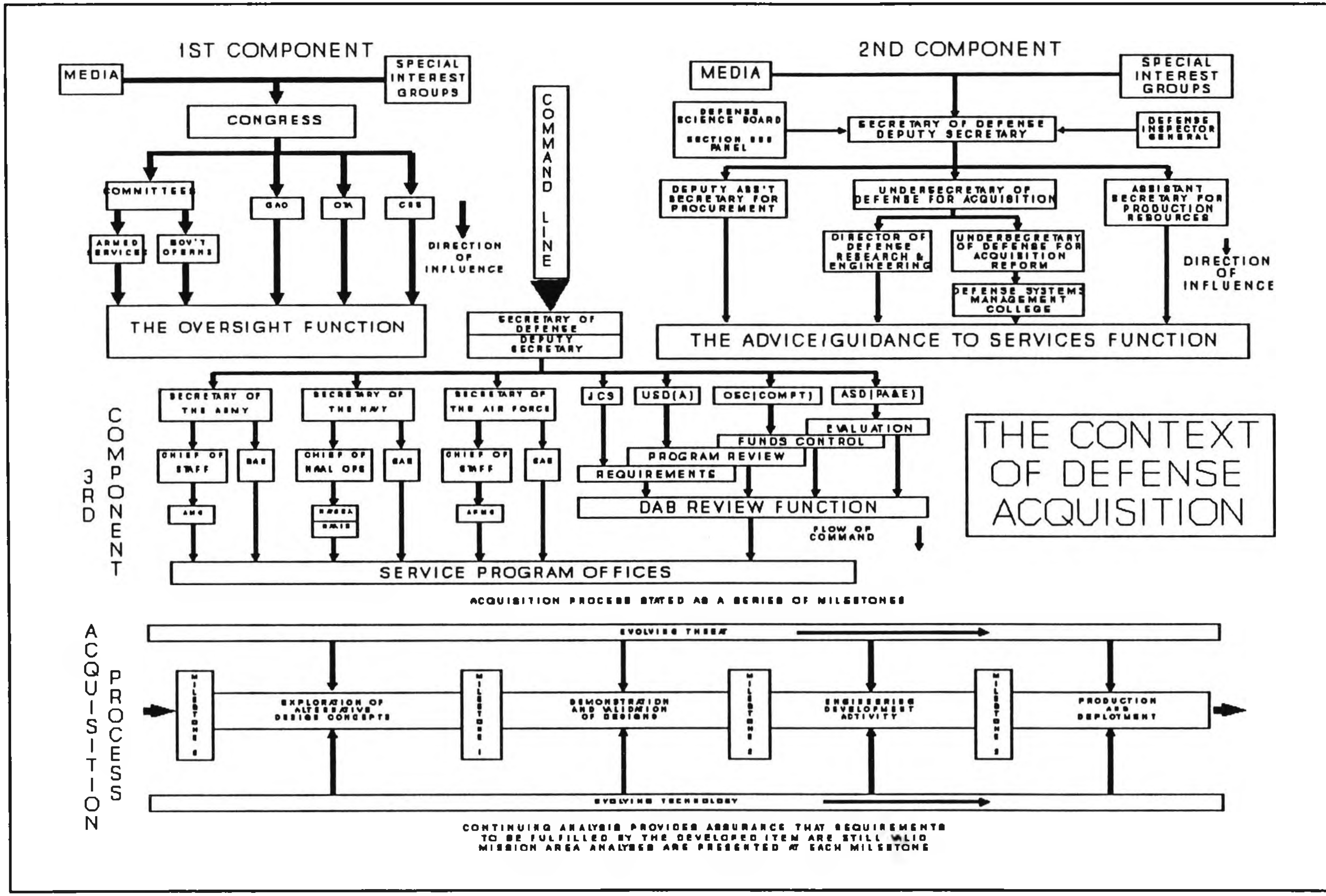
Chapters 1 and 2 discussed governmental entities which intertwine within the defense acquisition process. In this context, those entities are called "stakeholders". The word "stakeholder" describes any organization (and the individuals within it) engaged in (1) overseeing the acquisition process, (2) providing guidance to acquisition activities, (3) performing any acquisition functions, or (4) disseminating information about Defense Acquisition. Chapter 2 reviewed and analyzed literature produced by those stakeholders over the past 14 years to demonstrate their perceptions of the defense acquisition process and how well it functions.

Figure 5-1 is a consolidation of (1) The oversight function and how it affects the acquisition process (Figure 3-1), (2) The advice and guidance function exercised by Government entities within and outside the Department of Defense (Figure 3-2), (3) The chain of command and authority within the Department of Defense (Figure 3-3), and (4) The acquisition process as defined in DoDD 5000.11.

The purpose of Figure 5-1 is to indicate the complexity of the full panoply of relationships which lie under the umbrella terminology "The Defense Acquisition System".

Figure 5-1 helps to understand why any productive examination into the acquisition process, its problems, and suggestions for system re-design requires integrating the viewpoints of large numbers of individuals.

The state of the acquisition process is strongly affected by the perceptions of all entities involved with oversight, advice, direction, and execution of acquisition functions: all stakeholders play a part in how the DAS is structured, how rapidly that structure changes



CONTEXT OF DEFENSE ACQUISITION

Figure 5-1

and the direction taken by change. Recent history abounds with examples of Congressionally-mandated change brought on by changing perceptions of the integrity of people involved with the DAS (see Chapter 3).

Indeed, previous attempts at acquisition reform have lacked broad stakeholder participation. The narrowness of the group involved in previous attempts at "acquisition reform" may have mitigated against success. The activity reported here provided a disciplined mechanism for simultaneous: (1) examination of stakeholder viewpoints; (2) definition of the genesis of those concerns;, and, (3) generation of understanding both of the DAS shortcomings, and the shortcomings of organizations which support the acquisition functions. It was also the first time an attempt had been made to form an integrated product and process team (IPPT) with focus on defining how the DAS might best be structured.

Twenty eight workshops were held during a 39 month period. Table 5-1 provides: (1) The dates of the workshops, (2) Workshop sponsor, (3) General area of investigation, and (4) The focus question posed to workshop participants (where applicable). Most of the workshops were reported in detail in DSMC publications called "Technical Management Advanced Workshop (TMAW) Reports". Although each TMAW report is given as a reference, those reports are not widely available. Much of the information was provided under DSMC's "***NON-ATTRIBUTION***" rule, and the sources of the data are protected. Limited copies can be made available for brief periods. For a few workshops sponsored directly by the Undersecretary of Defense (Acquisition) or by the Director of Defense Research and Engineering (DDR&E), special reports were issued under their imprimatur and distributed by their office. In the case of Concurrent Engineering activity, a report and annexes were widely distributed throughout the Department of Defense, the individual Services and the defense industrial base. During the past three years, Concurrent Engineering has become institutionalized throughout the defense community as Integrated Product and Process Development (IPPD) and Integrated Product Team (IPT) organizational methodology. In fact, most DoD development programs are now required to organize themselves as stipulated in the Concurrent Engineering documentation reports.

Workshop participants were drawn from all of the stakeholder organizations and thus represented the full spectrum of perceptions and perspectives involved with the DAS.

The workshop sponsor sent a personal letter to the Commanding General of the major Defense command elements asking for submittal of *curriculae vitae* (CV) of individuals whom the Commander felt were capable of contributing at the level and to the depth necessary. When the CV had been received, the workshop director and the sponsor selected the individuals who would participate. Participants were generally quite senior individuals (Army, Air Force and Marine Colonels, Navy Captains, and highest level Civil Servants (GM-15's). In some instances, General Officers and Senior Executive Service members were requested. Industrial participants were usually Department or Division chiefs of large, major corporations; or executives (President, Vice President, or Directors) of smaller campiness. The Workshops were usually limited to not more than 15 participants.

During the period between June 1988 and August 1991, there were three instances when a variant in Interactive Management methodology was used. Workshops held to examine concurrent engineering definition, planning and implementation had more than 100 participants. After a plenary session, work groups of 15 to 18 individuals were formed to examine selected issues. When the smaller groups had finished their work, each work group selected a representative who then joined a smaller integration group. The integration group produced the final workshop product. The IM variant inquiry process was also used for two conferences which USD(A) John Betti sponsored during the course of his tenure (1990 to 1991). Betti's management style included assembling all senior managers once a year to discuss ideas and devise plans for the following year. The 1990 and 1991 Defense Acquisition Leadership Conferences (ALCs) used the IM variant described above. Because of the extremely confidential nature of these proceedings, the conferences are not listed in Table 4-1. In the discussion which follows, workshops will be grouped to reflect the subject of inquiry.

5.2 WORKSHOP GROUPINGS

5.2.1 Technical Management Functions (Workshops 1, 2, and 3 in Table 5-1)

The first set of workshops involved defining precisely what functions were performed by Defense program managers. There had been other studies made of functions performed by Program Managers. In 1980, the U. S. Naval Personnel Research and Development Center provided information to DSMC about tasks performed by service program managers; and other, less intensive studies had been undertaken for various oversight agencies within government (see Chapter 3 above). But there had been no holistic study of both tasks performed and the processes within which they were performed. The focus was on "what" was done rather than on "why". Thus the questions asked in the first three workshops: "What do Program Managers do", "Why do they do it?, and "How should it be done?"

In the first workshop, a myriad of functions were identified as things program managers did [149]. Except for work involved in establishing the program office and defining the product by producing and seeing to approvals of detailed technical and acquisition plans, most of the work involved "responding to change". Everyone listed the basic task activity at program inception as: (1) defining the technical and contractual approaches; (2) establishing a schedule of events and expenditures; and (3) coordinating the schedule and advising others who would provide support or oversight of development program activity schedules. Once the program was underway, however, the task list became eclectic. The major share of tasks had to do with responding to: (1) changed requirements, (the threat was perceived differently than it had been); (2) changing technology availability, (there are new devices which would permit better performance of some system function); and (3) changes to resource availability, (the budget has been cut or the staff levels in the program office have been changed). The workshop revealed the first of many dichotomies. Workshop participants enunciated two overpowering difficulties they had experienced in managing major programs: ***(1) they had been frustrated by a lack of program stability; and (2) they were unable to satisfy their need to remain flexible, specifically to waive use of inappropriate specifications and regulations when that is necessary to maintain program integrity.*** The problem of being flexible but retaining necessary environmental stability was, at least to some extent, a dilemma caused by forces outside the acquisition process.

The second workshop [150] was convened to find out exactly what those forces were. A major factor in the success of this workshop was the ability to convene some workshop sessions on the "home ground" of two major generators of the change which affects acquisition management: The United States Congress, and the Office of the Secretary of Defense. In conversations with the staff of the Armed Services Committee,

#	*DATES*	*SUBJECT MATTER*
1	06/15 to 06/19 1988	Defining the Technical Management Process; "What do Technical Managers do?"
2	11/30 to 12/04 1988	Defining how change is generated; "What are the forces which cause significant change with which technical managers must deal?"
3	05/26 to 05/30 1989	Responses to change; "How should Technical Managers deal with change?"
	08/11 to 10/13 1989	Smart Munitions Workshops: "Why do Smart Munitions programs cost more? Why are they late?"
4	*08/11 to 08/13*	*Air to Surface Workshop*
5	*09/12 to 09/13*	*Surface to Surface Workshop*
6	*09/19 to 09/21*	*Surface to Air + ASW Workshop*
7	*09/27 to 09/29*	*Air to Air + ASW Workshop*
8	*10/11 to 10/13*	*Task Force Integration Workshop*
9	10/02 to 10/04 1989	DoD Inspector General; "How should the Test and Evaluation Inspection be structured?"
10	11/27 to 12/01 1989	DoD Inspector General; "Should the HARPOON Program be fragmented into multi-procurements?"
11	12/04 to 12/08 1989	Predicting Response to Change; "Suppose we adopted the Smart Munitions Recommendations?"
12	02/12 to 02/14 1989	System Engineering Round Table; "What do Industrial and Government systems engineers do?"
13	03/14 to 03/15 1990	USD(A) Workshop; "Define and discuss problems with 'Program Stability'."
14	06/25 to 06/29 1990	DDR&E Workshop; "What problems are there in implementing CAALS?"
15	07/17 to 07/19 1990	USD(A) Industrial Base Workshop; "Why are firms leaving the 'Industrial Base'?"

WORKSHOP DATES AND SUBJECT MATTER

Table 5-1

#	*DATES*	*SUBJECT MATTER*
16	11/06 to 11/07 1990	USD(A) Risk Reduction Workshop; "What problems do we have in reducing risk?"
17	11/27 to 11/28 1990	USD(A) Requirements/Resources Workshop; "What problems are there in aligning requirements?"
18	11/29 to 11/30 1990	USD(A) Program Oversight Workshop; "What problems do we have in program oversight?"
19	12/11 to 12/12 1990	USD(A) Industrial Base Workshop; "How can we improve the defense industrial base climate?"
20	12/17 to 12/21 1990	DDR&E Concurrent Engineering Workshop; "Formulating an Integrated Plan to implement concurrent engineering."
21	01/22 to 01/26 1991	DDR&E CALS/CITIS Workshop; "How can development of Contractor Integrated Technical Information Services be encouraged?"
22	01/28 to 01/29 1991	DDR&E Concurrent Engineering Continued: "Developing a detailed plan for easy implementation."
23	02/27 to 03/02 1991	USD(A) North American Industrial Base Technology (NADIBO) Rationalisation Workshop; "Which of the 21 Critical Technology Areas should be joint U.S.-Canadian Efforts?"
24	05/22 to 05/24 1991	USD(A) NADIBO Rationalization continued; "Which technologies should be integrated?"
25	06/21 to 06/25 1991	USD(A) Workshop; "Integrating the Acquisition System Data Base."
26	07/23 to 07/24 1991	USD(A) Workshop (Continued); "Integrating the Acquisition System Data Base."
27	08/19 to 08/21 1991	USD(A) Workshop; "What is the role of the Industrial Base in the future?"
28	08/28 to 08/30 1991	DDR&E Workshop; "Contractor Integrated Technical Information Service continued."

WORKSHOP DATES AND SUBJECT MATTER

Table 5-1 (Concluded)

participants reviewed the legislative process, and the reasons for legislative concern. They found that ***much of that concern was generated by Congressional "perceptions" of their constituency and its concerns!*** Legislation proposed was thought to reflect "the public will" as the constitution provides for that will to be expressed. Legislation, once enacted, is implemented within the Office of the Secretary of Defense (OSD). Participants met with individuals within the office of the Secretary who were responsible for generating the Federal Acquisition Regulations (FAR) and keeping them current. They found that despite Congressional efforts to make clear the intent of the legislation, the Defense department interpretation of what the Congress "meant" tended to strict construction of language within the legislation. The effect of that was to constrain actions beyond what the Congress said it had in mind (i.e. what was written in the legislative history portion of legislation) when the legislation was crafted and enacted. ***In short, participants found that a major cause of change was faulty perceptions of public concern and desire, as interpreted by intermediate layers of Department of Defense management and supervision.***

The third workshop [151] explored the issue of how to deal with change. Participants assumed that change was inevitable, and generally beyond the program office's control. Participants presented their ideas about how change could best be accommodated. The answers were surprising. Participants believed they needed to be "pro-active: to get out in front" of anticipated change. They also said there was need to build a program management strategy which would make response to change easier, and to build a mechanism to help anticipate change to come. In short, they wanted to deal with change openly; to help shape change and make it beneficial to their activities.

5.2.2 A Set of Generic Development Programs (Workshops 4, 5, 6, 7, and 8 and Workshop 11 in Table 5-1 Reported in a Single Volume [152])

In early 1989, the Secretary of Defense held a series of discussions with his staff to examine reasons why, although all "Smart Munitions" performance goals had been met, the advertised cost and schedule goals had not beet met. The term "Smart munitions" includes devices which seek out targets after having been directed to their general vicinity. PATRIOT, SPARROW and other such guided missiles and "intelligent bombs" are within this particular weapon system category. The five Smart Munitions workshops examined all Smart Munitions programs to see if a set of common problems affected them and if means to alleviate the problems could be found. Participation in four of the workshops was limited to program managers; for the fifth workshop, participants were drawn from the all OSD agencies who administered acquisition program activities and made policy decisions about resource allocations.

In workshops 4, 5, 6, and 7, program managers identified a large number of problems, and suggested some solutions for them. One major difficulty concerned constraints on their capacity to make crucial program decisions. Not only did they indicate clear impediments to their taking timely actions, they also cited the practice of "review well after the fact" as an inhibitor to their attempting to take necessary actions at all. ["Review well after the fact" refers to the management style which avoids pre-decision discussion but reserves the right to review decisions at any time subsequent to their implementation. The result is to establish innocence of the reviewer before the fact so that blame on the decision maker can be placed if that is necessary]. A second major problem concerned resource uncertainties; absorbing cuts in resource levels already authorized on a continuing, and almost *ad hoc* basis. ***The recommendations from these four workshops focused on change to the acquisition management structure in order to give the program managers authority commensurate with their responsibilities.***

In the eighth workshop (the fifth in this series), OSD senior management reviewed the program managers recommendations. Participants demonstrated clear understanding of why those recommendations were made; but they also pointed to the existence of rules, regulations, policies, and legislation which might make implementing the suggested changes difficult. There was much discussion about how to construct "implementable" solutions which could be presented to the Defense Acquisition Board (DAB) for ratification and subsequent institutionalization. In fact the workshop did generate a set of eight potential actions to be taken by USD(A). Three of them concerned changes to authority and command structure to establish a direct reporting authority for Program Managers to a Service Acquisition Representative at the level of the Service Secretary. The DAB approved those recommendations on 6 December 1989. Figure 3-4 shows the Service Acquisition Executives (SAEs) positions established as the result of the DAB action.

As soon as the final Smart Munitions workshop began design of its recommendations, it became clear that there was no established methodology which would permit predicting the results of making broad change to the DAS. *The 11th workshop* [153] was convened to discuss how the DAS organization would be likely to respond to the specific changes recommended to the DAB as the result of the smart munitions workshops. Participants in this workshop were drawn from: (1) the U. S. Congress Armed Services Committee staff; (2) The Office of the Defense Inspector General; (3) The Office of the Defense Comptroller; (4) Assistant Secretary of Defense for Program Evaluation and Analysis; (5) The Individual Service (Army, Navy, Air Force, and Marine Corps) commands; and (6) Defense Industry. The workshop produced insight into the probable effects of the making those changes proposed to the DAB. However, the major workshop outcome was confirmation of a general organizational inertia and inflexibility which made it almost impossible to respond easily to change. ***At the conclusion of the workshop, methodology to predict what would result if proposed changes were implemented was still lacking.***

5.2.3 The Perspectives of the Defense Inspector General (Workshops 9 and 10 in Table 5-1)

The office of the Defense Inspector General (DoDIG) generally has been assigned two major oversight areas: (1) Inspecting Departmental functions to assure that desired activities are adequately pursued, and (2) Ensuring that opportunities to conserve resources are appropriately considered, and instituted when advantageous to the government. To gain better understanding of the DoDIG perception of how the acquisition process functioned, two workshops were conducted for them.

5.2.3.1 - *Adequacy of DoD Test and Evaluation Activities*

During the period 1987 through 1989, the Congress had legislated establishment of special kinds of weapon system test and evaluation activities. Specifically the independent office of Director, Operational Test and Evaluation had been created to report to Congress on operational performance of new weapon systems. There had also been continuing media discussion about how DoD tested its developing (and developed) weapon systems. In the latter months of 1989, the DoDIG had been charged with inspecting the DoD Test and Evaluation (T&E) process.

DSMC was asked to provide DoDIG with expert technical assistance in formulating their inspection plan for DoD's Test and Evaluation (T&E) process.

The DoDIG wanted to gain understanding of the techniques, technology and practices of the T&E process sufficient to insure an informed inspection. In addition, DSMC was also asked to convene a workshop to plan the T&E audit in detail. *The 9th workshop* [154] provided that assistance. The workshop concentrated on designing a focused oversight process in crucial T&E activity areas. As a result of that workshop, the DoDIG inspection plan was broadened to include considerations which would have been well beyond the scope of the original inspection concept. The workshop took place immediately following publication in the news media of numerous articles (Reference [155] is representative of them) about the "test and evaluation community's failure to perform its function". That conclusion was triggered by problems experienced with the Army's Bradley Fighting Vehicle in tactical exercises in Europe. Thus, the inspection team at first was simply interested in how to "prove" the allegation rather than in understanding what the problems were and why they had occurred. The complete shift in direction of the final inspection plan was a clear effect of workshop environment on the inspection process.

5.2.3.2 - ***Acquisition Methodology***

Concomitant with media discussion about DoD's T&E activities, there was a series of internal DoD reviews about selection of acquisition strategies, specifically about when to change them. In beginning and fledgling development efforts, Industrial prime contractors usually contract for sub-systems and components directly with suppliers. Primes then integrate all system components within the end product. When a program is mature, the government Program Management office may take responsibility for procuring sub-systems and supplying them to the prime contractor for integration. The strategies are called "The Prime Contractor" and "The Government Program Office Management-Integration" respectively.

In its inspection of one particular smart munitions program, the DoDIG had recommended a change in management methodology. *The tenth workshop* [156] revisited those recommendations in detail to provide insights to DoDIG about the technical and management effects (as opposed to the financial effects) likely to result from adopting its recommendations. The workshop provided program office participants with an understanding both of the DoDIG frame of reference and the mechanisms used to project the effects of change.

5.2.4 Concerns of the Undersecetary of Defense (Acquisition)

The USD(A) sponsored a conference at DSMC late in 1988 to discuss acquisition problems and concerns. Participants in that conference were DoD senior acquisition leaders. The Secretary's goal was to use the knowledge and acquisition expertise available within government to define, in detail, problems burdening performance of acquisition activities and devise solutions for them which could be implemented by the Undersecretary.

The 70 persons who attended were divided into seven 10 person groups. Each group's membership was arranged to ensure cross-service and cross-functional representation. All groups were asked to develop their own "important acquisition problem set". DSMC provided all group facilitators. The facilitators used Nominal Group Technique to generate ideas which were then clustered under major headings determined by group consensus. The individual group results were then discussed in plenary sessions to arrive at a sense of the most important acquisition issues. Subsequent to the 1988 general gathering, and the Smart Munitions Workshops, USD(A) asked DSMC to use the IM Workshop methodology to define particular problems in detail and to define suggested solutions for them. Most of the workshops listed in Table 5-1 which were held after December 1989 responded to USD(A)'s request.

5.2.4.1 - ***The Program Stability Workshop (Workshop number 13 of Table 5-1)***

This workshop addressed the issue of Program Stability [157]. It was held almost two years after the initial series of workshops had determined stability to be an issue. Participants were asked to: (1) define what was meant by program stability; (2) develop a listing of impediments to its achievement; and, (3) devise a set of suggested USD(A) actions which, if taken would eliminate the impediments. The workshop is most notable for the definition of program stability which emerged: ***A program is stable if it can respond...adequately to change.*** [157, 25]

5.2.4.2 - ***The Risk Reduction Workshop (Workshop 16 of Table 5-1)***

The Risk Reduction workshop [158] discussions provided an understanding of how events which cannot be foreseen affect how programs are perceived. The participants concluded that the concept of "risk" was many faceted, and that no single accepted definition had been developed for their guidance. Another conclusion was that considerable risk was due to "instability" and could likely be ameliorated if program stability could be achieved. Participants used the definition of program stability provided by the program stability workshop.

5.2.4.3 - ***The Requirements and Resources Workshop (Workshop 17 of Table 5-1)***

Participants who addressed issues of Requirements and Resources alignment [159] quickly developed a set of problems which focused on problems arising because program managers did not have control of financial and manpower resources, nor could they take program decisions freely to respond to changes in those resources. The core issue was the existence of both the Defense Acquisition Board (with its charter limited to "Programmatic" decision making), and the Defense Resources Board (whose charter permitted it to allocate DoD resources to all programs as the board determined appropriate). ***Participants said that although they had responsibility for program success and the ultimate delivery of a product, they had no authority to obtain and retain resources necessary to discharge those responsibilities*** [158].

5.2.4.4 - ***The Program Oversight Workshop (Workshop 18 of Table 5-1)***

Participants in this workshop immediately identified problems created because of the large numbers of organizations charged with overseeing acquisition activities, the overlapping responsibilities they have, and the tremendous work load they generate for the program management organization. Since many of those organizations were established by legislation, and report outside of the USD(A) (or even Defense Department) structure, ***participants expressed some concern that the cost of oversight might be more than the potential savings which result*** [160].

5.2.4.5 - ***The Industrial Base Workshops (Workshops 15, 19,and 27 of Table 5-1)***

Three Industrial Base workshops were held to consider problems in maintaining sufficient industrial capacity within the U.S. to respond to national security needs. In mid 1988, DSMC had been asked to study the problem of diminishing industrial capacity and had reported to USD(A) that the exodus from defense work was alarmingly high. DSMC's conclusion was not unique: many media articles and television clips had called attention to the problem (e.g., [161]). At that time, Cabinet Officers were speaking out on the same issue, and Congress had held hearings to clarify options which might ameliorate the industrial support problem.

- Participants in *the first workshop* [162] (Number 15) were very senior industrial managers: Presidents, Vice Presidents, and Directors of functional areas or divisions of major industrial corporations. Their charge was to provide USD(A) with a comprehensive overview of their perception of their difficulties in doing business with the government and suggest steps he might take to motivate industry's continued support of DoD. At the conclusion of three days of intensive work, the participants had the opportunity to spend three hours with the Under Secretary at DSMC and explain their findings and conclusions to him.

  The group had developed a structural relationship between a diverse group of problems. The structure described negative influences that some problems had on others. Warfield [3] calls such structures "problematiques". Once having created the structure, participants had mapped onto it a carefully constructed set of possible Secretarial actions which would, in their judgement, ameliorate problems [162], Page 25]. When the Undersecretary viewed the problem and solution sets, it became quickly apparent that he would find it difficult, perhaps even impossible, to implement some of the actions the participants thought essential. For example, one recommendation was to "eliminate the Defense Contract Audit Agency" (DCAA) and other oversight entities which had been established by Congress. Clearly that action was beyond USD(A)'s powers. After their discussion with USD(A), participants decided to return to the table and continue their deliberations to the point where they had a set of implementable actions. They spent two days working to refine their solution set to generate a few critical, implementable actions. The group met later with the USD(A)s Principal

Deputy who agreed with the new action set and took responsibility for pressing the recommendations in hope of implementing them. For example, the original recommendation to dis-establish DCAA had been replaced by the recommendation that USD(A) "limit the numbers of audits which can performed by all oversight agencies", a recommendation USD(A) could implement for all DoD oversight agencies including DCAA.

- *The second Industrial Base workshop* [163], Number 19 of Table 5-1, continued the work of the first. The participants were senior Government officials and managers. They were asked to suggest ways to improve the climate in which the industry-government team worked. They concluded that much of the difficulty had to do with how their work was perceived by those outside the defense community. Many problems they identified were the result of legislative remedies to perceptions of acquisition personnel wrong-doing. The resulting suggestions for action centered about reversing that set of constraints.
- *The third Industrial base workshop* [164] dealt with the issues of maintaining sufficient industrial capability to respond to security needs. Participants were senior Government and Industry representatives. The workshop examined three issues: (1) Defining the environment within which industrial organizations would operate in the future; (2) Determining, in light of that environment, the problems which needed to be addressed by DoD; and, (3) Specifying which agencies or individual positions should take those actions.

5.2.5 Issues of Technology

A series of 8 workshops dealt with aspects of technology's role in the acquisition process.

5.2.5.1 - *Integrated Engineering Methodologies and Processes Workshops numbers 12, 20, and 22 of Table 5-1*

- *The first workshop* [165] (Number 12 of Table 5-1) addressed issues of integrating engineering phases, functions, and processes was held in December of 1989. DSMC was then in the process of reexamining the

System Engineering curriculum. Industry had been asked to participate in a round table to determine what concepts they felt were included within the "System Engineering" umbrella. The private sector Defense contractors shared their ideas freely and openly and the sessions were very productive. The lack of conflict in freely expressing ideas may have resulted from the use of the IM process and from DSMC non-attribution policy. At the time of the workshop, it was apparent that industry had already taken steps to implement concurrent engineering functional integration (now known as IPPT and IPD). Industry had begun to ensure all aspects of the development process were considered early: even discussions of initial design option alternatives considered potential effects on installed manufacturing processes.

- *The second workshop* [166] (Number 20 of Table 5-1) asked participants to suggest specific mechanisms for ensuring that integrated engineering practices were adopted throughout the acquisition process. The workshop was known as the "Concurrent Engineering Workshop". 10 groups of 10 individuals each discussed methodology which would institutionalize engineering integration within DoD and its industrial support base. ***Many of the ideas developed in this workshop finally started to become common practice in industry in 1992.***
- *The third workshop* [167] (Workshop 22 of Table 5-1) developed an integrated plan for encouraging industry to institutionalize the integration of engineering, manufacturing and logistic support activities as recommended in the "concurrent engineering" workshop (Workshop number 20). ***The document which emerged was used as a guide in implementing Integrated Project Teams (IPT) and Integrated Product and Production Development (IPPD) management concepts within DoD and its supporting industrial organizations.***

5.2.5.2 - ***Moving To Integrate Engineering and Management Data Bases (Workshops 14, 21, and 28 of Table 5-1)***

A group of 3 workshops focused on the methodologies already available, and those emerging which would permit forming an electronically accessible, singular, integrated, systems information repository which included all engineering and management data. The idea was first given the name "Computer Aided Acquisition Logistic Support" (CAALS) and had been made part of defense policy. There had been considerable difficulty in its implementation.

- *The first workshop* [168] (Workshop 14 of Table 5-1) considered problems of building an easily accessible electronic data base and encouraging its use. The participants were practitioners drawn from both government and industry. They found a major difficulty in defining just what data should be included, and specifically who would be permitted access. There was considerable anxiety about open access to what might be considered "proprietary industrial information" of potential utility in open competition. There was also uncertainty about the economic viability of the concept.
- *The second workshop* [169] (Workshop 21 of Table 5-1) focused on technical issues of installing and accessing contractor (industrial base) generated, maintained, and managed integrated information systems. By this time, the term CAALS had been replaced by "Continuing Acquisition Life-Cycle Support (CALS), and the particular area of concern was known as "Contractor Integrated Technical Information Service (CITIS). While it was clear that technology would permit crafting an integrated electronic information repository, there were many issues of equipment interfacing and system data refreshment which cast doubt on the practicability of quickly implementing those systems.
- *The third workshop* [170] (Workshop 28 of Table 5-1) was held at the end of August 1991 to discuss economic implications of integrated data bases. Its burden was to explore mechanisms acceptable for proving economic advantages of integrated electronically accessed data repositories.

5.2.5.3 - *Issues of International Technology Integration (Workshops 23 and 24 of Table 5-1)*

Two workshops were sponsored by the North American Defense Industrial Base Organization (NADIBO). The goal of these workshops was to devise a strategy for integrated international programs to support areas of critical technology as defined by the Congress and the Department of Defense. The idea is very similar to efforts within the European Community to integrate their industrial capacities and gain more focus and effectiveness.

- *The first workshop* [171] (Workshop 23 of Table 5-1) drew participants from senior Government officials of the U. S. and Canada. They examined 21 technology areas defined as "critical technologies" by the Assistant Secretary of Defense for Production Resources (ASDPR) in DoD's yearly report to the Congress. This workshop developed mechanisms to permit determination of which of the 21 critical technology areas *could* be implemented by the NADIBO governments in joint activities within NADIBO's industrial base.
- *The second workshop* [172] (Workshop 24 of Figure 5-1), again drew its participants from senior government levels in the U. S. and Canada. Results achieved by joint work which had been undertaken on the recommendation of the first workshop were reviewed. ***The participants concluded that there was considerable advantage to integrating high technology activities within the NADIBO family.***

5.3 INTEGRATING THE TOTAL WORKSHOP DATA BASE

Workshops 25 [173] and 26 [174] of Table 5-1 were held at DSMC to review results obtained from all of the previous workshops and integrate them into a single data base. The participant group consisted of 11 Service and defense industry members nominated by Army, Navy, Air Force and Marine Corps Commands; and Industry. Participants were selected because they had broad knowledge of and expertise in the Defense Acquisition process.

At the time these workshops convened in June, there was no integrated data base of Defense Acquisition System problems formed from systematically collected data; that is, data collected by use of a consistent process of inquiry. ***Because 11 of the total of 24 workshops (held up until that time) had focused on particular acquisition issues of importance to the USD(A), and all had used the Interactive Management methodology, it was thought likely that development of such an integrated overview of common acquisition system process problems could now be achieved.***

The stated workshop purposes were: (1) to review results of 11 prior USD(A) workshops; (2) gain a deep understanding of the basic problems common within the acquisition process; and, (3) develop a set of implementable actions which would ameliorate those problems.

Specific workshop tasks as stated to workshop participants were: (1) Review the work of the workshops 4, 5, 6, 7, 8, 13, 15, 16, 17, 18, and 19; (2) Define a consolidated problem space; (3) Establish relationships between the problem sets within the problem space; (4) Select from opportunity sets developed in any of the 24 previous workshops, a set of most useful opportunities to alleviate acquisition problems; (5) Develop relationships among the most useful opportunities.

5.3.1 The first step

The first step was to develop a common set of broad problem areas which included all of the problem statements developed in previous USD(A) workshops. A total of 678 problem statements had been identified: 295 problem statements from the Smart Munitions Workshops (numbers 4 through 8); 66 from the Program Stability Workshop (number 13); 80 from the 1st Industrial Base Workshop (number 15); 73 from the Risk Reduction Workshop (number 16); 35 from the Requirements/Resource Allocation/Acquisition Workshop (number 17); 54 from the Program Oversight Workshop (number 18); and 75 from the 2nd Industrial Base Workshop (number 19). Participants were asked to consider the most important problems as determined in the workshops, and determine whether any other problems were of similar nature. All participants considered each problem and discussed reasons why problems should be grouped together. At the conclusion of this work, *all 678 problems had been grouped within 20 general problem areas*. The 20 problem category titles are presented below together with a brief statement which defines the aggregation of problem ideas within them.[1]

1. ***Program Manager Authority*** - The authority of the program manager is severely undermined by the cumulative effect of a variety of intrusions into program management. In their totality these intrusions introduce major confusion into ongoing activity, and damage incentives to do careful planning for effective

[1] Dr. John Warfield wrote the original statements which were edited and adopted by the participants.

program management, increase costs, and delay schedules. Program effectiveness and efficiency are both casualties.

2. *Contract Requirements Development* - Contractual requirements are intended to specify the working relationships between government and contractor and to describe the end product. At present too many constraints impact ability to deal properly with data and standards. One consequence is the inability of the program manager to reward good performance and penalize poor performance.
3. *DAB-DRB Process* - DAB/DRB processes do not reflect an encompassing treatment across programs, with thoughtful priority setting. Moreover the processes do not adequately promote the gathering of relevant information from the acquisition community that should pertain to DAB /DRB decisions. DAB and DRB are often in conflict, not taking time to resolve differences. Failure to correct this situation leads to major and undesired budget surprises for those who inherit the impact of poorly thought out past decisions.
4. *Technical Requirements Management* - An overly myopic interpretation of technical requirements mistakenly assumes that they can be rigorously specified at program inception and need never be changed. The unduly restrictive interpretation placed on "requirements" and the ensuing difficulty in modifying them as new knowledge becomes relevant, over-constrains program management and is a significant source of excess time and costs. Effective program management demands that program managers have an approved and well-paved pathway to change requirements as conditions warrant.
5. *Funding Instability* - The effect of current program funding practices is capricious and destructive of responsible management practices. The acquisition budgeting system is not conducive to effective program management, leading to enormous waste and dissatisfaction.
6. *Statutory/Regulatory Influences* - Statutory/regulatory influences are often unnecessarily burdensome and do not reflect what has been learned from decades of DoD program management.
7. *Cost And Schedule Estimates* - Cost and schedule estimates which have high leverage in terms of program effectiveness and manageability are seldom realistic. The current management style inevitably forces bad information into

the system where it infiltrates like a virus and is a prime source of program sickness.

8. *International Factors* - Current regulations and plans involving international military transactions furnish inadequate guidance for effective management of international transactions.
9. *Long Range Planning* - An overhaul of the long-range planning system is needed to improve investment decisions and to reflect integrated program tradeoffs.
10. *User Support* - Failure of users to sustain strong, consistent, long-term support for programs in situations where need for program products has been clearly established leads to major disruptions, confusion, and waste. Program initiation does not reflect consideration of system priorities in relation to all other existing or prospective programs. Long-term plans are not connected to short-term decision making.
11. *Inadequacy of Program Team* - An effective acquisition program team supports matching of demand (which involves a whole portfolio of task imperatives that grow unpredictably) with a portfolio of personnel who can respond capably. Steady increase in demand in an eroding resource environment, accompanied by high personnel rotation; inadequate personnel experience and training; and difficulties in organizing and sustaining the program team erodes program quality.
12. *Executive Decision and Policy Makers* - High personnel turnover among executive decision makers and policy makers causes policy to change frequently. Also the turnover is responsible for (a) continuing misunderstanding of the acquisition system due to lack of program management training, experience, and skill at top DoD and services management level; (b) discontinuities and low quality of oversight, and (c) inability to provide consistent rationale to program personnel leading to de-motivation.
13. *Risk Management* - Inadequate contingency planning to manage cost, performance, and schedule. There is no uniform methodology either to define or to handle risk.
14. *Industrial Base* - The nation is losing its defense industrial base because it lacks

a consistent, rational, realistic approach to industry. In the absence of articulated policy, *de facto* policy operates in an undesirable way.

15. ***Credibility*** - No total quality philosophy operates to govern program oversight. Inadequate communication flows through the system, promoting lack of trust throughout.
16. ***Oversight*** - As presently practiced, program oversight is ill-conceived, disorganized, and replete with role conflicts.
17. ***Transition Management*** - Effective system design and development requires phasing, which implies a need for smooth phase-to-phase transitions. Present practice involves inadequate phase definition, insufficient emphasis on transition management, and poorly managed transitions from one phase to another.
18. ***Test and Evaluation*** - Current government philosophy and implementation of test and evaluation inadequately reflect good management practice. Test and evaluation practice is inconsistent with overall program objectives.
19. ***Immutable*** - Detached, capricious, and uncontrollable high-level acquisition decision processes are responsible for micro-interference in programs. Such intrusions translate into deterioration of program quality, morale, and performance.
20. ***Program Execution*** - Current constraints on program execution favor rigidity when and where flexibility is needed; and they promote flexibility when and where rigidity is beneficial; thereby frustrating good management practices. Structural impediments, noted for their frequency and variety, make program execution inefficient, and make it very difficult for the program manager to do his job.

5.3.2 The Second Step

The second step was to determine the relationship between the 20 problem categories. Participants were asked to consider the question:

"Do problems within category 1 make problems in category 2 worse?"

Because there were 20 aggregated problem groups whose relationships to one another were structured, the resulting model was quite complex. In the hope of simplifying the way in which the structure was portrayed without altering the relationships established, Dr. John Warfield was asked to assist TMAW participants to analyze the structure and review the aggregate problem groups to see if a simpler structure could be devised. ***The group felt that 6 generic problem categories could be formed.*** Table 5-2 indicates how the primary aggregate problem areas fit within the six generic problem sets. With the exception of the "oversight" problem category (which fits within two categories, D and F) all problem categories fit within only one problem set. For convenience, each generic problem set is assigned a letter from A to F.

	GENERIC SET NAME	PROBLEM AREAS INCLUDED
A	Test and Evaluation	Test and Evaluation
B	High Level Planning and Management	DAB/DRB Process Funding Instability Statutory/Regulatory Influences Long Range Planning User Support Executive Decision and Policy Makers Immutable
C	International Factors	International Factors
D	Program Office Effectiveness	Program Manager Authority Technical Requirements Management Inadequacy of Program Team Risk Management Credibility Oversight
E	Industrial Base	Industrial Base
F	Program Execution Effectiveness	Contract Requirements Development Oversight Program Execution Cost and Schedule Estimates Transition Management

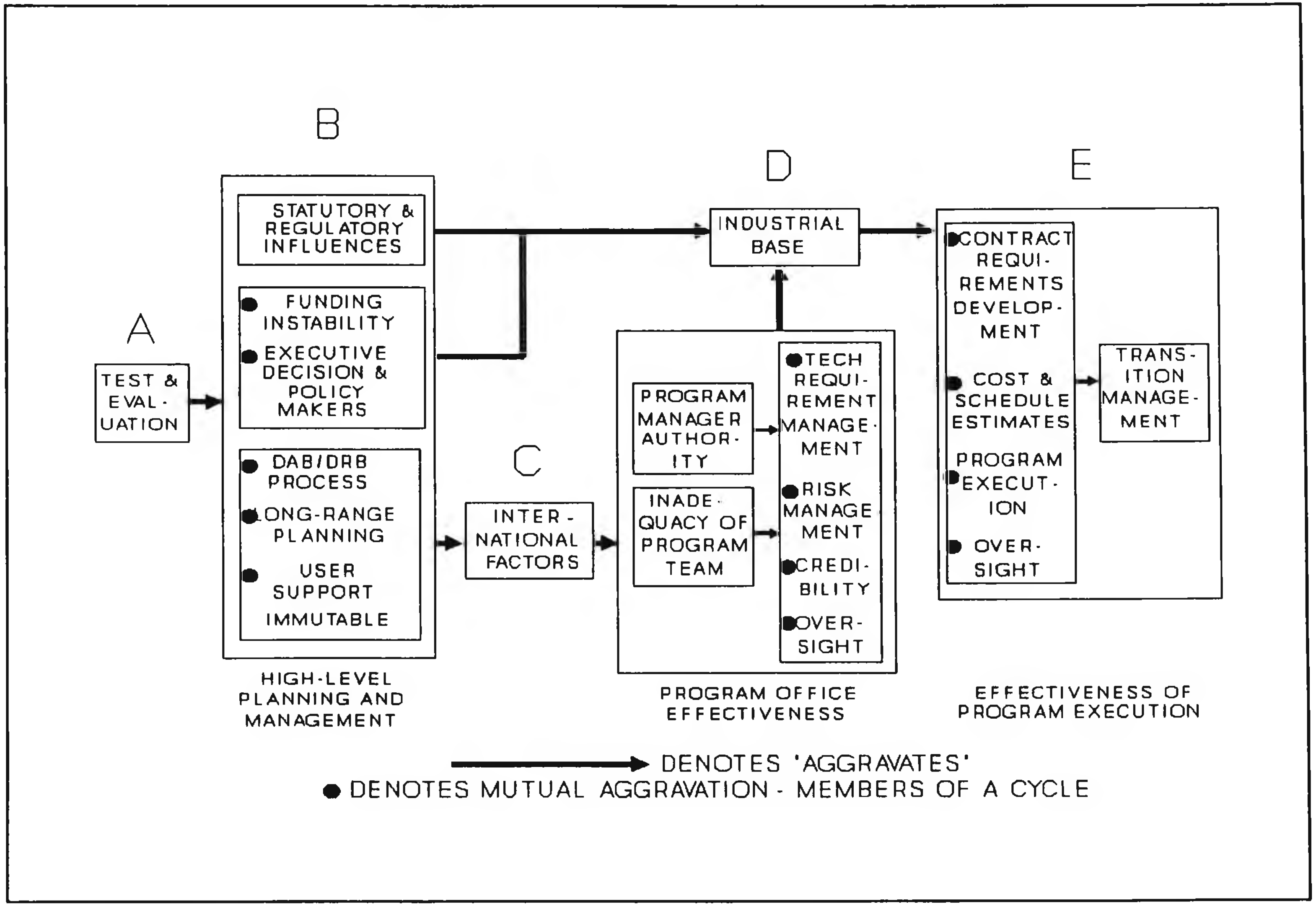
GENERIC PROBLEM CATEGORIES
Table 5-2

5.3.3. The Third Step

The third step was to apply Interpretive Structural Modeling (ISM) methodology to construct a "problematique" for the total population of aggregate problem categories. The structural model is shown as Figure 5-2. Figure 5-2 has preserved relationships between the 20 aggregate problem categories but shows as well how those problem categories populate the six generic problem sets.

In Figure 5-2, the direction of aggravation is indicated by the arrows which connect the six generic problem sets. In Figure 5-2:

- *Test and Evaluation problems aggravate all other problems.* This was a surprising result and at first was felt to be incorrect. However, as participants considered the implications of the relationship they came to understand that the aggravating relationship was quite understandable. Usually, test and evaluation specifications are written only after the item under development has completed engineering development and production has begun. It follows that one cannot build an item to meet test requirements which are unknown when the item is being designed.
- The *High Level Planning and Management Problem set aggravated both the International Cooperation problem set and the Industrial Base problem set.* Within that generic problem set, there are two cycles of mutually aggravating problems. (1) Executive decision and policy makers usually have a short term of office. The USD(A) historically is incumbent for sixteen to twenty four months. When one USD(A) leaves his policies and priorities depart as well. Therefore funding instability is a natural consequence of short USD(A) tenure. The reciprocal relationship is also true: when funding instabilities cause a set of USD(A) policies to become untenable, the incumbent has often preferred to depart rather than preside over a disorganized set of programs. Similarly, when resources, military requirements, and other factors change rapidly, it is difficult to formulate and maintain long term plans.
- *International Cooperation aggravates Program Office Effectiveness.* The shifting resource availability creates a climate which encourages foreign military sales. Resources which might be unobtainable through normal U. S. agency relationships might be obtained from other governments. But the price paid is to de-stabilize program office activities and much time is drawn away from the normal program activity.
- *Program Office Effectiveness aggravates Industrial Base problems.* An ineffective program office creates difficulty for the industrial organizations who are in support of the program. Decisions cannot be taken when required, timely contractual modifications do not take place and guidance is not exercised



ACQUISITION PROBLEM AREAS AND GENERIC PROBLEM SETS

Figure 5-2

appropriately. The problems of program office effectiveness are also complex. Lack of program manager authority and inadequacies of program office staff aggravate a cycle of 4 mutually inter-acting problems: inability to manage technical requirements because rapid response to change is inhibited works to lessen the capability to manage risk. The effect of those deficiencies is to reduce the credibility of the program office staff which, in turn, leads to increased oversight imposed from above on what seems to be an inadequate management organization.

- *Industrial Base Problems aggravate Effectiveness of Program Execution.* When there is instability of direction from the program office, and when policy change is the norm rather than the exception, it is difficult to execute any activity well. The cycle of mutually aggravating problems with program execution indicates the elements which cause problems in managing transition between program milestones shown in Figure 2-1. When contract requirements are difficult to develop because of instabilities throughout the system, cost and performance estimates become unreliable at best. In turn, when program execution seemingly lacks continuity, oversight will be applied in an attempt to correct the difficulties.

5.4 CONCLUSIONS DRAWN FROM THE WORKSHOPS

The aggregation process succeeded in: (1) reducing the complexity represented by 678 individual problem statements to a set of 20 major problem groupings; and, (2) placing the 20 problem groups within six general problem areas. In the sense that this process could preserve the integrity of the original 678 problems while reducing the cognitive complexity to what participants agreed was a set of six most fundamental high level problem areas, the structural model of Figure 5-2 represents the ultimate aggregation of the problem space wisdom incorporated within the 10 previous USD(A) workshops. When the result of the workshop was reviewed, it became clear that resolving the problems which generated Figure 5-2 would require considerably more than simply a set of patches and revisions to current practice. When the integrated problem structure was studied, it provided some insights into the persistence of many of the problems in spite of concerted efforts aimed at their elimination.

- ***The present acquisition system, and the problem set described co-exist and are mutually dependent.***

This "truism" served as a base line to understanding. Participants presumed the present acquisition process had originally been derived to satisfy functional needs specific to creation, design, production, operation and disposal of military equipment. They also understood that the underlying structure of today's acquisition process was devised during the original industrial expansion effort beginning in 1938 (immediately prior to World War II). Although today's acquisition process (which served during Operation Desert Storm) has grown to be much more complex (by virtue of making numerous changes to the original process design) it is, basically, the same system.

During the time between 1938 and now, functions have been added to the acquisition system which do not seem essential to the process of conceiving and acquiring advanced weapon systems. Many functions were added to implement elements of National Policy: for example, legislation such as Equal Employment Opportunity Act, and Competition in Contracting Act are neither essential nor beneficial in the context of Defense Acquisition. They have been superimposed on the Defense Acquisition System as a means to effect what Government perceives to be positive end goals.

Participants believed that amalgamating sometimes disparate, perhaps even dichotomous functions has created an increasingly complex set of rules and regulations mostly concerned with ensuring financial and legal accountability through very close oversight of daily operations. To the extent that such oversight creates or adds difficulties to expeditious acquisition (i.e., some of the problems described by workshop participants) it is counterproductive.

As long as the acquisition system retains its present omni-functional configuration, devising ways to achieve increased efficiency and effectiveness may represent an almost insurmountable task.

- ***Even if non-acquisition critical functions had not been incorporated within the DAS, those functions which describe an "ideal" acquisition process today are likely to be different from those which were necessarily associated with acquisition when the original process was defined.***

An *ideal* acquisition process would be highly focused on functions specific to acquisition. Other functions would be incorporated within or overlaid upon the system only to help in accommodating change. The rapidity with which technology becomes obsolescent has accelerated remarkably over the last one and one-half decades. It is problematic whether any process established to serve functions derived for a previous acquisition environment could be expected to be equally applicable today even if that process had not been materially altered to accommodate National goals unrelated to acquisition. There have been major changes both in the way technology is applied to product development, and in how products are produced. Rather it is likely that the magnitude of environmental, societal, and technological change would require change to any such underlying DAS structure.

Too, greatly improved technological capacity has encouraged development of more complex, perhaps even truly multi-functional systems. Development of those systems may require performing new functions; or old functions under circumstances very different from those which previously characterized the acquisition environment.

At the end of the workshop deliberations, participants believed that a different kind of approach was necessary if the DAS were to undergo major change. The following logic was offered in justification for beginning a new series of workshops to deal with acquisition reform.

Participants believed that:

- ***If many problems enunciated in prior workshops were indeed generated by the acquisition system process; and***
- ***If the functions necessary to acquisition had changed (for whatever reasons);***
- ***Then a new set of workshops should focus on devising an acquisition process focused on facilitating performance of the current set of functions associated with an effective, efficient acquisition process.***

Participants understood that over the years, the once-simpler process of weapon system acquisition had been made complex; and a result of expanding the scope of oversight in Government contracts is that doing business within the defense acquisition system requires use of management and accounting methodologies quite different than those of normal non-governmental management functions and commercial market business practices. Not only do government oversight requirements create additional costs, they also compromise the efficiency of the process which moves ideas through prototypical equipment production, adequate user testing, and deployment in the field.

At the end of these workshops, it was said that:

- Conditions for participating in the defense market have no parallel in most commercial markets.
- The effect of concentrated oversight might be stated as: fostering a development process structured to permit a higher level of oversight than is necessary to perform the acquisition functions to the detriment of those functions required to perform product development efficiently
- Mandating very long range detailed cost-in-use and performance estimates for products not yet proven practical (the life cycle concept) creates the need to produce cost estimates for operating weapons in the field 20 or more years in advance of their having been manufactured, tested, or used by military personnel. The estimates are almost certainly grievously in error from the moment they are developed.
- Assuming that one can accomplish "invention on demand" in the absence of "proof of principle" must at least lead to disappointment when the results do not materialize on schedule.
- When the world is changing rapidly, creating a Defense Acquisition Process with a very long "time constant of response to change" encourages technology obsolescence for new items fielded in support of fighting forces.

The conclusion generated by all of the work reported here was that the fighting forces would be best served by developing an alternative defense acquisition process based on a thorough understanding of those functions necessary to effective and timely acquisition process performance.

The next chapter explores the design of a functional Defense Acquisition process capable of ameliorating the problems identified above which are inherent in the existing Defense Acquisition System.

CHAPTER 6
DESIGNING A FUNCTIONAL ACQUISITION PROCESS

This chapter: (1) Establishes the framework within which a functional acquisition process was designed. The purpose is to explain the guiding principles which drove the effort; (2) Describes the IM workshop activities to provide an understanding of how the IM process generated information used in process design; (3) Describes and discusses the acquisition process which resulted from workshop activities; and, (4) Discusses the differences between the way the 1991 Defense Acquisition System performed in practice and the way it was envisioned that the newly defined functional system would perform. This discussion provides the basis for the organizational and system constructs presented in Chapter 7.

6.1 THE FRAMEWORK USED FOR FUNCTIONAL ACQUISITION PROCESS DESIGN

Major change to world political alignments occurred during the period 1989 to 1992. In 1987, Soviet leadership, seeking to re-engineer the mechanisms of government and industrial production within the Soviet Union embarked on the policies of "peristrioka" (restructuring) and "glassnost" (openness) [175]. Eastern European nations which were then an integral part of the Soviet political and economic bloc also began re-examination of their own political and industrial mechanisms to determine actions required of them as the Soviet Union modified its structure. In the United States, some U. S. National Security Council members thought the new policies would cause the collapse of the Soviet system: they perceived a reduced threat to the United States. To gain knowledge about the effects of reduced threat on the weapon development process, the Deputy Secretary of Defense ordered a review of the DAS process defined in DoDD 5000.1 (shown in Figure 2-1) shortly before the first workshop session began. To respond to their perception of a reduced threat, the Secretary and Deputy Secretary developed a policy which had as a principal element, the concept of fractioning the development process.

The DAS imbedded within DoDD 5000.1 established a series of steps in moving from ideas to a fully supported operational system. Those steps were: (1) "Concept Exploration and Definition", (2) "Demonstration and Validation", (3) "Engineering and Manufacturing Development", (4) "Full Scale Production", (5) "Deployment and Operational Support".

The new policy divided the process into two parts:

- During the first part of the process, weapons development would proceed from concept through construction of one or more prototype units. The units would be tested for operational performance and suitability. When devices had been declared "suitable for operational use", one of two decisions would be made: (1) If there was no immediate requirement for production quantities, the prototypes would continue to be used in the field, but no production units would be procured; or (2) If there was need to produce more units, full scale production, deployment and support would proceed for the quantities deemed appropriate.
- When it became necessary to re-equip active fighting units, one of the prototype weapon system designs would be chosen and produced in quantity.

This policy separated "production, deployment and support" components of the process in Figure 2-1 from the generation of ideas and production of prototype systems.

The workshops were constrained to recognize the Secretarial policy and to formulate a new acquisition process which could support it. Therefore, Participants in the process design workshops were asked to consider the acquisition process in two stages: the first stage would move from ideas to prototypes, the second would move from prototypes to operational systems.

The U. S. Government adopted the concept of Total Quality Management (TQM) and invested considerable time and effort educating its members about TQM principles [176]. The concept of Process Action Teams (PATs) is an integral part of the TQM philosophy [177]. The purpose of a PAT is to define the process which will later be implemented by a "system". Because the purpose of this series of workshops was to suggest specific change to the Defense Acquisition System (DAS) defined in DoDD 5000.1, workshop participants were a *de facto* Process Action Team. Previous workshops had developed deep knowledge of the present Defense Acquisition system and the problems imbedded within it. **Participants in this series of workshops were chartered to design an acquisition process**. Their task was to design a process which included all of the functions necessary to: (1) develop concepts for new weapons (or provide for improved capability to weapons already in use); (2) demonstrate that the concepts could be reduced to practice and would operate as anticipated; (3) define a production mechanism for any devices designed or modified; (4) allow for efficient test and evaluation of products under conditions appropriate for a weapon system during combat; and, (5) provide for establishing and operating a production capability for replicating the tested weapon system in sufficiently large quantities to equip fielded combat units.

Workshop participants were carefully selected from both industry and government. Major defense industrial firms such as Martin-Marietta (a conglomerate defense contractor), Grumman (aircraft, spacecraft, and information systems), Boeing Airplane Company (commercial and military aircraft and data systems), Bath Iron Works (naval ships), General Dynamics (tanks and other ground combat vehicles), and smaller Research and Development firms who bridge the gap between basic and applied research were all asked to nominate participants. On the Government side, the Services were asked to nominate their most senior Acquisition professionals, and the Office of the Secretary of Defense and the UnderSecretary of Defense (Acquisition) were also asked to nominate participants. The Deputy Director of the Congressionally chartered Section 800 Panel was a participant as was the Deputy Director of the Research Institute for Systems Studies of the Russian Academy of Sciences. Once again, *curriculae vitae* for all prospective participants were submitted with the nomination and selection was made by the author based on the nominee's background and experience.

Each participant was given copies of prior workshop reports, and other writings which discussed the performance of the DAS and the need for change to the acquisition process. All of the participants indicated that they had studied the read-ahead material provided. They were encouraged to ask questions about what they had read. Only after participants said they felt comfortable with the previous workshop material were they asked to begin their own work.

At the outset, participants perceived a primary requirement for a new acquisition system to be capable of rapid response to change; they were predisposed to design a functional process which would make that possible. The revised acquisition "system" resulting from their work would have to be substantively different from the established DAS. That objective imposed a number of fundamental limitations. Any new acquisition system would need to:

- Recognize that decreasing the Defense budget from 6% of Gross Domestic Product (GDP) to 3% of GDP makes achievement of high technology at low cost necessary;

- Link the acquisition process closely with national military strategy;
- Have a goal of replacing the "unstable, inflexible, fault intolerant" system (then in place) with a stable and flexible system;
- Create a process which promotes ethical management by removing those system characteristics which impede truthfulness;
- Abandon attempts to monitor program office decisions in detail (micro-manage) and revert to the more *laissez-faire* attitude associated with generalized oversight (macro-management); and
- Devise a holistic system which permits synergy between system elements to replace the fractionation and sub-optimization which result from characteristics imbedded in the acquisition process then in use;

It had been anticipated that process design could be accomplished in a single, 5 day workshop permitting succeeding workshops to define an implementing organization and devise a new acquisition system. In the event, it quickly became clear that because of the very large amount of information developed in group deliberations, a number of additional workshops would be necessary to complete that agenda. There were seven workshop sessions. The dates and subject of each of them appears in Table 6-1. Workshop details are recorded in [178] and [179].

NO	DATES	SUBJECT
1 2	11/18 - 11/22 1991 12/10 - 12/12 1991	Define Functions and Structure For A New Defense Acquisition System
3 4 5	03/09 - 03/13 1992 03/18 - 03/18 1992 03/24 - 03/24 1992	Define Functions and Structure For A New Defense Acquisition System; Organizational Concepts for the Defense Acquisition System
6 7	04/21 - 04/24 1992 04/27 - 04/27 1992	Derive Organization and Complete Design for the New Defense Acquisition System

DEFENSE ACQUISITION SYSTEM RE-DESIGN WORKSHOPS

Table 6-1

It required 20 days of intensive work to redesign the acquisition system. An additional three months was spent consolidating workshop results and creating documentation suitable for transmittal to USD(A), the Section 800 Panel, and the Congress. Eight months more was required to coordinate the material sufficiently to create a climate of acceptance for the recommendations. The Federal Acquisition Streamlining Act of 1994 which enacted many of the workshop recommendations was signed on 18 October 1994.

6.2 HOW THE INTERACTIVE MANAGEMENT METHODOLOGY WAS APPLIED TO STRUCTURING THE SYSTEM

The IM methodology is quite flexible and permits many variants of application within its overall discipline. In this system re-design activity, the following sequence of events was used to derive functions/tasks required to move from ideas to prototypes, and from prototypes to fully supported operational systems.

6.2.1 Nominal Group Technique was used define the individual functions and tasks: (a) a trigger question was posed; (b) the facilitator asked each participant, in turn, to contribute one answer to the question; (c) each contribution was assigned a number (in sequence of presentation) and transcribed onto large sheets of paper which were hung on the walls of the room. Contributions were simultaneously entered into a computer data base. Participants continued to contribute all of their ideas on continuing rounds; and contributions were always accepted at any time participants offered them.

Because the complete acquisition process had been divided into two parts, two trigger questions were used to stimulate idea generation. The first question was:

> ***"What functions or tasks need to be accomplished to move from ideas to prototypical items?"***

The second question was:

> ***"What functions or tasks need to be accomplished to move from prototypical items to fully supported operational systems?"***

6.2.2 Voting for the Most Important Functions/tasks was the second step in structuring the functions/tasks performed in moving from ideas to prototypes, and from prototypes to fully supported systems. After they had completed development of the functions and tasks, ***participants were asked to choose the five "most important" functions or tasks.*** Participants wrote their choices on a 3"x5" card indicating the ***number of the function or task and its order of importance from 'one' to 'five'.*** A separate card was provided for each of the five statements. Votes were tallied and the number of votes received by each function/task were counted. Order of importance was also recorded.

6.2.3 **Grouping All Functions/Tasks** was the third step in structuring the functions/tasks performed. Each function/task statement was printed on a single sheet of 8.5" x 11" paper. Those functions/tasks which two of more participants felt to be of importance were suggested as foci for grouping others. The functions/tasks which had received two or more votes were placed on the walls of the room and participants were asked to group under them any of the remaining functions/tasks they believed fit appropriately within that group. Two question were used to group functions/tasks:

"In the context of moving from weapon system concept to weapon system prototypes, does function/task

A

belong in the same function/task group as function/task

B?"

The second question asked was:

"In the context of moving from prototypical weapon systems to operational weapon systems prototypes, does function/task

A

belong in the same functional group as function/task

B?"

When all functions and tasks had been grouped, participants were asked to *name each group and organize all of the component functions/tasks within that group into primary and included functions/tasks*. Primary functions/tasks were those whose performance required the prior or concomitant performance of included tasks.

Participants were also encouraged to combine groups of functions/tasks. The objective was to reduce the numbers of individual groupings.

In this series of workshops, "grouping" included (1) aggregating functions/tasks within groups and indenturing functions/tasks - indicating task performance relationships within the group of functions/tasks.

6.2.4 **Determining the Order of Function/Task Performance** was the fourth structuring step. When the aggregated functions/tasks had been defined and indentured, Interpretive Structural Modeling (ISM) was used. Participants were asked *whether it was necessary to perform one functional/task category prior to performance of each of the other functional/task categories*. The two questions asked were:

"In the context of moving from weapon system concept to weapon system prototypes, do functions within functional/task category

A

need to be performed before, or at the same time as functions/tasks in functional/task category

B?"

The second question asked was:

"In the context of moving from prototype weapon systems to operational weapon systems prototypes, do functions/tasks within functional/task category

A

need to be performed before, or at the same time as functions/tasks in functional/task category

B?"

6.2.5 **Develop A Generalized Organizational Structure**. As the penultimate step, after all functions/tasks included within the complete development process (from ideas to operational systems) had been structured, *participants were asked to develop a generalized organizational structure for a typical "smart munitions" program*. Participants considered the functions/tasks to be performed, described the kinds of human capabilities (attributes) necessary to perform them. When individual attributes based on function/task performance had been defined, participants were asked to estimate the workloads involved and estimate the numbers of individuals required within the program office (Chapter 7 details the process methodology).

6.2.6 **Develop an alternative acquisition system**. Finally, *participants were asked to construct an alternative acquisition system based on their work*. The structure and the staffing levels were used as a basis for construction of a new acquisition system to be proposed to the USD(A) as a substitute for the one imbedded within DoDD 5000.1 and described in Figure 2-1 above.

6.3 OTHER CONSIDERATIONS

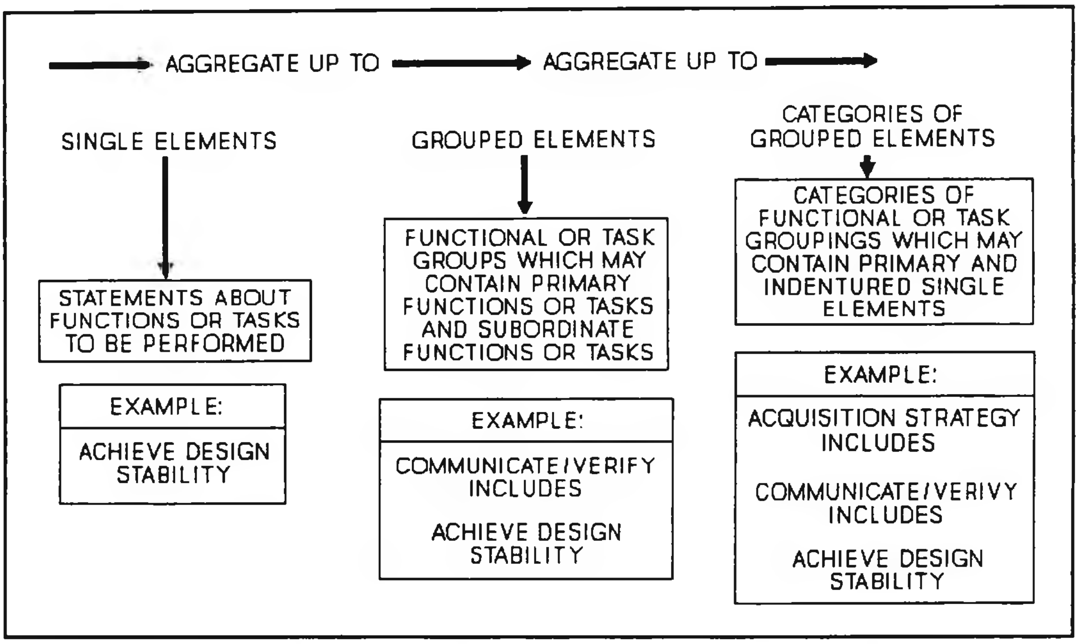
The discussion of functions/tasks necessary to move from ideas to prototype systems which follows shows an example of the detail of how individual functions/tasks were structured. There are two reasons for this:

1. Executives who make decisions about the form and structure of Defense organizations do not often participate in the detailed work which provides the knowledge upon which those structures are based. They rely on others to provide them with information sufficient to permit their choice between alternatives. Often, the alternatives are provided by individuals who also did not participate in the detailed analysis and synthesis labor which led to the recommendations presented to the mid-level management. Lacking complete understanding of the details of the process and the logic imbedded within the recommendations, mid and upper level executives often make what they consider minor changes to the recommended process and organization which turn out to have unintended major consequences. Keeping the detail embedded within the recommended processes can encourage managers at all levels to take the time to understand precisely why recommended actions are necessary. Particularly when designing or modifying complex systems, the present cultural practice of seeking a short cut (summary of the details) to understanding complexity needs to be used with great caution. Acting in the absence of understanding can condemn even the most carefully designed system before it comes into existence.

2. Retaining the detail can ensure that careful examination of the logic and rationale generated from the detailed analysis is not easily separated from the data. This permits others to experience the same sequence of steps which led participants to generate their structures in the workshops. If the alternative acquisition system is understood in detail by those who must endorse it and order its implementation, the likelihood that the recommended system will survive intact is enhanced.

It will be clear from this discussion that the aggregative and structuring processes are quite complex. Therefore, some explanation of the aggregation levels is necessary at the outset. Three levels of function/task aggregation are used in the discussion which follows. The levels are shown in Fig 6.1 with examples. The lowest level is an individual statement about a function or task to be performed. Individual functions/tasks aggregate first to functional/task groups. Functional/task groups aggregate to categories of functional/task groups.

The steps above led to a much simplified process. In turn, the simplified process permitted much reduced staffing levels in program offices and oversight agencies. The results of applying the methodology described are presented below.



FUNCTIONAL/TASK AGGREGATION LEVELS

Figure 6-1

6.4 FUNCTIONS/TASKS REQUIRED TO MOVE FROM IDEAS TO PROTOTYPICAL SYSTEMS

The first and second workshops defined functions required in moving from initial weapon system concept to production of a system prototype; the functions imbedded within "Concept Exploration and Definition", "Demonstration and Validation", and "Engineering and Manufacturing Development".

The eight participants believed performing 96 functions/tasks were necessary to move from ideas to prototypical systems.

When all the participants had thoroughly discussed each function/task and understood what each of them meant, every participant selected the five most important functions/tasks. Table 6-2 lists the 28 functions/tasks were considered to be among the five most important by one or more participant(s).

To facilitate the grouping process, each function/task was printed on an 8½" x 11" paper and posted on the wall of the room. The seven functions/tasks thought important by more than one participant were used to begin the functional aggregation process. The seven function/task statements were placed on a separate wall of the room and an area designated around the statement for aggregating other statements. Participants were

FUNCTION/TASK TO BE PERFORMED	# ITEMS	# VOTES
Clearly defined need.	1	5
Up-front risk evaluation. Contract definition.	2	3
Use seamless program management including major decisions minimizing program delay Test and evaluate operational prototypes and system integration Performance evaluation. Finalize acquisition strategy.	4	2
Understand the operational environment. Organize program management team. Analyze/Evaluate need. Review existing and required technologies. Life cycle costing. Establish configuration control process and accountability. Contractor propose price. Complete production engineering data. Build the operational prototypes. Feasibility testing. Design of demonstration process. Develop application scenarios Tell industry what is needed, heavy on performance and light on military specs. Fabricate the experimental prototypes. Define buyer involvement in contractor performance (oversight, inspection, GFE, GFP, facilitization, whole system integration) Identify Interfaces Second order effects (technology) Complete design of tooling Use pre-production model for final test evaluation Design organizational and management support for operational system Consider socio-economic burdens on performance	21	1
TOTALS	28	40

MOST IMPORTANT FUNCTIONS/TASKS PERFORMED GOING FROM IDEAS TO PROTOTYPES

Table 6-2

asked to consider whether any of the remaining 89 functions/tasks (21 which received one vote and 68 which had received no votes) should be grouped with any of the seven functions/tasks. Participants went to the wall, removed the paper containing the functional/task statement and placed it within one of the seven designated aggregation areas. Participants were asked to explain why they believed a function/task belonged together with other functions/tasks within that group. Participants were asked to confirm the aggregation by answering the question, "Does function/task *'A'* belong together with the functions/tasks now aggregated there?" Participants voted either "yes" or "no. When the group failed to reach "consensus" as defined in Chapter 4, they were asked to explain their "yes" and "no" votes so that the rationale of their argument was clear to the group. At the end of those explanations, another vote was taken. The process was repeated until consensus was reached. ***In this way, all 96 functions/tasks were grouped into seven categories.*** Table 6-3 lists the seven categories and the numbers of functions/tasks within each of them; (one function appears in two different categories).

FUNCTIONAL CATEGORIES AND NUMBERS OF FUNCTIONS IN EACH OF THEM		
1	Identify the Need	9
2	Analyze Need	15
3	Develop Acquisition Strategy	16
4	Strategy Implementation	23
5	Design Test and Evaluation	17
6	Develop Output	5
7	Management/Organization	12

FUNCTIONAL CATEGORIES IN MOVING FROM IDEAS TO PROTOTYPICAL SYSTEMS
Table 6-3

6.4.1 Functional/Task Categories

Each of the seven functional/task categories defined by the aggregation process contained five or more functional/task statements or functional/task groups. By using the aggregative process, participants formed functional/task groups and categories and indenture relationships within them. The categories and functional/task statements contained within them are described below. The convention used is to state "grouped elements" (umbrella functions/tasks) and list the included individual functions/tasks at the right of that group. If no individual functions are indentured within a set of grouped elements, the space is blank. Appendix A contains the details of all functional/tasks and task groupings within the process of moving from ideas to prototypical systems. Table 6-4 is an example of the product provided by this aggregation process. It shows the 9 individual functions/tasks involved in identifying the need for the new system.

GROUPED ELEMENTS	INCLUDED SINGLE ELEMENTS
Develop application scenarios	*Joint Service/Multi-National needs*
Clearly defined need	*Define integrated system boundaries* *Identify and define interfaces* *Evaluate countermeasures.*
Define resource and manpower requirements	*Including training and simulation needs*
Validate need	

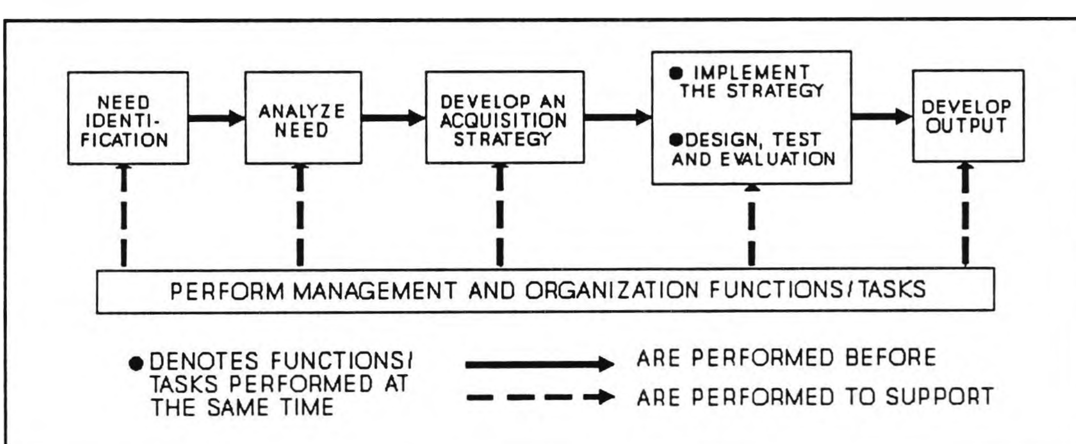
FUNCTIONS/TASKS REQUIRED TO IDENTIFY NEED AND THEIR AGGREGATE RELATIONSHIPS

Table 6-4

6.4.2 <u>Relationships Between Functional/Task Categories</u>

Having defined a set of functional categories and the indenture of all functions included within them, participants devised the relationship between functional categories. Participants achieved consensus on the structure shown in Figure 6-2 below.

Figure 6-2 indicates an intuitively logical structure among functional categories. It shows that (1) need identification must be completed before (2) needs can be analyzed; then (3) an acquisition strategy can be developed and (4) the implemented strategy, after adequate testing, can produce the output prototype weapon systems.



FUNCTIONS/TASKS TO GO FROM IDEAS TO PROTOTYPES

Figure 6-2

6.5 FUNCTIONS/TASKS REQUIRED TO MOVE FROM PROTOTYPES TO OPERATIONAL SYSTEMS

The Interactive Management methodology described in 6.2 above was used again in workshops 3 and 4 to define and structure the functions/tasks performed in moving from a working, tested prototype system to quantities of operationally supported weapon systems. The work proved to be very intricate and required considerable time to complete. Participants initially developed 260 statements which they felt should be considered as functions/tasks to be performed in moving from prototypes to fully supported, fielded weapon systems. As work progressed, some additional functions/tasks were added, and others were either consolidated or deleted. In the end, 247 individual functions/tasks were recognized and grouped within functional/task categories.

When participants had enunciated all of the functional/task statements, they were again asked to group the statements within common functional/task categories. The result of this activity was to define *four major functional/task categories*; (1) 199 individual "Pre-Production" functions/tasks structured within 10 aggregate functional/task groups, (2) 56 individual "Production" functions/tasks structured within six aggregate functional/task groups, (3) 33 "Deploying" functions/tasks structured within six aggregate functional/task groups, and (4) 26 "Sustaining" functions/tasks structured within five aggregate functional/task groups. Appendix B shows the function/task assignments within each major and aggregate group.

Because so many individual functions/tasks were grouped within major functional/task categories, the indenture process within each category was lengthy. It involved creating a large number of subordinate groupings and finding relationships within them. Appendix B shows the detail of how the individual functions/tasks are aggregated.

The discussion below deals with only the 4 major functional/task groups. Table 6-5 shows the four major groups and the aggregate groups within each of them.

Each of the major groups of functions/tasks are discussed and the sequence of performance of each aggregate group of functions/tasks shown.

6.5.1 - **Relationship Between Pre-Production Aggregate Functional Groups**

The sequence of performance among the 10 aggregate functional/task groups is shown in Figure 6-3. The "Requirement Definition" functions/tasks are performed prior to performing the functions/tasks within the Design Definition functional/task group.

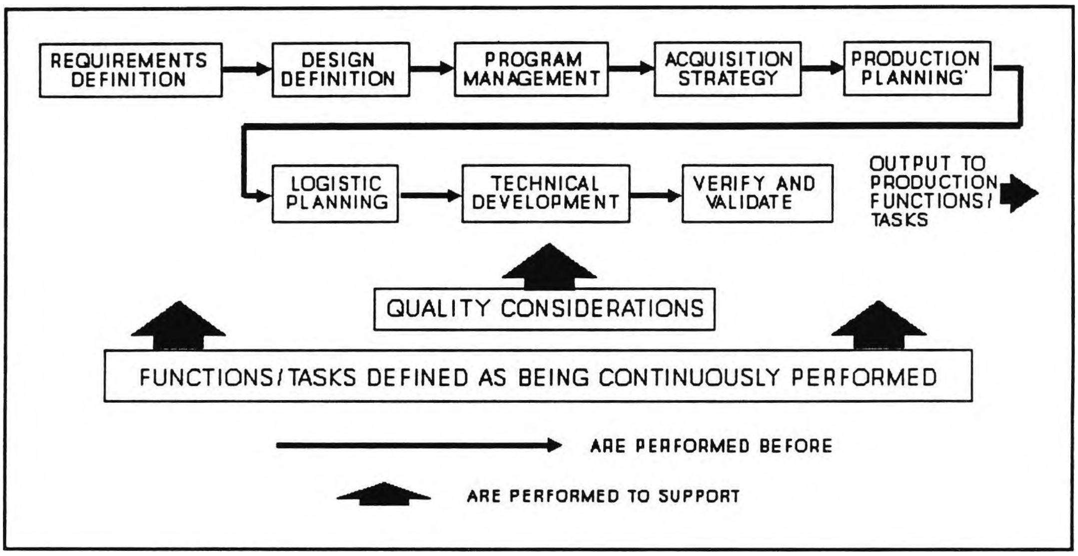
FUNCTIONAL CATEGORIES AND NUMBERS OF FUNCTIONS IN EACH OF THEM

1	**Pre-Production Functions/Tasks**	199
1-1	Requirement Definition	7
1-2	Design Definition	37
1-3	Program Management	60
1-4	Acquisition Strategy	31
1-5	Production Planning	13
1-6	Logistics Planning Considerations	19
1-7	Verify and Validate	7
1-8	Technical Development	2
1-9	Quality	2
1-10	Continuous	21
2	**Production Functions/Tasks**	56
2-1	Gear Up	22
2-2	Execution	19
2-3	Test	6
2-4	Deliver	2
2-5	Support	5
2-6	Additional Program Management	2
3	**Deployment Functions/Tasks**	33
3-1	System	4
3-2	Final Operational Test and Evaluation	3
3-3	Training	8
3-4	Facilities	2
3-5	Support	6
3-6	Continuous Management	10
4	**Sustaining Functions/Tasks**	26
4-1	Support/Refurbish	14
4-2	Monitor Performance	7
4-3	Update	2
4-4	Retire	2
4-5	Continuous	1

FUNCTIONAL CATEGORIES IN MOVING FROM PROTOTYPES TO FIELDED SYSTEMS

Table 6-5

The time line of Figure 6-3 indicates a sequential temporal relationship between 8 of the 10 functional/task groups. Quality Considerations and other functions/tasks defined as "Continuously Performed Functions/Tasks" go on throughout the pre-production phase. Figure 6-3 also indicates that the understanding derived from performance of the pre-producing functions/tasks is the basis for performing detailed production functions/tasks.

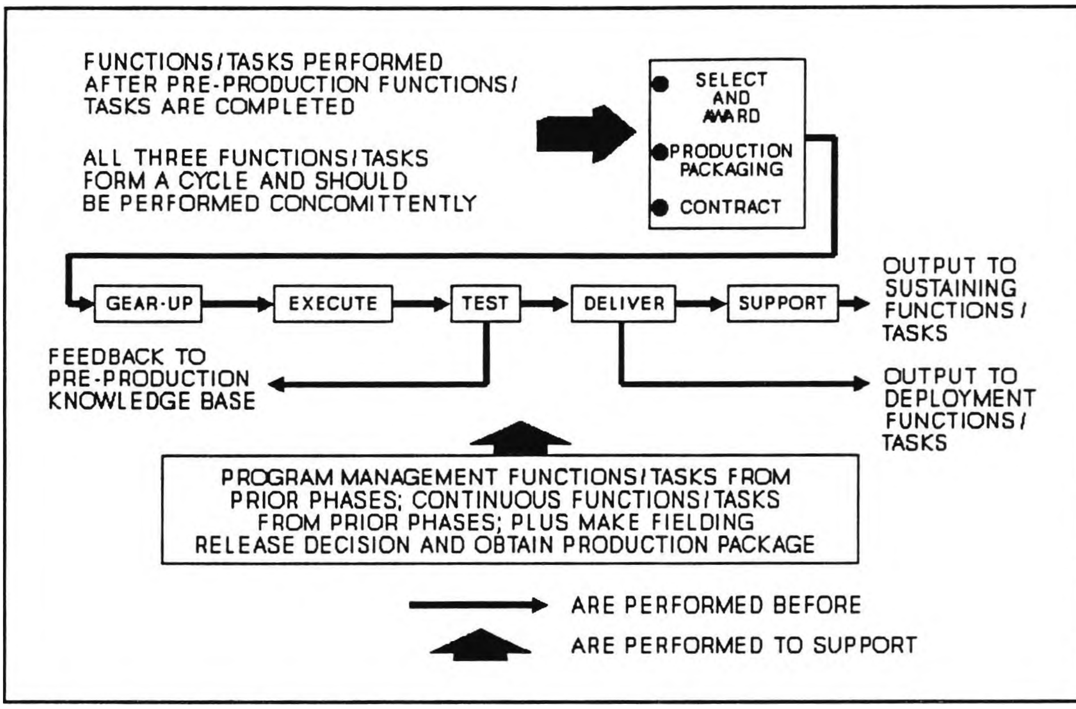


PRE-PRODUCTION FUNCTIONAL/ TASK GROUP RELATIONSHIPS

Figure 6-3

6.5.2 - <u>Relationship Between the Production Aggregate Functional Groups</u>

The Production functional/task category contained the second largest number of individual functions/tasks. Five major groups were defined, the continuous functional/task group from the pre-production function/task grouping carries through production as well; and several functional/ task statements from pre-production influence directly what occurs when the production functions/tasks are performed. These three functions form a cycle: that is, they need to be coordinated during performance and are performed concomitantly. Figure 6.4 shows the temporal relationship these three pre-production activities and between aggregate functional/task groups grouped within the Production aggregate functional group.



PRODUCTION FUNCTIONLAL/ TASK GROUP RELATIONSHIPS

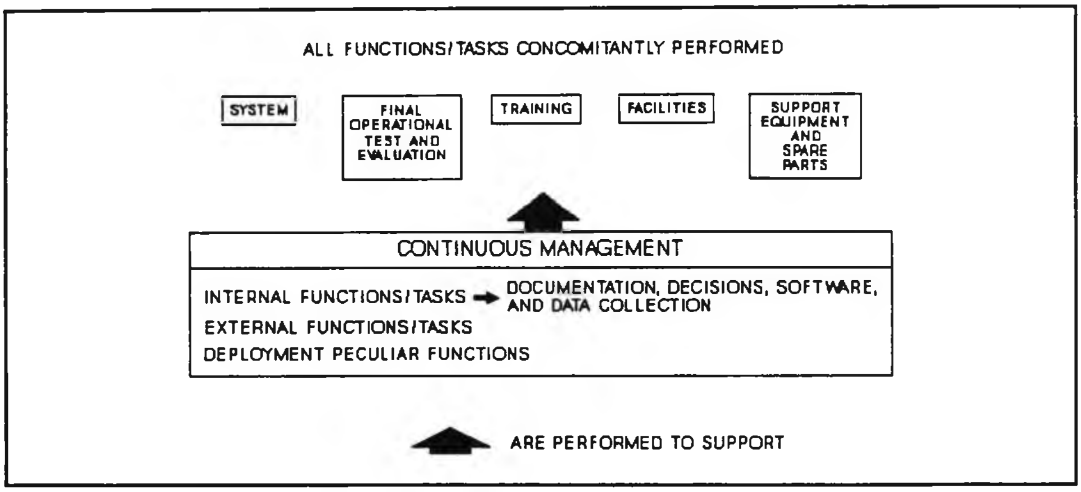
Figure 6-4

6.5.3 - <u>Relationship Between the Deployment Aggregate Functional Groups</u>

The Deployment functional/task group contained 33 discrete functions/tasks within six major groups. Only the Support and Continuous Management functional/task groups contained indentured functions.

Figure 6-5 presents the deploying functions/tasks as a group of continuing activities carried out in parallel. Although no integrative relationships are shown, it is clearly necessary to coordinate activities among the groups involved in the deployment process. The continuous management activities are, therefore, shown as a broad box which is beneath all other functional sub-groups.

Deployment of production systems can take a considerable amount of time especially if production quantities are slowed because of budgetary constraints. Deployment requires careful organization to ensure effective provision of new equipment to field locations.

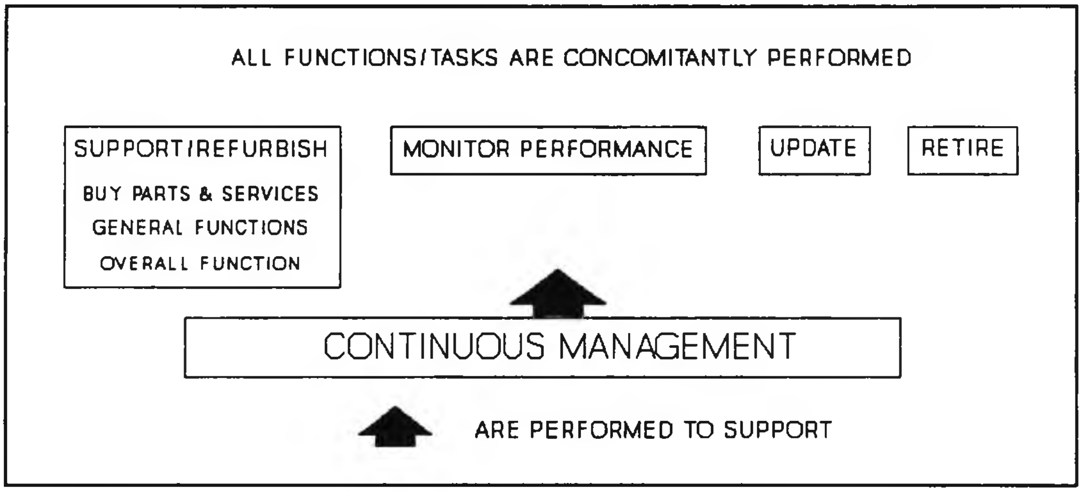


DEPLOYMENT FUNCTIONAL/ TASK GROUP RELATIONSHIPS

Figure 6-5

6.5.4 - <u>Relationship Between Sustainment Aggregate Functional/Task Groups</u>

Figure 6-6 presents the sustaining functions/tasks as groups of activities carried out in parallel.



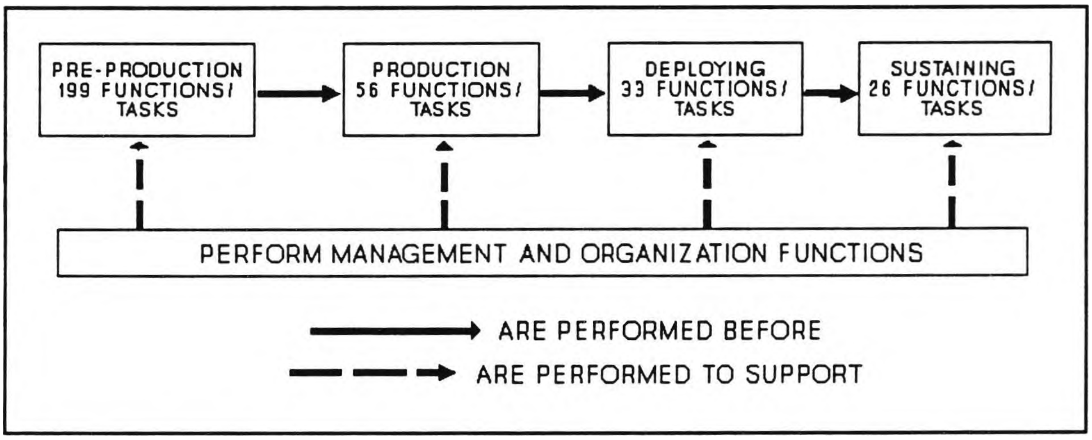
SUSTAINING FUNCTIONAL/ TASK GROUP RELATIONSHIPS

Figure 6-6

Once again, although no interactive relationships are shown, coordination among all of the functions being performed is necessary; therefore the management functions are shown in a broad box beneath all of the other functional/task groups.

6.5.5 - Functional/Task Aggregate Relationships Going from Prototype to Fully Supported Operational Systems

Figure 6-7 shows the time line of functional/task performance required to proceed from prototype devices to fully supported, fielded operational weapons. It shows that the aggregate functional/task categories are sequenced. It also indicates a group of management and organization functions/tasks that participants believed needed to be performed throughout the process of moving from prototypes to fully supported systems.



FROM PROTOTYPES TO FULLY SUPPORTED SYSTEMS

Figure 6-7

6.5.6 - Management Functions/Tasks Performed Throughout The Process of Moving From Prototypes to Operational Supported Systems

After the functional/task groupings had been completed, participants recognized that 60 functions/tasks could be aggregated as an identified "Management Functions/Task" group. All of the tasks are normally performed by the Program Management Office. To help understand exactly which functions/tasks were performed during the four major steps of the process described in Figure 6-7. participants analyzed each activity to determine when it was performed. The results of the analysis revealed that: (1) 56 management activities were performed during Pre-Production; (2) 26 were performed during Production; (3) 22 during Deployment; and (4) 25 during the Sustainment phase. The results of this comprehensive analysis are presented in Table 6-6 in matrix form.

FUNCTION/TASK	PRE-PRODUCE	PRODUCE	DEPLOY	SUSTAIN
Review and implement risk management plan	X	X	X	X
Perform production readiness reviews	X			
Concur in "Go-No Go" decisions	X			
Determine system affordability	X			
Complete sub-contractor management plan	X			
Design modification procedure and evaluation modification scope		X	X	
Determine if funding is available	X	X	X	X
Agree on delivery documentation and requirements	X	X		
Determine if the schedule is realistic	X		X	X
Determine the requirement for follow-on prototype (EMD & production)	X			
Obtain funding necessary to execute directed program	X	X	X	X
Re-organize/re-establish Program Management Office		X	X	X
Review and update configuration management plan	X	X	X	X
Ensure appropriate access to, usability and portability of essential data	X	X	X	X
Develop plan for audits	X			
Design a phasing-out process				X
Review/develop a value engineering program	X	X		X
Complete the acquisition program baseline	X			
Establish a program master schedule	X			
Establish essential elements of program information	X			
Develop a production budget	X			
Create an integrated documentation/communication network	X			
Verify that all acquisition documentation is approved and current	X	X	X	X
Develop management reserve requirements(*)	X	X	X	X
Obtain approval to award production contract	X			
Prepare CBD announcement	X			
Determine when procurement starts for procurement IA law	X			
Execute plans to build, field, and support systems/ products		X	X	X
Plan for real users to test the system	X			
Obtain required waivers (e.g., live fire testing, warranties, work measurements)	X			
Review and update system safety plan	X	X	X	X
Monitor status and manage dependencies with associated acquisitions (e.g., interfacing systems, facilities, trainers, etc)	X	X	X	X
Perform independent cost analysis	X	X	X	X
Co-ordinate DARPA involvement	X			
Define Contractor data requirements	X	X	X	X
Establish a program management team	X			
Establish a cost surveillance system	X			
Conduct source selection and award production contract	X			

PROGRAM MANAGEMENT FUNCTIONS/TASKS

Table 6-6

FUNCTION/TASKS	PRE-PRODUCE	PRODUCE	DEPLOY	SUSTAIN
Establish a technical performance measurement/monitoring system	X			
Establish a configuration control board	X			
Obtain multi-year procurement authority	X			
Maintain status of essential elements of program information(*)	X	X	X	X
Provide the contractor with approximate funding limitations	X	X	X	X
Establish Industrial Modernization Improvement Program (IMIP) Plan	X			
Establish and update CAD/CAM plan	X			
Implement contractor performance assessment and reporting system	X	X		X
Augment CAD/CAM plan with integrated computer aided software engineering tools (CASET), etc. to provide integrated data for program participants	X	X		
Establish cost schedule controlled system	X			
Integrate concurrent of weapons, associated support systems, etc.	X			
Obtain and validate work breakdown structure	X	X		
Establish Congressional and media liaison	X		X	
Project estimated weapon system management, maintenance and support costs to users	X	X		X
Establish end item sales prices for users	X			X
Establish exit criteria	X	X	X	X
Develop production contract	X			
Preserve essential program knowledge	X	X	X	X
Define and establish relationships between the PMO, Defense Contract Management Service and Contractors	X			
Develop or validate risk management plan	X	X	X	X
Develop trade-off analysis in cost, schedule and performance	X	X	X	X
Develop the Procurement and Deployment plan	X			

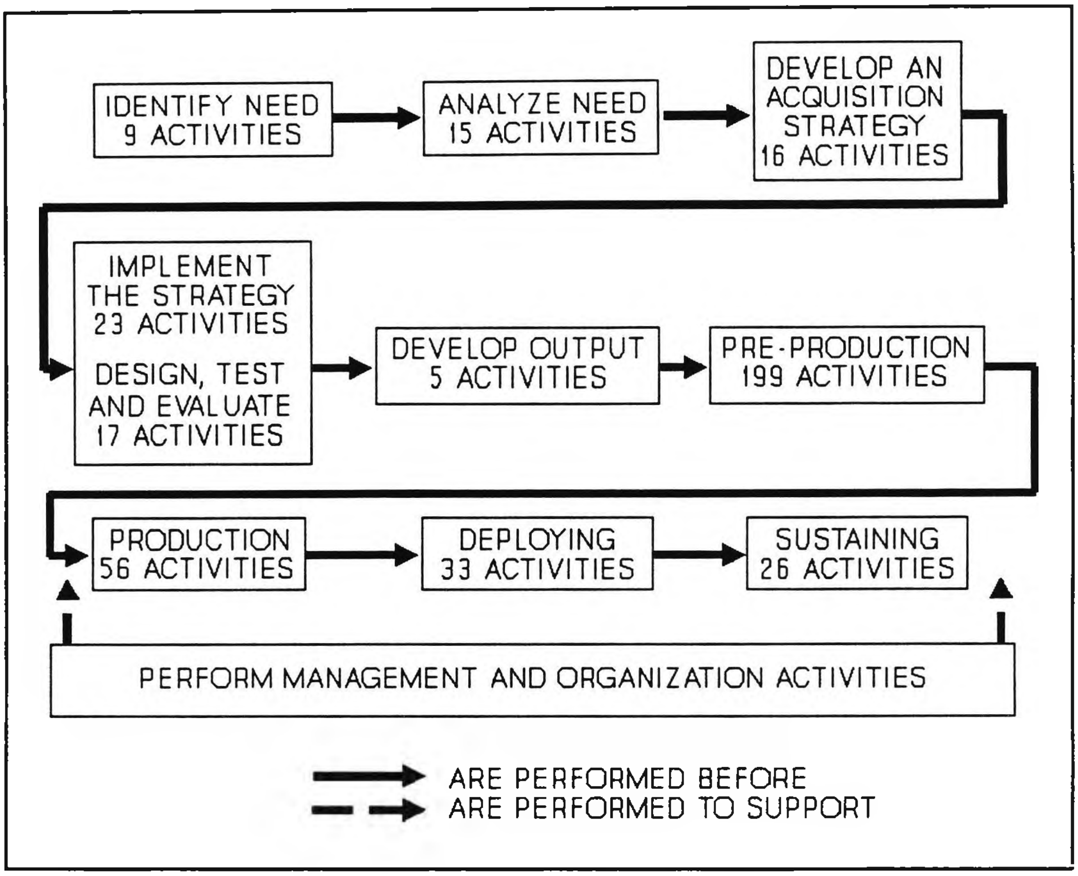
PROGRAM MANAGEMENT FUNCTIONS/TASKS

Table 6-6 (Concluded)

6.6 SUMMARY OF FUNCTIONAL/TASK ACTIVITY TO MOVE FROM IDEAS TO OPERATIONALLY SUPPORTED WEAPON SYSTEMS

Participants concluded that moving from ideas to fully operational supported weapon systems required performance of 314 functions/tasks. Participants believed that the process they developed was complete: there were no functions left out, nor were any superfluous.

Figure 6.8 presents the entire process on a time line of performance.



TIME LINE OF ACQUISITION ACTIVITY PERFORMANCE

Figure 6-8

It was clear from the work that the process of moving from ideas to fully developed, supported systems had no internal functional impediments which would delay taking appropriate actions as necessary. However, the knowledge gained from the work did indicate that the system in place had developed many impediments to efficient and effective operation developed over the years. Participants believed that the cause was concern for oversight: the perception of pervasive and consistent wrong-doing in acquisition programs which required Congress to ensure that funds were well spent led to many system functions which impeded attempts to be more effective in conduct of acquisition programs. Participants also believed that it was entirely possible to use the functional/task knowledge they had gained through the workshops to construct a new acquisition process which could permit greatly reduced acquisition staff levels and improve the cost effectiveness of the activity as well. Accomplishing those objectives would require that the process developed through this work be organizationally designed The following chapter reports on that activity and presents guidelines for creating a completely re-designed acquisition process.

CHAPTER 7
DEFINING THE FUNCTIONAL ACQUISITION PROCESS ORGANIZATIONALLY

This chapter: (1) Discusses the how participants derived organizational attributes for the functionally designed acquisition process; (2) Discusses the methodology used to derive the sets of skills required to perform the functions; (3) Reports the analytical work done to derive from the functions themselves, the particular skills necessary to implement the functional acquisition process; (4) Presents the functional acquisition process as an alternative mechanism for developing weapon systems, and (5) estimates the savings in manpower costs which might result from implementing the organization.

7.1 DERIVING ORGANIZATIONAL ATTRIBUTES FOR THE FUNCTIONALLY BASED ACQUISITION PROCESS

Participants felt that organizational attributes were defined through the functions to be performed by the organization. They believed that, given their own knowledge of acquisition functions, discussion of all of the broad aggregate functional/task groups they had generated (and each function with them) would enable them to describe the kind of work required in terms of broad, general descriptors. Phrases which described the functional/task content were developed for each of the major aggregate areas (and for aggregations of functions/tasks contained within them when large numbers of functions/tasks had been placed within subordinate aggregate groupings).

7.1.1 Moving From Ideas To Prototypes

Participants began by considering the functions/tasks to be performed in moving from ideas to prototypes. They first addressed each of the 6 major functional aggregates (Identify Need, Analyze Need and Define Program Objectives, Develop Acquisition Strategy, Implement Strategy, Design Test and Evaluation, and Develop Output) individually, and then, considered the process continuity.

Participants believed that defining organizational attributes was necessary to gain broad understanding of the functional process they had defined. Since most participants had participated in more than one major weapon development program that had passed through the first two milestones shown in Figure 2-1 (Concept Exploration and Demonstration and Validation), they also believed that, as a group, they had considerable knowledge about the kind of organization required to move from ideas to prototypes. The organizational attributes they developed are presented in Table 7-1.

PROCESS STEP	ORGANIZATIONAL ATTRIBUTES
Identify Need	● Organization has the ability to articulate operational/user needs considering joint service and multi-national perspectives. Very sensitive to strategic considerations. ● Acts as a centralized focus group which defines need. Need is handed off to analysis team interactive and the group then acts as clearing house/honest broker to focus ideas which are input and provide a clear output product for analysis. ● Strategy is driven by a "get" from a variety of sources and has the ability to deal with three distinct worlds: technological, political, and operational.
Analyze Need and Define Program Objectives	● A small group of technical and operational personnel established as a task force for the effort. May be multi-service or multi-disciplinary or both. First organizational structure with direct link to decision-makers. ● Agreement on concept and cost permits presentation of product to decision maker with funds. If approved, program goes on to next step.
Develop Acquisition Strategy	● Design physical constraints. Define "What-to-do"; concept translated into reality including policy, social, political and program constraints. ● External requirements; "How-to-do" including oversight and accountability. ● Management (organizational constraints); "How-to-make-it-happen"; progress measures, links back to essential elements of information. ● Opportunity for P.M. to review program with decision maker. Decision maker should strongly justify any change to the program
Implement Strategy	● Organizational lines of authority clearly defined (charters, organization charts, realistic elements of authority including the "golden rule"). P.M. has direct and total control: picks his own people and can reward and punish. Well resourced in facilities, well trained and experienced personnel, and financed. ● Good two way communication with higher authority.
Design Test and Evaluation	● Separate design teams - innovative - allow design team chief to select personnel, design methodology and provide resources which support innovation. ● Alert P.M. to need for continuous communications between teams and facilitate inter-team communication. ● Separate Test and Evaluation team independent of design team. T&E design commensurate with project evaluated - includes operational user.
Develop Output	● Provide output to production - technical and manufacturing capability. End of the Prototype Process.

ORGANIZATIONAL ATTRIBUTES OF PROCESS STEPS IN MOVING FROM IDEAS TO PROTOTYPES

Table 7-1

7.1.2 Moving from Prototypes to Deployed, Supported Systems

Table 7-2 presents the result of the review of the functional aggregates they derived for major functional aggregate groups and the grouped functions within the Pre-Production functional aggregate group.

PROCESS STEP	ORGANIZATIONAL ATTRIBUTES
Pre-Producing Group	
Requirements Definition	• Predominantly a user and high level management team.
Design definition	• Basically a technical and logistics oriented team with a high degree of management integration augmented by specialty disciplines. • Coordinates and interfaces with users. • Builds on work/outputs from prior phase.
Acquisition strategy	• Basically a management and procurement team capitalizing on best practices.
Production Planning	• Primarily a manufacturing activity.
Logistic Planning	• Primarily a logistics activity with close user coordination.
Technical Development	• Research/scientific organization.
Verify and Validate	• Engineering activity with test development skills: ability to test,inspect, analyze and demonstrate.
Quality	• An independent managerial activity.
Continuous Functions	• Basically a management lead team with a well balanced and dedicated interdisciplinary corps from all other disciplines. • Sustained coordination and interface with users. • Anticipates consequences (forward looking), and discerns relationships/fixes/resources. • Maintains continuity of team membership.
Producing Group	• A manufacturing and management team augmented by inter-disciplinary support. • Process oriented and highly planned activities.
Deploying Group	• Basically a logistics and technical team augmented by other interdisciplinary support. • High degree of coordination and interface with users. • Flexible, service oriented with site, user, and schedule dependencies.
Sustaining group	• Basically a logistics team with management and engineering support. • A high degree of coordination and interface with users. • Flexible/responsive; event and cycle driven. • Co-located with primary source of supply and accessible industrial support. • Flexible contractual vehicle for maintenance is desired.

ORGANIZATIONAL ATTRIBUTES OF PROCESS STEPS IN MOVING FROM PROTOTYPES TO DEPLOYED WEAPONS

Table 7-2

7.2 DETERMINING THE KINDS OF SKILLS AND SKILL LEVELS REQUIRED TO PERFORM ACQUISITION FUNCTIONS

While participants believed they had correctly assessed the organizational characteristics necessary to proceed through the functional acquisition process, they were less certain of their ability to determine skills required of individuals who performed that process. The Workshop Director had been involved in organizational analysis of that kind and was asked to provide information about that work to participants.

7.2.1 The Hay Methodology

Once every four years, the U. S. Government empanels a group of individuals to review compensation levels of government workers and compare them with worker compensation in similar industrial jobs. Comparisons between the private and public sector work are made using a set of analytical tools developed in 1927 by Edward N. Hay. founder of Edward N. Hay and Associates (a prominent world-wide management consulting firm). Hay hypothesized that all jobs could be described in terms of their content using three basic categories of descriptor: (1) Know-How, (2) Problem Solving, and (3) Accountability. Throughout the years, because of the wide use of the method, much data has been collected to test the methodology. Its survival and continued use after almost 70 years is testimony to its utility and acceptance throughout the private and public sectors. Complete discussion of the methodology and how it is applied can be found in works by Milton L. Rock [180]; and Alvin O. Bellak PhD [181].

The three basic variables in the Hay method are treated as independent variables in job analysis. For each variable, a set of phrases was developed which described individual job performance. Each phrase indicates a more demanding job skill level. Quotation marks in the discussion and tables that appear in paragraphs below indicate direct quotation from [181].

- **Know-How**: Know-How is defined as "the sum total of every kind of skill, however acquired, required for acceptable job performance. This sum total which comprises the over-all 'savvy' has three dimensions: (1) Practical procedures, specialized techniques, and scientific disciplines; (2) Know-how of integrating and harmonizing the diversified functions involved in the managerial situations occurring in operating, supporting and administrative fields. This Know-how may be exercised consultively (about management) as well as executively and involves in some combination the areas of organizing, planning, executing, controlling, and evaluating; (3) Active, practicing face-to-face skills in the areas of human relationships." "Know-How has both scope (variety) and depth (thoroughness. Thus a job might require some knowledge about a lot of things or a lot of knowledge about a few things. The total Know-How is the combination of scope and depth....How much knowledge about how many things."

The set of eight phrases in Table 7-3 describe levels of knowledge required to perform tasks/functions.

- *"PRIMARY - Elementary plus some secondary or equivalent education plus work indoctrination.*
- *"ELEMENTARY VOCATIONAL - Uninvolved standardized work routines and/or use of simple equipment and machines.*
- *"VOCATIONAL - Procedural or systematic proficiency which may involve the use of specialized equipment.*
- *"ADVANCED VOCATIONAL - Some specialized (generally non-technical) skills however acquired which give additional depth to a generally single function.*
- *"BASIC TECHNICAL SPECIALIZED - Sufficiency in a technique requiring grasp of involved practices/precedents; scientific theory/principles; or both*
- *"SEASONED TECHNICAL SPECIALIZED - Proficiency gained through experience in a specialized or technical field*
- *"TECHNICAL SPECIALIZED MASTERY - Exceptional competence and unique mastery in scientific or other learned discipline"*
- *"PROFESSIONAL MASTERY - Exceptional comprehension and unique mastery in scientific or other learned discipline."*

HAY METHOD "KNOW-HOW" JOB ANALYSIS DESCRIPTORS

Table 7-3

Using the Hay methodology requires selection of one phrase from among the group of eight which best describes the work to be done.

Each of the eight phrases is subject to a group of four alternative conditions which describe the scope of activity performed. These conditions appear in Table 7-4.

- *"LIMITED - Performance or supervision within a single function with operational regard for relevant activities.*
- *"RELATED - Primarily within a single function with some internal or external integration with related fields.*
- *"DIVERSE - Integration and co-ordination of diversified activities in an operating unit or in a corporate wide function.*
- *"COMPREHENSIVE - Comprehensive integration and co-ordination in a major management complex, or of a corporate-wide activity.*

HAY METHOD "KNOW-HOW" JOB ANALYSIS DESCRIPTOR ALTERNATIVE CONDITIONS

Table 7-4

- **Problem Solving**

Problem solving is defined as "the original, 'self-starting' thinking required by the job for analyzing, evaluating, creating, reasoning, arriving at and making conclusions. To the extent that thinking is circumscribed by standards, covered by precedent or referred to others, problem solving is diminished and the emphasis correspondingly placed on Know-How."

Problem solving has two dimensions: (1) The thinking environment in which the problems are solved, and (2) The thinking challenge presented by the problem to be solved." Problem solving measures "the intensity of the mental process which employs Know-How to identify, define, and resolve a problem. 'You think with what you know'...is true of even the most creative work...The raw material of any thinking is knowledge of facts, principles and means; ideas are put together from something already there. Therefore, problem solving is treated as a percentage utilization of Know-how." Table 7-5 lists the eight levels of problem solving skills.

Each of the eight phrases is further affected by a group of five conditions which describe the scope of activity performed. Table 7-6 presents those conditions.

- **Accountability**

Accountability is defined as "the answerability for action and for the consequences thereof. It is the measured effect of the job on end results. It has three dimensions: (1) Freedom to act - the degree of personal or procedural control and guidance as defined by one of the seven iterations below, (2) Job

- *"STRICT ROUTINE - Simple rules and detailed instructions*
- *"ROUTINE - Establish routines and standing instructions*
- *"SEMI-ROUTINE - Somewhat diversified procedures and precedents*
- *"STANDARDIZED - Substantially diversified procedures and specialized standards*
- *"CLEARLY DEFINED - Clearly defined policies and principles*
- *"BROADLY DEFINED - Broad policies and specific objectives*
- *"GENERALLY DEFINED - General policies and ultimate goals*
- *"ABSTRACTLY DEFINED - General laws of nature or science, within a framework of cultural standards and business philosophy."*

HAY METHOD "PROBLEM SOLVING" JOB ANALYSIS DESCRIPTORS

Table 7-5

- *"REPETITIVE - Identical situations requiring solution by simple choice of learned things.*
- *"PATTERNED - Similar situations requiring solution by discriminating choice of learned things*
- *"INTERPOLATIVE - Differing situations requiring search for solutions within one of the learned things*
- *"ADAPTIVE - Variable situations requiring analytical, interpretative, evaluative, and/or constructive thinking*
- *"CREATIVE - Novel or non-recurring pathfinding situations requiring the development of new concepts and imaginative approaches."*

HAY METHOD "PROBLEM SOLVING" JOB ANALYSIS DESCRIPTOR ALTERNATIVE CONDITIONS

Table 7-6

impact on end results"; whether the impact is *indirect* (whether the work has a remote or contributory impact), *direct* (the work involves participating with others not subordinate or superior, within or outside the organization unit taking action), or *has a controlling impact on end results*, (where shared accountability of others is subordinate).

There are seven levels of accountability described in Table 7-7

- ***"PRESCRIBED - Direct or detailed instructions. Close supervision***
- ***"CONTROLLED - Instructions and established work routines. Close supervision***
- ***"STANDARDIZED - Standardized practices, procedures. General work instructions. Supervision of progress and results***
- ***"GENERALLY REGULATED - Practices and procedures covered by precedents or well defined policy. Supervisory review***
- ***"DIRECTED - Broad practice and procedures covered by functional precedents and policies. Achievement of a circumscribed operational activity. Managerial direction***
- ***"ORIENTED DIRECTION - Functional policies and goals. Divisional management and/or policy direction***
- ***"TOP MANAGEMENT GUIDANCE - Inherently subject only to broad policy*** and ***top management guidance."***

HAY METHOD "ACCOUNTABILITY" JOB ANALYSIS DESCRIPTORS
Table 7-7

Table 7-8 lists the alternative conditions which apply to the accountability phrases. Each depends upon the level of incumbent dollar responsibility.

- ***"VERY SMALL OR INDETERMINATE - Under $100 thousand***
- ***"SMALL - Between $100 thousand and $1 million***
- ***"MEDIUM - Between $1 million and $10 million***
- ***"LARGE - Between $10 million and $100 million."***

HAY METHOD "ACCOUNTABILITY" JOB ANALYSIS DESCRIPTORS ALTERNATIVE DESCRIPTORS
Table 7-8

7.2.2 Author's Experience Applying The Hay Methodology

In April 1978, the author used the Hay methodology to compare compensation of U. S. Naval personnel with that of comparably employed individuals in the private sector. As a result of that work, the author created a computer driven organization analysis model which permitted alternative organizational structures to be evaluated and compared in terms of the way in which job functions/activities were distributed among staff, and by the cost of direct and indirect manpower. The model was used by the Hay Company to evaluate three competing Research and Development organizational schemes. The Hay Company reported the model results to its client firm and made its recommended organizational selection based on those results.

The author's work was separately reported at a meeting of the Operations Research Society of America in April 1983 and published by the organization which sponsored it [182].

7.2.3 Devising Skill Sets For The Acquisition Process

After participants had been exposed to the Hay Methodology and to the organizational model methodology, they were asked to apply the work-factor concept to the skills required to perform the acquisition process they had devised. Participants reviewed the broad spectrum of functions/tasks involved in the functional acquisition process and decided to develop a set of acquisition work-factor definitions which could be used when reviewing the functions/tasks necessary in each step of the acquisition process. The purpose in doing this was to understand the kinds of people needed to staff the various organizational elements.

Because all of the people participating in Defense Acquisition are focused on specific functions, participants felt that the broad nature of the Hay job descriptors would not provide a balanced understanding of the personnel attributes required to perform the specialized tasks defined in Chapter 6. Participants believed skills necessary to perform defense acquisition would not be fully captured by the three sets of Hay job descriptors.

Participants then set about defining a group of personnel attributes (skills) which they organized into skill sets: a blend of several kinds of expertise. Participants constructed the seven skill sets shown in Table 7-9 to use in their analysis of personnel attributes required to perform the aggregate functional/task groupings which, in their totality, define the Defense Acquisition Process derived in Chapter 6.

For each individual function/task, the question was asked:

"In the context of the complete set of functions/tasks within this major aggregate, which of the 7 skill sets applies to each function/task?"

Table 7-10 provides an example of how the analysis proceeded using this methodology. Table 7-10 shows that except for task number 21, Determine Repair and

SKILL SET	NARRATIVE DESCRIPTION
Management Skill Set	Primarily skilled in managing diverse disciplines; capable of understanding details of significant factors in those disciplines integral to the program.
Engineering Skill Set	Highly expert in engineering disciplines; understands principles of other disciplines integral to development, production, and sustaining activities.
Logistic Skill Set	Highly skilled and having in-depth knowledge of the principles and practices of sustainment activity at both tactical locations and in production and program management sites.
Procurement Skill Set	Procurement professional with detailed understanding of contracting principles and practices; capable of using technical inputs from other program skill sets to achieve procurement objectives.
Finance Skill Set	Deep understanding and knowledge of financial activities and capacity to use technical inputs from other program skills to achieve timely financial support for program activities.
Manufacturing Skill Set	Expert in technology and practice of manufacture both of singular items and production quantities of complex technical sub-systems and systems. Capable of defining requirements for production facilities and individual production components for both "in-use" and "new" production techniques.
User Skill Set	Seasoned, skilled in theory and practice of military tactical operations. Capable of translating tactical understanding into useful input for program office team specialists to help define policies and actions which keep the program focused on its military objectives.

SKILLS REQUIRED TO PERFORM THE FUNCTIONAL ACQUISITION PROCESS

Table 7-9

Maintenance requirements) *User Skills* are required for all functions/tasks which comprise the aggregate group "*Identify Need*". For tasks numbers 1, 16, 44, 50, and 93, user skills are all that are necessary. *Logistic Skills* alone are required to perform function/task number 24, and for functions/tasks numbers 24 and 82. *Manufacturing Skills* and *Engineering Skills* are required for performance of 2 functions/tasks (24 and 82). And *Management Skills* are only required when *"Joint Service/Multi-National Considerations* are involved. The analysis appears to make it clear that the aggregate set of functions involved in this segment of moving from ideas to prototypes should be the responsibility of users. It also makes clear that there is need for mixed groups of skills in performing many functions/tasks. This point will be discussed in greater detail below. Details of the complete skill set analysis for all 314 functions/tasks performed

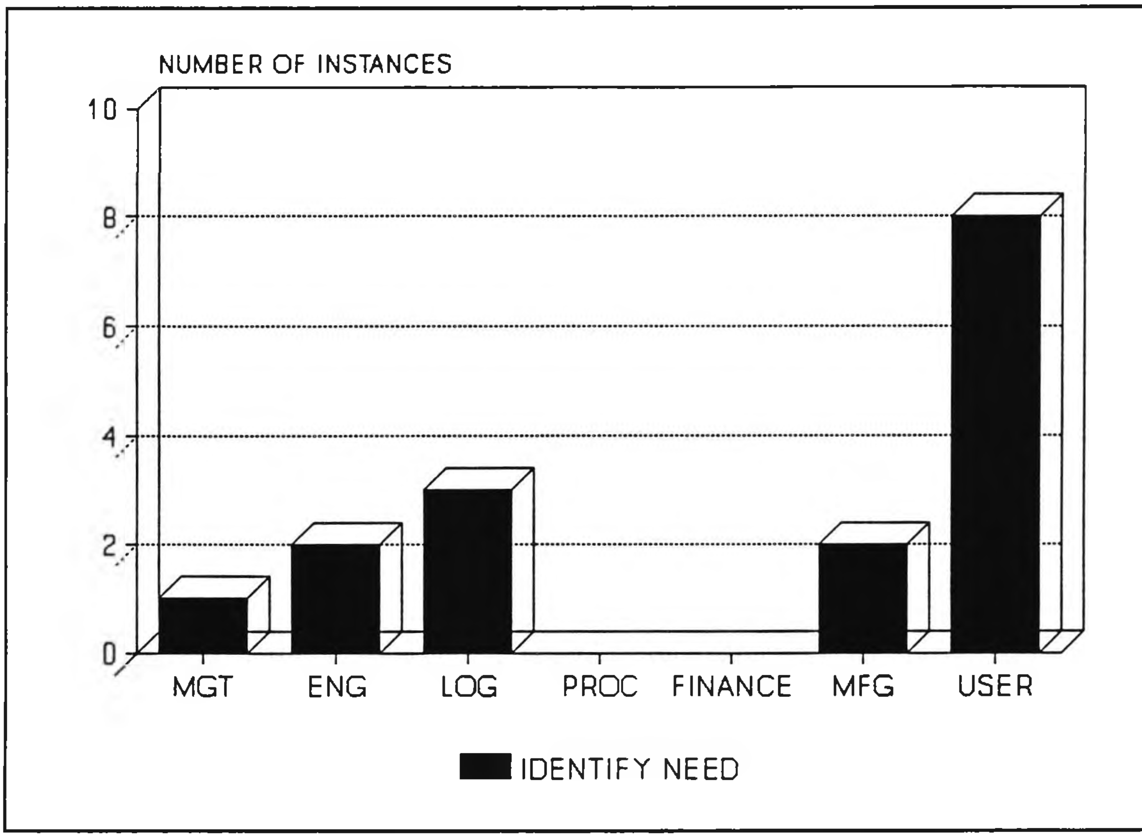
ACQUISITION PROCESS FUNCTIONAL/TASK GROUPS	MANAGEMENT	ENGINEERING	LOGISTICS	PROCUREMENT	FINANCE	MANUFACTURING	USER	CATEGORY TOTAL
CATEGORY A - IDENTIFY NEED								
1. Clearly defined need							X	1
16. Develop application scenarios							X	1
21. Define R&M requirements			X					1
24. Defining integrated system boundaries		X	X			X	X	4
44. Initial validation of need							X	1
50. Include training and simulation							X	1
82. Identify/define interfaces		X	X			X	X	4
93. Evaluate counter measures							X	1
104. Joint service/multi-national considerations	X						X	2
GRAND TOTAL	1	2	3			2	8	16

SKILLS SETS REQUIRED TO PERFORM FUNCTIONS/TASKS IN THE "IDENTIFY NEED" AGGREGATE GROUP

Table 7-10

in moving from ideas to deployed supported systems appear in Appendix C.

Figure 7-1 represents Table 7-10 graphically. It shows clearly that the predominance of tasks are performed by users. Together with the function/task statements, the skill set analysis (which provided skill mix for tasks to be performed within aggregate functional/task groupings) gave participants insight into how to organize for effective task performance. For example: if the largest share of functions/tasks required user skill sets, and the second largest number of tasks required engineering skill sets, the most effective organization might be one controlled by users and augmented by engineering skills as required.



SKILL SETS TO "IDENTIFY NEED" GOING FROM PROTOTYPES TO SUPPORTED SYSTEMS
Figure 7-1

Participants divided their skill-set analysis into two parts: (1) Skills required to move from ideas to prototypical systems; and (2) Skills required to perform Pre-Production, Production, Deployment, and Sustainment functions.

7.2.4 **Skills Required in Moving from Ideas to Prototypes**

When skill sets had been defined, participants nominated the group members most familiar with the process of moving from ideas to prototypes to meet with the Workshop Director and detail the skill set requirements for each of the functions/tasks included within this portion of the acquisition process. Table 7-11 summarizes the distribution of skill sets for each of the major functional aggregate groups formed in the process of moving from ideas to prototype items.

As participants reviewed Table 7-11, they became convinced that the functional process of moving from ideas to prototypical weapon systems contained two phases: (1) Identifying and Analyzing Needs and using those needs to Define Program Objectives;

ACQUISITION PROCESS FUNCTIONAL/TASK GROUPS		MANAGEMENT	ENGINEERING	LOGISTICS	PROCUREMENT	FINANCE	MANUFACTURING	USER	CATEGORY TOTAL
A	*IDENTIFY NEED*	1	2	3	0	0	2	8	16
B	*ANALYZE NEED AND DEFINE PROGRAM OBJECTIVE*	6	13	4	3	2	10	9	48
C	*DEVELOP ACQUISITION STRATEGY*	13	14	7	12	5	15	10	76
D	*IMPLEMENT STRATEGY*	16	15	9	18	7	13	5	83
E	*DESIGN, TEST AND EVALUATION (DOING)*	8	19	9	0	0	19	9	64
F	*DEVELOP OUTPUT*	5	8	3	2	3	6	4	31
G	*CONTINUOUS MANAGEMENT FUNCTIONS*	5	2	1	2	2	2	3	17
	GRAND TOTAL	54	73	37	37	19	67	48	335

SKILLS SETS REQUIRED TO PERFORM FUNCTIONS/TASKS IN THE AGGREGATE GROUPS IN MOVING FROM IDEAS TO PROTOTYPES

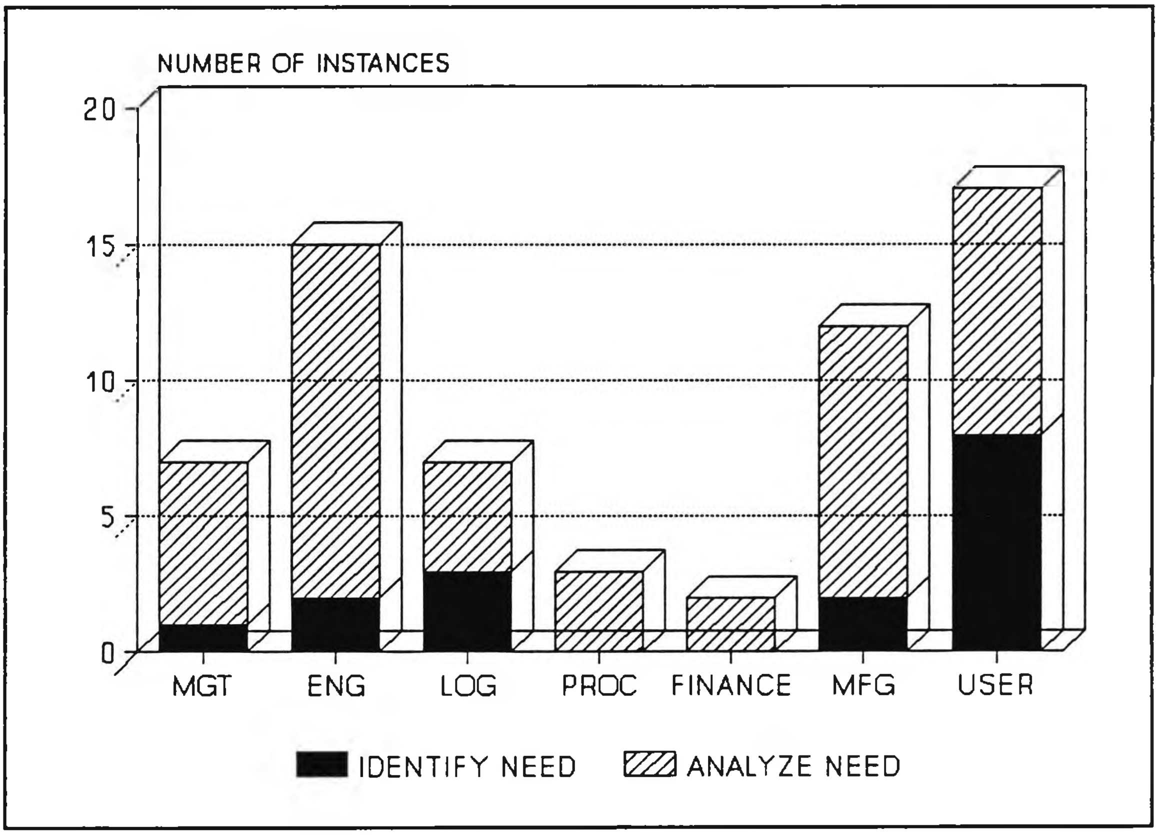
Table 7-11

and (2) Developing and Implementing the Acquisition Strategy, Design, Test and Evaluation of the new system, and Developing Output (i.e., prototypical systems). Participants also believed that the two phases were sequential and could be performed best if two different kinds of organizational groupings were established:

- The first phase would be carried out by those whose responsibilities included defining when new weapons were required.
- The Government would place the second phase on contract to an organization

which had previously developed prototypical weapons systems effectively. The organization used as an example of was Lockheed's "Skunk Works" [123] which had efficiently developed the U-2 and RB-71 surveillance aircraft (both of which became fully operational with little or no difficulty.)

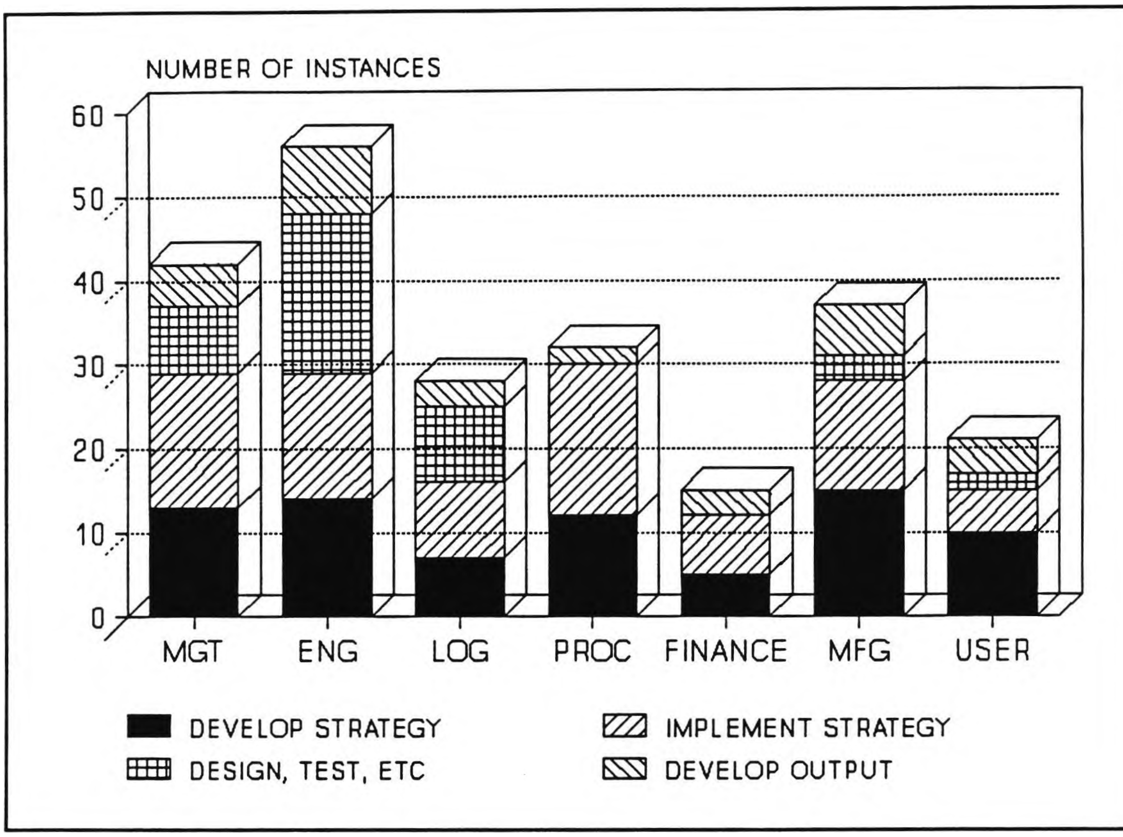
Figure 7-2 shows the skill set distribution for the first part of the process of moving from ideas to prototype weapon systems.



SKILL SETS TO PERFORM PHASE ONE FUNCTIONS GOING FROM IDEAS TO PROTOTYPE SYSTEMS
Figure 7-2

Similarly, Figure 7-3 shows how skill requirements distribute in the second phase of the process of moving from ideas to prototypes.

In performing the functions required to move from ideas to prototypical weapon systems, participants believed that each phase's management functions would be performed by individuals responsible for the product at that phase. **Managing the act-**



SKILL SETS TO PERFORM PHASE TWO FUNCTIONS GOING FROM IDEAS TO PROTOTYPES SYSTEMS
Figure 7-3

ivities which identified the need, analyzed it and provided the program objective would be accomplished by the *users responsible for those functions*. Similarly, developing acquisition strategy, implementing it, and delivering end product would be *contractor managed within a predominantly engineering development organization*.

7.2.5 Skills Required in Moving from Prototypes to Supported Systems

Participants reviewed the functional aggregates they had derived and analyzed them using the skill sets in Table 7-9. Participants felt their careful consideration of the skill sets necessary in performance of each function/task in moving from prototypes to fully supported systems had provided them with deep insight into how best to construct a functionally responsive organizational structure for that very complex portion of the functional acquisition process. Appendix C presents the details of this multi-faceted analysis.

Once again participants found that multiple skill sets were usually required to perform the tasks necessary.

Some additional insights were developed:

- A number of functions/tasks needed to be performed within more than one functional/task group or sub-group: for example, the function/task "determine if funding is available" and "reassess risk management plan" are performed in every major functional/task group; and "reassess operational suitability" is performed both within deployment and sustaining activities.
- To achieve adequate functional performance of some functions/tasks required simultaneous application of a broad set of skills: for example, of the 37 individual functions\tasks required to achieve Design Definition (moving from prototypes to fully supported system), 11 can be performed adequately using just a single skill set; 15 require two skill sets; six functions require three skill sets, and five demand four skill sets for satisfactory performance.
- A group of functions/tasks was performed, either sporadically or continuously during all phases of the process of moving from prototype systems to supported operational systems. These functions/tasks were a kind of "overhead" functional/task set. Their performance was necessary to permit performance of the fundamental developmental and support activities, "non-management functions/tasks".

Table 7-12 lists the aggregate function/task groups in each major functional/task aggregate group and shows the number of each kind of skill sets participants felt were required to perform them adequately. The functions in Table 7-12 enumerate both technical and management functions performed. It is important to remember that the functions/ tasks included there are performed by a Government agency and do not include all the detail of engineering and manufacturing tasks functions/tasks performed by the firm which has contracted with the Government to design, manufacture, test, and evaluate the end item. Neither does this include production and deployment of the product nor the field support which normally fall to a commercial original equipment producer. The Government role is to oversee and facilitate performance of those tasks by the contractor's staff at the contractor's facility.

The first column in table 7-12 shows functional/task groups defined in Chapter 6 as necessary to move from prototype systems to operational systems supported in the field. The middle 7 columns (labelled Management, Engineering, Logistics, Procure-

ACQUISITION PROCESS FUNCTIONAL/TASK GROUPS	MANAGEMENT	ENGINEERING	LOGISTICS	PROCUREMENT	FINANCE	MANUFACTURING	USER	CATEGORY TOTAL
PRE-PRODUCTION FUNCTIONS								
Requirement Definition	4	1	2	0	0	0	7	14
Design Definition	16	27	20	4	2	7	3	79
Acquisition Strategy	28	7	4	16	0	2	1	58
Production Planning	5	0	0	0	0	13	0	18
Logistic Planning	3	3	19	1	0	0	7	33
Technical Development	0	2	0	0	0	0	0	2
Verify/Validate	1	7	0	0	0	0	0	8
Quality	2	0	0	0	0	2	0	4
Continuous	18	8	10	5	7	3	7	58
Management	55	24	20	10	16	14	13	152
PRODUCTION FUNCTIONS								
Gear-up	13	4	2	6	0	17	0	42
Execute	4	3	6	2	0	8	2	25
Testing	1	1	2	0	0	2	1	7
Deliver	1	0	1	0	0	2	0	34
Support	1	0	5	0	0	0	0	6
Management	27	12	10	3	6	18	1	77
DEPLOYMENT FUNCTIONS								
System	1	1	1	1	0	0	0	4
Final Operational Testing	1	3	0	0	0	0	2	6
Training	0	1	8	0	0	1	4	14
Facility	0	0	2	0	0	0	2	4
Support	0	0	6	0	0	0	0	6
Internal Management	5	5	6	0	0	1	6	23
Management	23	11	14	3	5	5	14	75
SUSTAINMENT FUNCTIONS								
Support	4	3	8	5	0	1	1	22
Monitor	4	5	5	0	0	0	3	17
Update	2	2	1	0	0	0	0	5
Retire	1	1	0	1	0	0	0	3
Continuous	1	0	2	0	1	1	1	6
Management	25	11	19	2	7	2	12	78
GRAND TOTAL	**245**	**142**	**173**	**59**	**44**	**102**	**87**	**850**

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPE WEAPONS TO FIELDED, SUPPORTED SYSTEMS

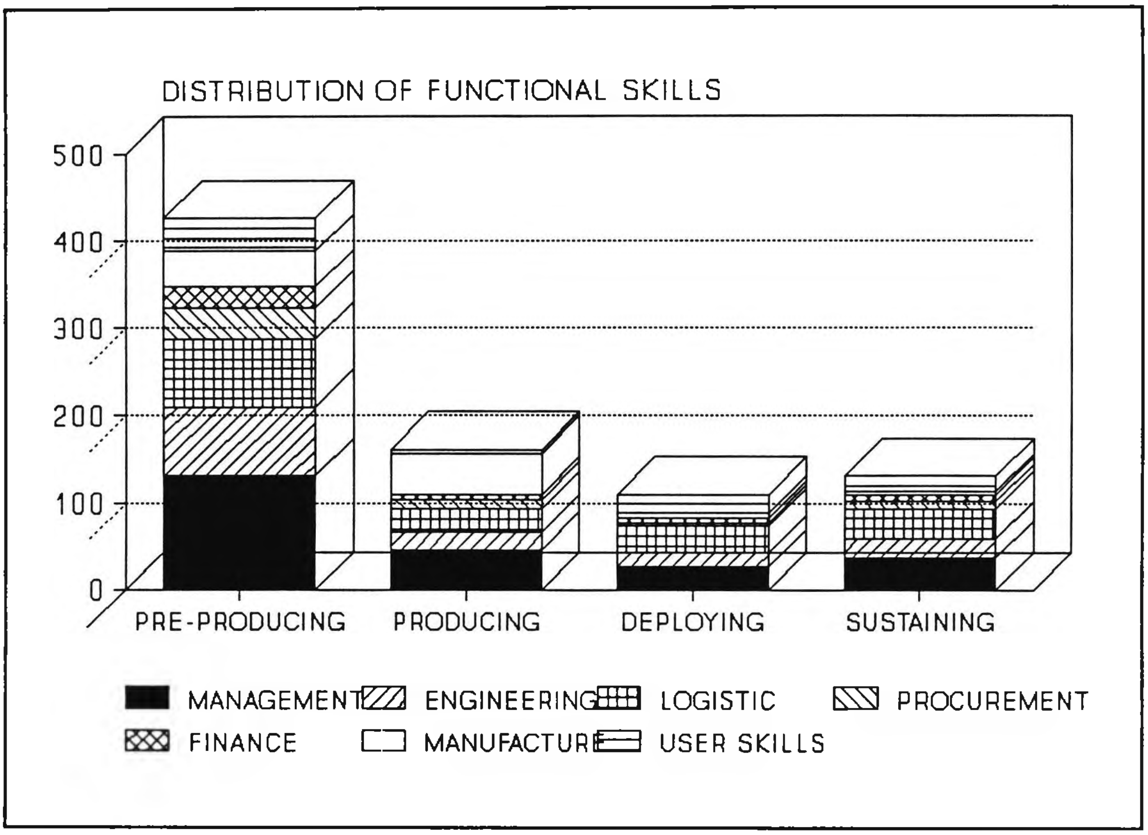
Table 7-12

ment, Finance, Manufacturing and User) are the skill set categories which participants defined. Numbers in these columns indicate how many functions/tasks within the functional grouping require application of those skill sets. The last column in Table 7-12 sums the number of functions/tasks included in the individual functional/task groupings.

As an example, Table 7-12 shows performing the 7 functions/tasks involved in the *Requirements Definition* portion of the *Pre-Production function/task groups* will require applying management, engineering, logistics, and user skill sets. Similarly, 36 functions/tasks were identified as necessary to do *Design Definition.* 16 of them will require application of management skill sets, 27 will require engineering skills, 20 will need logistics skills, 4 will have need for procurement skills, 2 for finance skills, 7 for manufacturing skills and 3 for user skills. Table 7-12 shows that performing all of the management and technical functions/tasks requires 850 applications of the 7 skill sets.

An extremely interesting observation resulted from this analysis: ***It is clearly evident from Table 7-12 that performance of almost all "non-management" and "management" functions requires application of more than one type of skill.*** The concept of Integrated Product Teams (IPT) is becoming popular with many kinds of organizations. When an organization adopts IPT it institutionalizes the mechanism for using teams of diversely skilled individuals to carry out complex tasks. The redesigned acquisition process accomplishes just such institutionalization.

Figure 7-4 shows the distribution of skill sets across the four major functional aggregate groups. It is clear from Figure 7-4 that the most complex tasks in going from prototypes to production involve Pre-Production activities. Not only are many more functions/tasks performed than are performed in any other developmental phase, but there are larger numbers of diverse skill sets required to perform them. Specifically, 199 functions/tasks are identified, and 426 applications of skill sets are required to perform them. Table 7-13 provides a comparison between Functional/Task numbers and numbers of Skill Set applications for each of the four major functional/task aggregate groups defined during the process of converting prototypical equipment to fielded, supported weapon systems.



SKILL SET DISTRIBUTION - GOING FROM PROTOTYPES TO DEPLOYED, SUPPORTED SYSTEMS

Figure 7-4

FUNCTIONAL AGGREGATE	FUNCTIONS IDENTIFIED NUMBER	%	SKILL SET APPLICATIONS NUMBER	%
PRE-PRODUCTION				
Specialty Functions	139	69.85	274	64.32
Management Functions	60	30.15	152	35.68
PRODUCTION				
Specialty Functions	56	68.29	90	53.89
Management Functions	26	31.71	77	46.11
DEPLOYMENT				
Specialty Functions	33	57.89	35	31.82
Management Functions	24	42.11	75	68.18
SUSTAINMENT				
Specialty Functions	26	50.98	53	40.46
Management Functions	25	49.02	78	59.54

FUNCTION/TASK AND SKILL SET COMPARISON

Table 7-13

7.3 COST IMPLICATIONS OF THE ANALYSIS

Contracting Officers and Financial Analysts in the Office of the Secretary of Defense and Auditors within the General Accounting Office had noticed that indirect costs of weapon system development programs have steadily increased over the period between 1970 and 1990. Given the prospect of decreasing Defense expenditures, there was considerable incentive to achieve very significant reductions during the process of moving from ideas to operational systems.

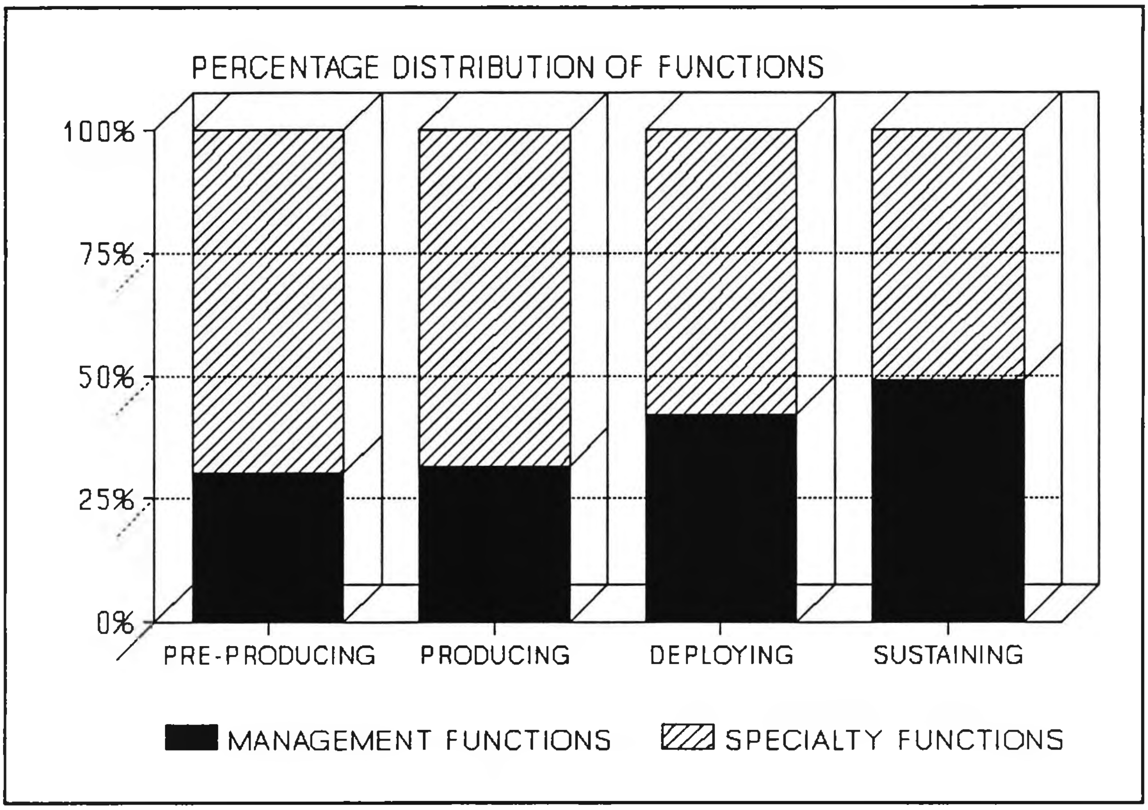
As workshops explored problems with the "mature" Defense Acquisition Process defined by the January 1991 re-issue of DoDD 5000.1 and DoDI 5000.2, participants described how their own program costs had soared because of new social legislation and the new oversight requirements which resulted from them. All enacted legislation mandates some reporting activity. The need to explain events, maintain records, and prepare reports for transmission, generates a "cost of compliance".

From the day legislation becomes effective, the Department of Defense and each individual Service must institutionalize the legislation within its operations. That is normally done through DoD and Service Directives and Regulations which direct establishment of data collection and reporting activities. All of those establishments generate "cost of compliance" too.

The Defense accounting structure describes costs as: (1) Direct cost: all cost of labor and materials necessary to produce the product; (2) Other direct cost: costs incurred in direct support of activities accounted for as "direct cost"; (3) Overhead cost: cost of maintaining facilities and equipment which do not directly support any single development effort but support all activities; (4) General and Administrative cost: costs which associate with overall organizational management, advertising, pension and other benefits, and (5) Profit. Preparing and processing engineering and test reports of development activity are usually accounted for as "other direct costs". Participants reported that other direct costs and overhead costs had risen remarkably (from 125% of direct costs to over 200% of direct costs) and those increases could be traced directly to mandated compliance with new legislation.

Since this "functionally derived" acquisition organization would perform only those functions necessary to move from ideas to prototypes and from prototypes to operating systems, the data in Table 7-13 can be used to estimate the cost of management unrelated directly to performance of necessary functions. For this purpose, "management" skills (which include the skill to respond to oversight entities) are considered to be "overhead" whether they are required to perform non-management or management functions. All other skill sets are considered to be "direct cost" kinds of skills. By comparing the numbers of "management" skill sets and the numbers of "other" skill sets and comparing the numbers of "management functions" and "non-management" functions, the dimensions of the "overhead" implicit within the functional system appears.

The data in Table 7-13 show some interesting relationships between the probable costs associated with management and non-management skills and skill sets necessary to perform the acquisition steps of moving from prototype systems to operational systems. It is interesting as well to show the data graphically. Figures 7-5 and 7-6 do so.



OVERHEAD FUNCTIONS PERCENTAGE - FROM PROTOTYPES TO DEPLOYED, SUPPORTED SYSTEMS

Figure 7-5

Figure 7-5 indicates graphically the percentages of management and other functions (called "specialty functions" within Figure 7-5) required to develop prototypical systems into deployed, supported weapons.

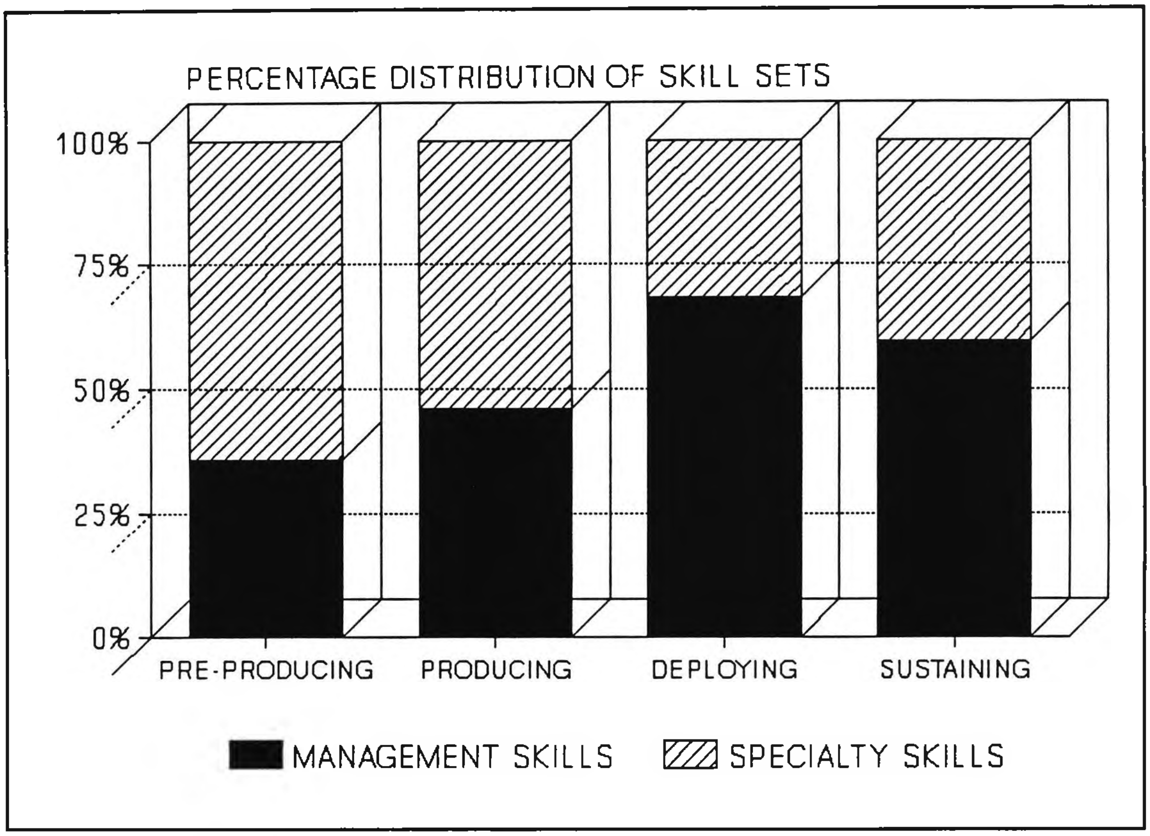
The percentage of overhead functions rises as the process proceeds to develop the prototype into a deployed weapon. After production is completed, most of the remaining work involves coordination and analytical activity. Operational data is collected and engineering effort is used to draw information from it for the purpose of suggesting system improvements. Overhead functions never exceed 50% of the total number of functions performed.

In the more traditional accounting, overhead is measured with respect to direct cost rather than stated as a percentage of total cost. Thus, if overhead cost were exactly equal to direct cost, the overhead rate would be 100%. Stated that way, Figure 7-5 shows the functional overhead to be: 43% for pre-production, 46% for production, 72% for deploying, and 95% for sustainment.

It appears that the functional overhead within the participants' re-designed DAS covers the same functions at much lower cost than is experienced within the present system.

Figure 7-6 displays the percentage of management skill sets required to perform the functions. Figure 7-6 shows that the percentage of overhead skill sets required also rises as the process proceeds to develop the operational system. Again, the system as redesigned does not reach the level of cost (associated with application of pure management skills) experienced with the present system. Skill set overheads are: 55% for pre-production activities; 86% for production activities; 214% for deployment activities; and 147% for sustainment activities.

Normally, the high overhead cost is experienced during prototype development and during production acquisition phases. Since both the functional and skill set "overhead" levels are considerably lower than those experienced with the existing acquisition process, participants concluded that the functional system they had designed would result in cost savings of between 35 and 50 percent during the prototype development, pre-production and production process phases, and would result in between 10 and 15 percent cost savings in the deployment and sustainment phases.



OVERHEAD SKILL SETS PERCENTAGE - FROM PROTOTYPES TO DEPLOYED, SUPPORTED SYSTEMS
Figure 7-6

7.4 THE RE-DESIGNED FUNCTIONAL ACQUISITION PROCESS

Participants used the functional attributes defined in Tables 7-1 (for moving from ideas to prototype systems) and 7-2 (for moving from prototypes to deployed weapons) and their knowledge of the functions and skills required to perform them to generate a re-designed defense acquisition system. The system is shown in Figure 7-7. There were a number of fundamental tenets which guided the work:

- The organization would need to be autonomous with oversight exercised sparingly and only when events made such oversight essential to maintain the integrity of the acquisition process. The process would be organized to respond to two directives:

  1. A directive authorizing development of a prototype system which would use the concepts described in a formal "development proposal" which responded to a requirement set issued by the Joint Chiefs of Staff. When the proposal was

accepted the program organization established would be responsible for performing the functions necessary to go from ideas to prototypes.

2. The second directive would be issued after successful demonstration of the prototype and would direct production, deployment, and support for quantities of equipment in the image of the functional prototype (or of an amended prototype more suitable for operational use over a long life-cycle). The organization would be established upon receipt of the directive and would staff to perform the functions necessary to move from a prototype to a fully operational, fielded, and supported system.

- The organization would be built around three major process components:

1. Defining requirements and maintaining their currency
2. Responding to the requirements by producing, testing, and deriving an envelope of operational integrity for a prototype system; and
3. Producing, deploying and sustaining operational systems derived from the "well understood prototype".

- Participants felt strongly that oversight should occur at three points in an acquisition process:

1. ***The point at which a defined requirement emerged from an on-going analytical process under the aegis of the Joint Chiefs of Staff.*** Participants envisioned a group of highly skilled technical and military operational staff members who would review technology and operational needs and, when such action was indicated, would recommend a new weapon capability be developed. [To some extent, this function is performed by the Advanced Research Projects Agency (ARPA) which functions under the authority of the Assistant Secretary of Defense, Research and Engineering. ARPA evaluates technologies available or in advanced state of emergence to see when they can be used to develop capabilities or products useful to Defense. Although ARPA is composed of both military and civilian technical staff, there is no formal linkage with national security needs as defined by the JCS].

   One reason for oversight at this point is to insure that consideration is given to modifying existing systems or up-dating platforms already in service before authorizing development of a new capability (prototype system). When either a new start or an up-graded system was felt to be justified a decision would be made to authorize funding to develop that capability. Once the funding decision was made, a program office would be given the directive to produce a prototypical system.

2. ***The point at which a prototype has been developed and tested sufficiently to have defined an envelope of operating capability.*** At this point, the prototypical system would be evaluated against updated requirements to see if some quantity of items should be produced. If it was decided to proceed with system production, deployment and operational utilization, a directive would be issued to a re-formed program office to see to equipping and support operational units with the new system capability.
3. ***The point at which: (a) production items which have been deployed and sustained under operational conditions long enough to judge their effectiveness; and, (b) operating economies, and the forces have confirmed their need for a new capability.*** If field commanders decide a new capability is required, the process would begin again. The independent permanent organization working with the JCS would need to certify the revised need, and a decision would be made to proceed with development of a new prototype.

7.5 SUMMARY OF THIS CHAPTER

This chapter has treated in some detail the methodology used to derive an organizational structure based on performance of the functions/tasks developed for an acquisition process in Chapter 6. The goal of the work was to create an organization structure which would permit efficient performance of the functions/tasks required to create effective weapon systems from ideas generated by a congruence of military need, available technology, and engineering capability. This chapter has discussed how a respected work factor analytical system (the Hay method of organizational design) was used to stimulate participants to develop a set of work factors (skill sets) specific to the acquisition process. The discussion continued by showing how skill set analysis combined with functional analysis permitted definition of broad organizational attributes and how those were used to create a new acquisition process organizational concept. The discussion described how the new organizational concept was evaluated with

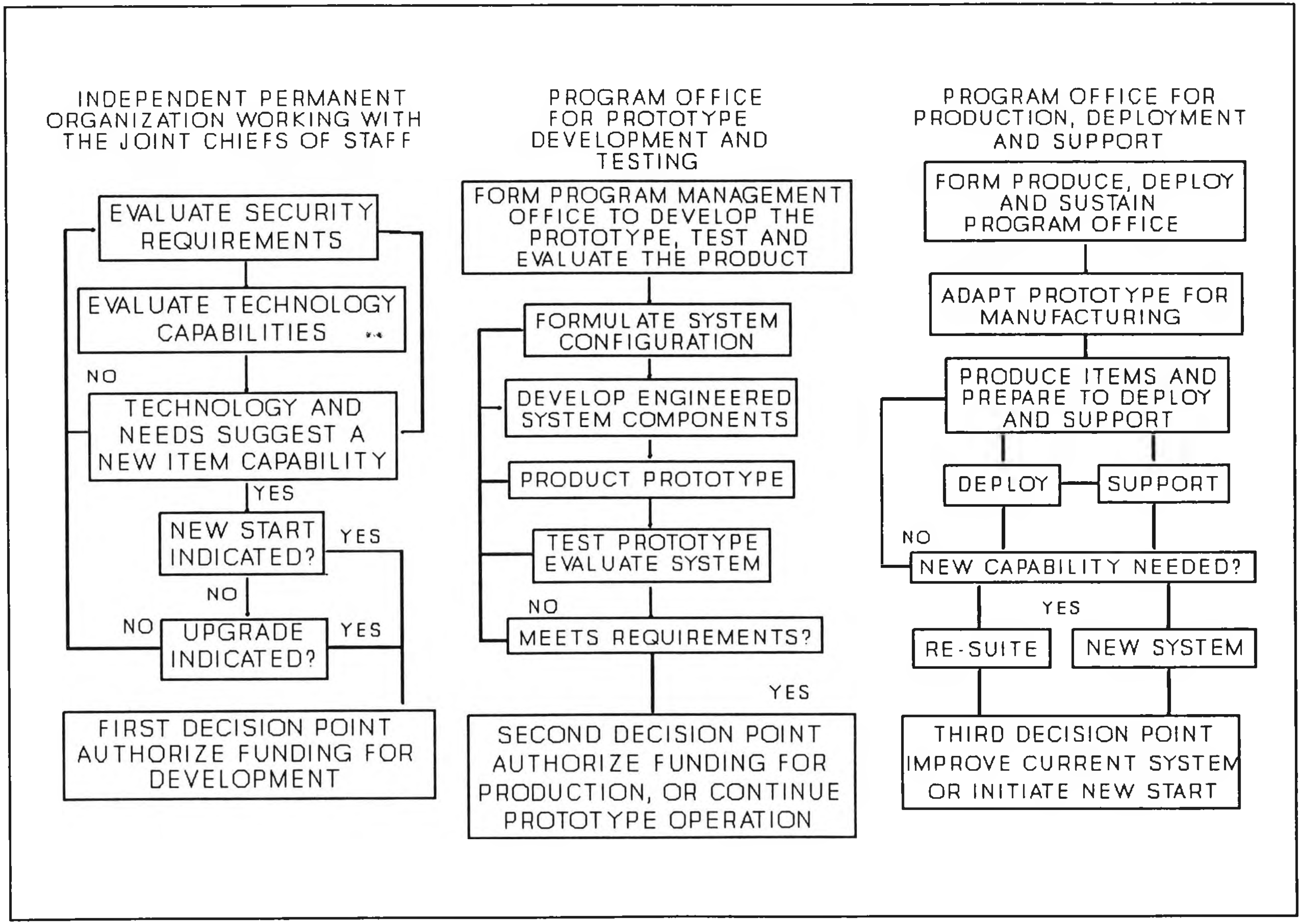


Figure 7-7

THE FUNCTIONALLY DESIGNED ACQUISITION PROCESS respect to its potential for fostering reductions in currently experienced acquisition costs.

The discussion in this chapter sets the stage for the discussion in Chapter 8 which focuses on the question; "If the new process was institutionalized, would all of the problems described in Chapter 6 be alleviated?".

CHAPTER 8
EVALUATING THE EFFICACY OF THE FUNCTIONAL ACQUISITION PROCESS

This chapter: (1) Discusses the defense environment existing at the time of this work; (2) Discusses assumptions made about the manner in which the redesigned acquisition process would be introduced; (3) Discusses methodology used to evaluate whether the redesigned acquisition process, introduced in the extant environment under the assumed conditions would eliminate the opportunity for previously experienced problems to arise; (4) Summarizes the participants conclusions about problems which would remain even after implementation of the redesigned acquisition process; and (5) Derives an interface oriented problem aggregation set.

8.1 THE DEFENSE ENVIRONMENT OF JUNE 1992

All prior workshops involved with acquisition process redesign concentrated either on (1) past experience: defining and consolidating problems stated by over 300 DoD and Contractor program managers to understand why acquisition program managers acted as they did and the problems they had experienced in taking pursuing their programs; or (2) functional process analysis: defining a functionally based acquisition process by determining the actions necessary to arrive at a desired end goal starting from a given point of departure.

The workshop held during the period 15-19 June 1992 was of a different kind: it attempted to project future change. The previous attempt to predict the likely result of institutionalizing change to the acquisition process (Workshop #11 in Table 5-1 above) had clearly demonstrated the need to develop better mechanisms for predicting the effects of change. This workshop, which concluded the redesign process begun in 1988, sought to determine whether the functionally defined acquisition process epitomized in Figure 7-7 would create an acquisition environment within which the defined problems would be precluded.

But the environment in 1992 was considerably different than it was at the start of the redesign effort in 1988. Two major changes had taken place:

(1) Using its legislative process in Section 800 of Public Law number 101-510 (the National Defense Authorization Act for Fiscal Year 1991) Congress had directed DoD to establish the "DoD Advisory Panel on Streamlining and Codifying Acquisition Laws" (generally known as "The 800 Panel"). The Chairman of the

panel was the Commandant of the Defense Systems Management College. Sections of the Panel's charter were presented in the introduction to its report to the Congress [183, I-1 *et seq*]: "to provide a practical plan of action for moving from present law to an understandable code containing specific recommendations to Congress to: eliminate any laws 'unnecessary for the establishment of buyer and seller relationships in procurement;' to ensure the 'continuing financial and ethical integrity' of defense procurement programs; and to 'protect the best interests of the Department of Defense'. Finally, the panel was asked to 'prepare a proposed code of relevant acquisition laws'"

(2) DoD was itself taking action to reform the acquisition process through changes to DoD rules and regulations. The impetus for departmental change resulted from the request to Secretary Dick Cheney from President George Bush to review departmental practice and indicate changes necessary to increase departmental efficiency and effectiveness. In his July 1989 Defense Management Report (DMR) to the President [184] Secretary Cheney indicated a number of concerns and outlined some possible actions which could be taken. In a May 1992 follow up DMR implementation report [185], DoD summarized actions taken and results achieved through January 1992

The work reported here had significant input to both activities.

- With respect to the Congressionally chartered activity: (1) Two members of the Senate Armed Services Committee staff (Majority and Minority Counsel) participated in three of the re-design workshops; (2) Results of other redesign workshops were discussed with them when information of value to then current Senate debate had been obtained; and (3) The 800 Panel Task Force Director participated in the redesign workshops, and the Panel was routinely briefed about detailed results of workshop activities.
- With regard to internal Defense acquisition reform, the various Undersecretaries of Defense (Acquisition) and their staffs were directly involved in generating the information upon which this particular acquisition redesign was founded and workshop reports were provided them as necessary. In almost every instance where workshops were sponsored by a DoD office, workshop results were used to plan reforms to the acquisition process and its mechanisms

The evaluation workshop was convened in an environment which not only sought to make change in the way defense acquisition was performed but had already made change to the acquisition process - some of which had been suggested or planned for as the direct result of the workshops enumerated in Table 5-1.

To be sure that participants understood fully: (1) The environment within which acquisition would proceed in the future; (2) Previous work accomplished by workshops and by changes within the DoD; and (3) The purpose of the workshop of which they were a part, an entire workshop day was spent in discussions about those topics. Table 8-1 presents the schedule of events for 15 June 1992.

TIME	DISCUSSION TOPICS
0800-0900	Working Continental Breakfast, Welcome by the Commandant, DSMC; Self-Introduction of Workshop Staff and Participants; An Historical Background - Workshop Director
0900-1000	Review of the Redesign Workshops: "What We Have Wrought" - Dr. Paul Lamb, Aircraft Carrier Program Office, Naval Sea Systems Command and Participant's Redesign Workshops
1000-1230	Review of Prior Workshops - Workshop Director; Secretary of Defense Budget Briefing, 29 January 1992 - CNN Report
1230-1300	Lunch at the Workshop Table
1300-1445	Presentation by Workshop Director: "The Path to Acquisition Functional Redesign", "A system of Stewardship", Kinds of Problems in Acquisition", "The Purpose of This Workshop (TMAW 92-3)"
1445-1600	Discussion of Workshop Procedures - Workshop Director

WORKSHOP SCHEDULE FOR 15 JUNE 1992

Table 8-1

8.2 THE PERSISTENT PROBLEMS TO BE CONSIDERED

The workshops had generated a considerable number of suggestions for change to the acquisition process and many of those suggestions had been used by various DoD elements and by Congressional staff members. Specifically:

- The majority counsel of the U. S. House of Representatives Armed Services Committee had participated in workshops #2 and #3 of Table 5-1 above. During the period between July 1989 and September 1991, the U. S. House of Representatives Armed Services Committee was actively engaged in crafting legislation concerning establishment of the Defense Acquisition Corps. The information about the program management workload and the problems experienced in transforming ideas into weapons was provided to them both through reports and personal discussions. In addition, DSMC's Commandant observed workshop sessions he felt to be appropriate to his 800 Panel role.

- Workshops had been sponsored by various USD(A) and various other DoD elements. The results of those workshops provided sponsors with suggestions about actions which could improve acquisition process performance. In cases where USD(A) was the workshop sponsor, a point was made to provide sets of recommendations he could implement within his own authority. When other DoD elements sponsored a workshop, their purpose was usually to obtain a plan for change to their particular jurisdiction. Many of the workshops listed in Table 5-1 provided sets of recommended actions which were institutionalized by the workshop sponsor.

By the time of the redesign evaluation workshop in June 1992, a large number of acquisition problems had been solved by direct action aimed at bringing that solution about, or had disappeared because of organizational change within the Department of Defense. But there were still a number of serious issues left unresolved.

The problem aggregation activity reported in Chapter 5 defined 20 problem areas which in turn were associated within five major problem groups as shown in Table 5-2 (Page 128). Table 8-2 revisits Table 5-2 but also shows the numbers of problems within each of the 20 groups which participants of prior workshops agreed were still in need of address. Table 8-2 shows that a total of 197 problems remain: four problems are involved with Test and Evaluation; 64 problems have to do with High Level Planning and Management; two problems involve International Factors; 68 problems have impact on Program Office Effectiveness; 11 problems impact the Industrial Base; and finally 53 problems effect Program Execution Effectiveness. Because Table 8-2 shows the five problems concerned with Credibility in two locations, the problem count shown in 202. To illustrate the kinds of problems within an unresolved problem set, Table 8-3 lists "Funding Instability" problems still unsolved as of June 1992. Most of the 18 problems listed there can be traced to the Congress and the way in which the Congress has inst-

	GENERIC SET NAME	PROBLEM AREAS AND NUMBERS OF PROBLEMS INCLUDED	
A	Test and Evaluation	Test and Evaluation	4
B	High Level Planning and Management	DAB/DRB Process	8
		Funding Instability	18
		Statutory/Regulatory Influences	9
		Long Range Planning	12
		User Support	4
		Executive Decision & Policy Makers	7
		Immutable	6
C	International Factors	International Factors	2
D	Program Office Effectiveness	Program Manager Authority	27
		Technical Requirements Management	18
		Inadequacy of Program Team	10
		Risk Management	6
		Credibility	2
		Oversight	5
E	Industrial Base	Industrial Base	11
F	Program Execution Effectiveness	Contract Requirements Development	10
		Oversight	5
		Program Execution	16
		Cost and Schedule Estimates	19
		Transition Management	3

GENERIC PROBLEM CATEGORIES

Table 8-2

itutionalized the budgetary processes within which funds are apportioned. The Congress is constrained by the U. S. Constitution which prohibits the Congress from appropriating funds which will be spent more than two years from the Fiscal year of their appropriation. The framers of the Constitution did not encourage undertaking programs which extended for periods of time greater than one year. Therefore, appropriation authority was limited to current need. Programs of the sort represented by today's materiel development activity were not a part of the culture at that time. The result of that particular constraint is to create great uncertainty about the levels of funding that will be made available from year to year. The difference in cycle time between the one year Congressional budgeting and appropriation system and the five year Defense weapon system program development structure creates a rather large system problem.

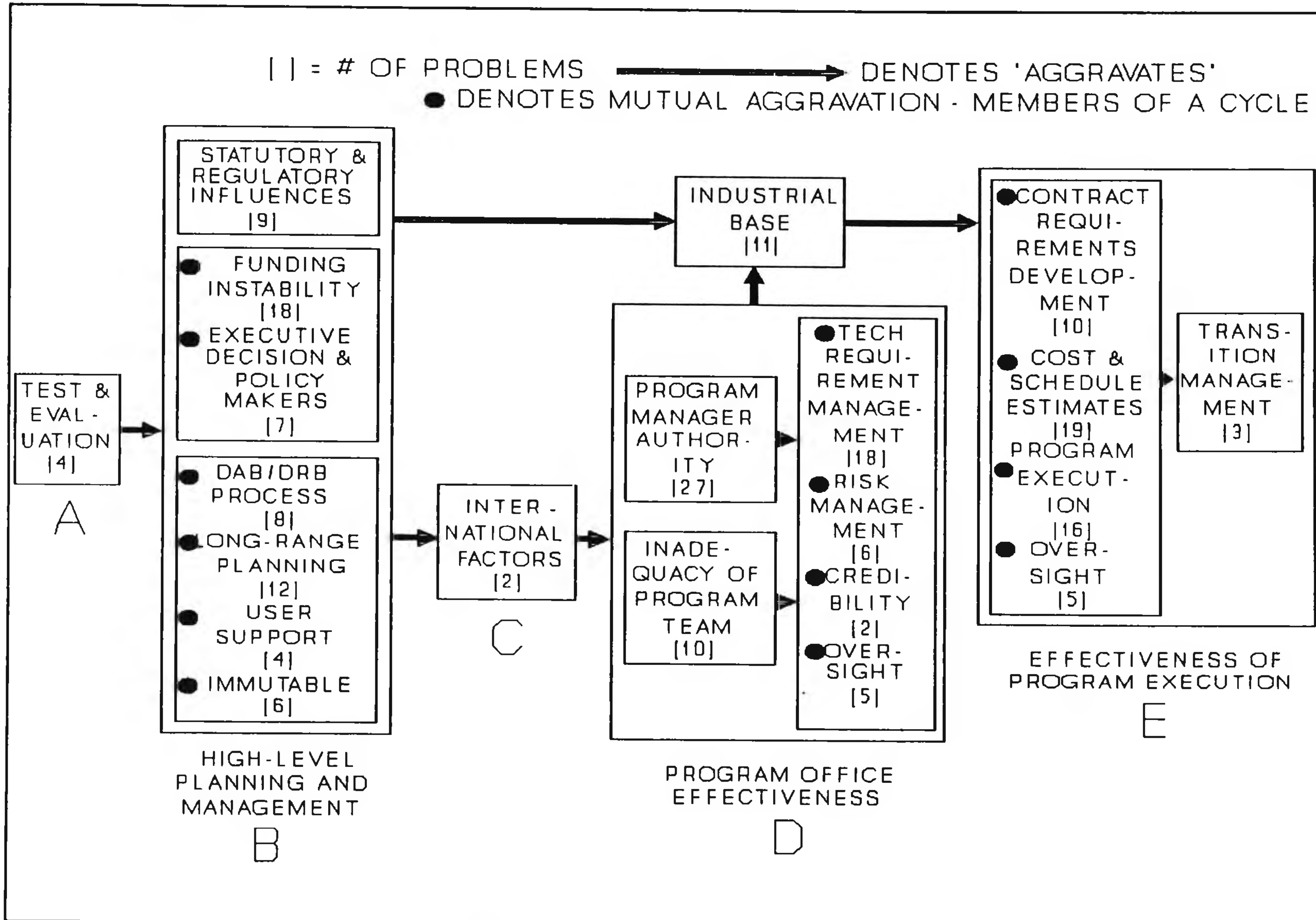
PROBLEM NUMBER	PROBLEM STATEMENT
1.	Lack of multi-year commitment.
2.	Year-to-year instabilities to budget and procurement quantities.
3.	Lack of program funding stability.
4.	Lack of consistent budget for planning purposes.
5.	Annual funding of production.
6.	Annual funding of development.
7.	Lack of fiscal planning.
8.	Annual production budget fluctuations leading to bathtubs and gaps.
9.	Lack of budget stability.
10.	Changing fiscal environment.
11.	Resource decisions are made hastily, usually at end of year, without adequate consideration for the acquisition impacts.
12.	The comptroller function (PBD, DMRD execution).
13.	Funding changes or problems.
14.	OSD/service failure to provide agreed resources.
15.	Arbitrary dollar takes; no prioritization; no consideration for exceptional direction.
16.	One year appropriations affect long-term stability and planning.
17.	Inherent disconnect between the DoD acquisition process and the Congressional budget process results in a production gap.
18.	Limitations on the DoD's ability to incentivize contractor investment (i.e., True multi-year contract).

UNADDRESSED ACQUISITION PROBLEMS IN JUNE 1992
Table 8-3

Figure 8-1 revisits Figure 5-2 and indicates how the remaining problems relate to the problem structure. From Figure 8-1 one can see how problem solutions might best addressed in groups derived from that structure. The point will be discussed below.

8.3 ASSUMPTIONS ABOUT HOW THE REDESIGN PROCESS WOULD BE IMPLEMENTED

Participants reviewed the problem structure shown in Figure 8-1 below, and then discussed the functional process previous participants had devised (Figure 7-7). One of the participants in the acquisition redesign workshops discussed the concepts implicit in that system construct and the assumptions made throughout the design process.



ACQUISITION PROCESS PROBLEM STRUCTURE

Figure 8-1

The 17 assumptions within the "System of Stewardship" are listed in Table 8-4 below.

#	ASSUMPTIONS ABOUT THE NEW SYSTEM
1	Each phase will be fully funded without the need for annual re-justification.
2	It is assumed all programs will ultimately be managed using this process.
3	All funds allocated to the program are made available to program manager without categorization or time limitations.
4	The program manager reports directly to the acquisition decision authority.
5	PM's charter will clearly state their responsibility to recommend without peril whether a prototype should go into production.
6	As used here, the word "Prototype" does not imply a production ready item but rather a proof of principle model.
7	Inspectors and auditors can only get involved at the three major decision points.
8	No reporting required external to the decision authority other than those required by law.
9	PM executes. <u>does not sell</u> the program.
10	PM has direct control of all program players except operational test [original item was: "PM has solid line relationship with all program players except operation test"].
11	There are only three decision points.
12	No annual negotiations with comptroller. (Subsumed in assumption #1.)
13	PM has an authorized management reserve funding.
14	Decision points are event based.
15	Model does not address OSD staff organizations.
16	Deal with statutory regulations as a "yes, if...".
17	Use of performance system specifications is presumed.

ASSUMPTIONS ABOUT HOW THE REDESIGNED ACQUISITION PROCESS WOULD WORK WITHIN DoD
Table 8-4

8.4 EVALUATING THE PROCESS AGAINST THE PROBLEMS

Participants understood that their purpose was to respond to the question:

> ***If a new acquisition system were installed which enabled efficient performance of functions defined by the TMAW workshops as necessary to move from ideas through prototypes to deployed, fully supported weapon systems, will that system likely eliminate situations such as those described by prior USD(A) and other workshops?***

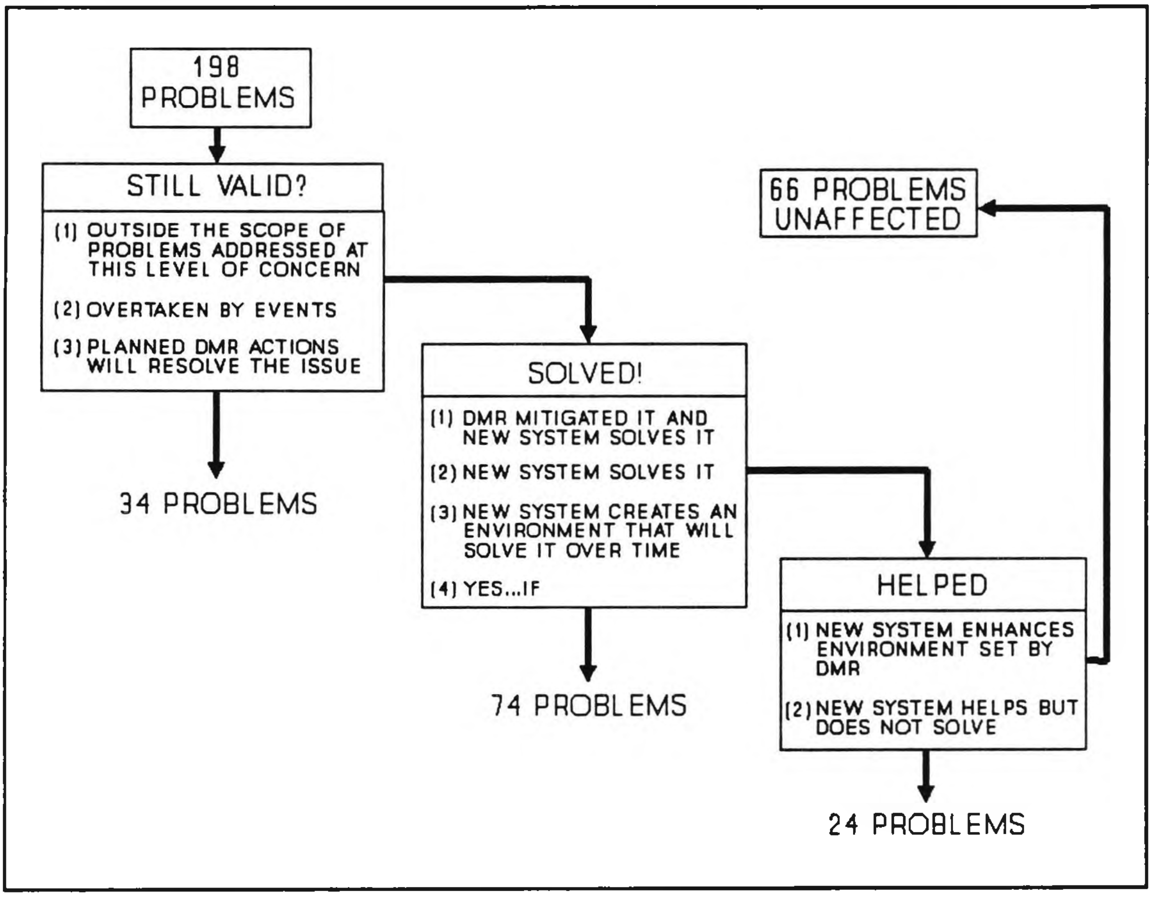
Each one of the 198 problems would be addressed *serie item.*

Participants asked about the number of ways they could respond to the question. The point was raised that some problems defined by prior workshops might already be solved or ameliorated as the result of actions taken in response to the Defense Management Review (DMR) and the 23 February 1992 issue of revised acquisition documents DoD Directive 5000.1 and DoD Instruction 5000.2. After some discussion it was agreed that in responses to the question, participants could comment on their understanding of effects already felt because of the DMR [184] as well as on likely effect of adopting the functionally based, redesigned acquisition process. Participants also discussed the advantages of agreeing on a small set of standard answers to the question to simplify the evaluative process. The following set of standard procedures was adopted:

- There were three acceptable reasons to conclude that a problem should be deleted: (1) It was outside the scope of the problems addressed at this level of this acquisition process; (2) The problem had been overtaken by events - it no longer existed; and (3) actions planned in response to the DMR would resolve it.
- There were four reasons for concluding that the problem would be solved: (1) the DMR mitigated the problem; and the redesigned system would eliminate it; (2) If the new process is implemented in accordance with the assumptions stated, the problem will cease to exist; (3) The new system will encourage an environment which, over time should eliminate the problem; and (4) Yes, if..... (giving a reason for the belief that the problem will be eliminated).
- There were two acceptable reasons for believing the problem would be ameliorated but not necessarily solved; (1) DMR has put a process in place which encourages solution of the problem and the redesigned system will enhance that environment; and, (2) If the new process were implemented in accordance with the assumptions stated, the problem will be mitigated.
- There were four reasons for stating the belief that there would be little effect on the problem by DMR, any other future actions about which participants were aware, or the redesigned system: (1) No, because...(the reason is then given); (2) Neither DMR actions nor the redesigned process will help solve the problem...(in participants judgement); (3) DMR actions have not mitigated the

problem, neither would the redesigned process...(in participants judgement); and, (4) DMR has mitigated the problem and the new system will not reduce the problem further.

There were eleven workshop participants and as before, the process was carefully administered to assure real agreement about conclusions reached. Workshop consensus was reached if there was agreement on responses to questions by 9 or more participants. The detailed responses to the question are recorded in Appendix D. Figure 8-2 shows how the four steps of the evaluation were accomplished.



REDESIGNED PROCESS EFFECT ON PROBLEMS
Figure 8-2

1. Participants were asked if the problem as stated was still valid. If any of the three statements discussed above applied, the problem was deleted from consideration. ***34 problems were deleted.***
2. For those problems which had not been deleted, participants were asked whether the new acquisition process would solve the problem. If any of the four state-

ments discussed above applied, the problem was counted as solved. ***74 problems were solved.***

3. Participants were asked if the new acquisition process might ameliorate the remaining problems. If there was a helpful effect, the problem was considered to have been acted on positively as the result of the new process. ***24 Problems were helped by the new system although they were not solved.***
4. In participant's judgement, the remaining problems were unaffected by any action already taken, nor would they be helped by institutionalizing the new acquisition process. ***66 problems were unaffected by any aspect of the change that had occurred, nor would the new acquisition process affect them.***

Appendix D lists the 66 problems and explains why each was placed in one of the four categories. Table 8-5, grouped to reflect the problem structure in Figure 8-1, shows how problems were distributed within categories.

Much was learned by looking carefully at the problem distributions within the categories of Table 8-5. Two examples of the kind of analysis applied illustrate the point:

- The problem structure indicates that four Test and Evaluation problems tend to aggravate all other problems. Participants in this workshop felt that two of the problems (*Lack of an "agreed to" way to test* and *Unrealistic and inadequate targets*) could be deleted from consideration, one problem (*Program Manager's decision subject to excessive test results*) would be helped, and the remaining problem (*Redundancy of test agencies and test during development*) would be precluded by the redesigned system. Participants effectively removed all Test and Evaluation problems from the problem set remaining.

- The Executive Decision and Policy Makers (seven problems) and Funding Instability (18 problems) problem areas form a cycle of 25 mutually aggravating problems. Six of the seven problems concerning Executive Decision and Policy Makers (*1. Key personnel turnover; 2. Changing players, priorities, guidance; 3. Executive leadership turnover causes policy objectives to change frequently; 4. Pervasive lack of understanding of the acquisition process; 5. Lack of Program Management training, experience, and skill at top DoD and Services management levels; 6. Overseers often do not have the skills and/or experience and/or time to understand what they are over-*

CATEGORY	DELETED	SOLVED	HELPED	NO EFFECT
Test and Evaluation	2	1	1	-
Statutory/Regulatory Influences	1	1	1	6
• Funding Instability	1	15	-	2
• Executive Decision and Policy Makers	6	-	-	1
• DAB/DRB Process	-	8	-	-
• Long Range Planning	2	4	2	4
• User Support	1	1	-	2
• Immutable	-	-	-	6
International Factors	-	-	-	2
Program Manager Authority	2	17	-	8
Inadequacy of Program Team	-	4	2	5
• Technical Requirements Management	7	9	-	2
• Risk Management	1	-	1	4
• Credibility	-	1	1	-
• Oversight	-	-	5	-
Industrial Base	-	-	-	11
• Contract Requirements Development	4	3	-	3
• Cost and Schedule Estimates	-	5	6	8
• Program Execution	5	4	5	2
• (Oversight see above)				
Transition Management	2	1	-	-
TOTALS	34	74	24	66

REDESIGNED ACQUISITION PROCESS EFFECTS ON THE WORKSHOP DERIVED PROBLEM SET

Table 8-5

seeing) and one Funding instability problem (*DoD/Service failure to provide agreed resources)* were deleted from consideration because of actions already taken by Congress (Establishment of the Acquisition Corps and the Defense Acquisition University to co-ordinate the training of acquisition corps professionals; and by inserting language in the appropriation legislation directing DoD to stabilize program managers' tours of duty) and within the DoD (stabilization of tours of duty and revising the DAB/DRB structures). In addition, participants believed that implementing the redesigned process and other actions being undertaken by DoD would solve 15 of the remaining problems within the Funding Instability area. The net effect was that only one Executive Decision and Policy Maker problem (*Leadership high turnover rate*) and two Funding Instability problems (*Year to year instabilities to budget and procurement quantities; Lack of fiscal planning*) still required address.

Table 8-6 shows the specific problems which remain in each of the problem categories.

STATUTORY-REGULATORY INFLUENCES

- Constraining procurement laws and acquisition regulations
- Excessive procurement laws and regulations
- Mandate for competition of small business that may be unqualified to participate
- Lack of regulation and historical approach cleansing
- Illogical competition
- Changes in policy and specifications

FUNDING INSTABILITY

- Year-to-year instabilities in budget and procurement quantities
- Lack of fiscal planning

EXECUTIVE AND POLICY MAKERS

- Leadership high turnover rate

LONG RANGE PLANNING

- Acquisition process considers program/requirements on only an individual basis without considering larger investment context and trade-off
- Lack of or undisciplined strategic planning
- Lack of clear military strategy and quantitative military requirements
- Short-term planning dominates decision making process

USER SUPPORT

- Lack of priority by acquisition organization for weapon systems
- Lack of strong, consistent, and long-term user support for smart munitions programs

IMMUTABLE

- Instability of DOD and Congressional support for programs
- Abrogation of commitment at all levels
- It's never over
- There is no agreement between the executive branch and the congress on the long-term budget projection
- Congressional authorization and appropriation process
- Congressional mistrust and meddling and language

INTERNATIONAL FACTORS

- Inadequate foreign sales planning
- U.S. security and Customs regulation not consistent with international co-development

PROGRAM MANAGER AUTHORITY

- Political motives in the decision process
- No one can say "Go" but everyone can say "Stop"
- Interference from congressional oversight
- Proliferation and lack of accountability of ankle biters
- Political influences beyond the program managers' control

PROBLEMS THOUGHT TO BE UNSOLVED BY THE NEW FUNCTIONAL DESIGN

Table 8-6

PROGRAM MANAGER AUTHORITY (Continued)

- Too many nay-sayers ... In the review chain
- Tendency not to surface problems
- Too many participants can stop or slow process without responsibility for delivering the product

INADEQUACY OF PROGRAM TEAM

- Loss of program focus due to program personnel rotations
- Lack of contractor's ability to provide people resources as required
- Lack of acquisition training and experience of superiors
- Inadequate resources outside the program office (doing more with less)
- Barriers erected between defense and non-defense divisions of companies and sectors

TECHNICAL REQUIREMENTS MANAGEMENT

- Inability to synthesize a design the first time
- Changes in policy and specifications

RISK MANAGEMENT

- Failure to know how to respond to risks even when known (risk/penalty/profit)
- Imprecise risk management methodologies
- Management of the DoD acquisition process is not disciplined enough
- Lack of early management focus

INDUSTRIAL BASE

- Loss of industrial base (inadequate R&D)
- OSD is a small customer of the general industrial base
- Outward migration of investment capital and skilled people
- DoD is unwilling to fund industrial base improvement program
- Intervention is not an administration policy
- The present acquisition policies contain conflicting goals making it virtually impossible to strengthen the base

INDUSTRIAL BASE (Continued)

- Lack of a clear understanding of the consequences of some of the perceived industrial base problems
- Lack of agreement on the crucial or core elements of the industrial base that must be sustained
- Failure to consider the industrial base early in the acquisition process
- DoD fiscal management structure does not support and strengthen the industrial base (unit cost policy)
- Need to formalize or institutionalize consideration of industrial base

CONTRACT REQUIREMENTS DEVELOPMENT

- Adverse impact of well meaning but ineffective attempts improve the process
- Data requirements
- Failure to adequately describe performance verification and validation process by which success is measured

COST AND SCHEDULE ESTIMATES

- Unrealistic program plans/schedules and associated funding profiles
- Pressure for unrealistic schedule, cost, and performance
- Ineffective cost estimating up-front
- Competitive pressures lead to unrealistic expectations
- Assessment of program cost risk by DoD is inadequate
- Failure of contractors to propose realistic costing to RFP's (buying in)
- The government forces contractor to buy in thereby increasing the risk
- Lack of government understanding of the cost of procuring many smart munitions programs

PROGRAM EXECUTION

- No OSD/Service policy on concurrent engineering
- Inability to award timely contracts due to external controls

PROBLEMS THOUGHT TO BE UNSOLVED BY THE NEW FUNCTIONAL DESIGN

Table 8-6 (Concluded)

8.5 ANALYSIS OF THE EVALUATION RESULT

It had been expected that the functionally derived acquisition process would, if institutionalized, preclude most of the problems enumerated in the problem compendium developed by workshop participants. Thus the conclusions reached by this set of workshop participants, that 66 of those problems were neither precluded nor ameliorated either by the functional process or by any of the actions taken in connection with the DMR and other DoD activities, was a surprise to both participants and the workshop director. And while it was thought essential to consider reasons why that was the case, the workshop participants had insufficient time to undertake that work. They asked the workshop director (the author) to do so and to provide them copies of the analysis for comment.

The workshop director reviewed problems in Table 8-6 thought to be unaffected. After studying the 66 problem statements, some ideas for a differently focused problem grouping set were generated. Specifically, the set of 20 problem groupings were derived to facilitate derivation and analysis of a problem aggravation structure *(problematique)*. In that role, they served well as a mechanism to focus attention on interfaces among problem structure elements. But since the functional acquisition process had not precluded their occurrence, perhaps insight could be gained to help solve them by looking at the interfaces between the Defense Acquisition System and the environment within which it must function. From that perspective, five potential problem grouping categories might serve better:

1 - Influences on DoD from outside the Department of Defense;

2 - Problems with defining adequate interrelationships between acquisition and national security;

3 - Industrial base issues which affect program execution;

4 - Problems of adequately integrating Government and Contractor activities; and

5 - Problems of personnel adequacy and availability in both Government and Industry.

The following paragraphs indicate how unsolved problems were re-grouped.

8.5.1 <u>Influences on DoD from outside the Department (17 problems)</u>

There are a number of influences which act on DoD from outside the Department. Six problem statements illustrate from whence such influence can come:

INFLUENCES ON DoD FROM OUTSIDE THE DEPARTMENT

- Congressional authorization and appropriation process - (Immutable)
- Congressional mistrust and meddling and language - (Immutable)
- Interference from Congressional Oversight - (PM Authority)
- Adverse impact of well meaning but ineffective attempts to help improve the process (Contract Requirements Development)
- Political motives in the decision process (PM Authority)
- Political influences beyond the Program Manager's control (PM Authority)

The effects of outside influences become manifest in three groups of subordinate issues: (1) The **first** issue might be captioned ***"political effects"***. The following six problem statements are representative of this issue:

POLITICAL EFFECTS

- Lack of regulation and historical approach to cleaning (Statutory-Regulatory Influences
- Excessive procurement laws and regulations (Statutory-Regulatory Influences)
- Constraining procurement laws and acquisition regulations (Statutory-Regulatory Influences)
- Illogical competition (Statutory-Regulatory Influences)
- Mandate for competition of small business that may be unqualified to participate (Statutory-Regulatory Influences)
- Inability to award timely contracts due to external controls (Program Execution)

The **second** of these issues might be captioned ***"DoD institutionalization of checks and balances in response to Congressional concerns about DoD actions"***. Five problem statements which illustrate this issue are:

DoD CHECK AND BALANCE INSTITUTIONALIZATION

- Proliferation and lack of accountability of ankle biters (PM Authority)
- No one can say "Go" but everyone can say "Stop" (PM Authority)
- Too many nay-sayers ... in the review chain (PM Authority)
- Too many participants can stop or slow process without responsibility for delivering the product (PM Authority)

The **third** issue may result from the combined effect of the three issues discussed above: ***"fear of career problems resulting from system inability to accept anything less than total success"*** A single problem statement encapsulates this issue:

- Tendency not to surface problems (PM Authority)

8.5.2 Problem of defining connections between acquisition and national security needs (14 problems)

14 problems fall within this category. Collectively, the problems deal with difficulty in accommodating rapidly changing needs (requirements) within a process which requires a long time period to achieve desired results (the development of new systems or improvement of old systems with new technology). Seven problem statements indicate that *even though the system of stewardship was meant to achieve linkage between national strategy and the acquisition process, participants felt that that objective was incompletely accomplished*:

DEFINING CONNECTIONS BETWEEN ACQUISITION AND NATIONAL SECURITY NEEDS

- Abrogation of commitment at all levels (Immutable)
- It's never over (Immutable)
- Lack of or undisciplined strategic planning (Long Range Planning)
- Lack of clear military strategy and quantitative military requirements (Long Range Planning)
- There is no agreement between the Executive Branch and the Congress on the long-term budget projection (Immutable)
- Instability of DoD and Congressional support for programs (Immutable)
- Changes in policy and specifications (Statutory-Regulatory Influences)

The difficulties stated within the set of problems above have other effects as well. The **first** effect is shown by a five problem grouping entitled "***inability to derive unchanging system design and consistent support for programs once undertaken***":

INABILITY TO DERIVE UNCHANGING SYSTEM DESIGN

- Inability to synthesize a design the first time (Technical Requirements Management)
- Lack of priority by acquisition organization for weapon systems (User Support)
- Lack of fiscal planning (Fiscal Instability)
- Year-to-year instabilities in budget and procurement quantities (Funding Instability)
- Lack of strong, consistent, and long term user support for smart munitions programs (User Support)

A **second** effect is that during each year, as fiscal constraints appear, there is a "***tendency to consider programs individually rather than in terms of their relationship with a whole strategic plan***". This situation is described by the following two statements:

INDIVIDUAL PROGRAMS RATHER THAN TOTAL STRATEGY

- Acquisition process considers program/requirements on only an individual basis without considering larger investment context and trade-off (Long Range Planning)
- Short-term planning dominates decision making process (Long Range Planning)

8.5.3 Industrial base issues which affect acquisition performance (13 problems)

The problems grouped within this category were divided into two groups: (1) the first group of seven problems which reflect how policies currently in place affect the condition and capability of the industrial base which supports DoD; and (2) the second group of five problems focuses on the economic health of the industrial base because of those policies. A single problem statement summarizes the situation.

AFFECTS OF CURRENT POLICY ON THE INDUSTRIAL BASE

- Inadequate foreign sales planning (International Factors)
- U.S. security and Customs regulation not consistent with international co-development (International Factors)
- The present acquisition policies contain conflicting goals making it virtually impossible to strengthen the base (Industrial Base)
- Need to formalize or institutionalize consideration of the industrial base (Industrial Base)
- Lack of agreement on the crucial or cost elements of the industrial base that must be sustained (Industrial Base)
- Intervention is not an administration policy (Industrial Base)
- DoD fiscal management structure does not support and strengthen the industrial base (unit cost policy) (Industrial Base)

HOW POLICIES AFFECT INDUSTRIAL BASE ECONOMIC HEALTH

- Outward migration of investment capital and skilled people (Industrial Base)
- OSD is a small customer of the general industrial base (Industrial Base)
- Lack of a clear understanding of the consequences of some of the perceived industrial base problems (Industrial Base)
- Failure to consider the industrial base early in the acquisition process (Industrial Base)
- DoD is unwilling to fund industrial base improvement program (Industrial Base)

The net result of this group of difficulties is that the Industrial Base is becoming less capable of providing necessary Defense support as evidenced by the problem:

- Loss of industrial base (Inadequate R&D) (Industrial Base)

8.5.4 Problems of inadequate integration of Government and Contractor activities (14 problems)

The 12 of the 14 problems within this category appear below within three groupings which illustrate potential "cause-effect" relationships between them: (1) Different Government and Industry methodologies to determine cost and schedule; (2) Different perceptions of Industry and Government intents; and (3) Conflicting approaches to risk management that result from different perceptions. A fourth grouping of two problems shows the effects of the precedent causal chain.

DIFFERENT GOVERNMENT AND INDUSTRY METHODOLOGIES USED TO DETERMINE COST AND SCHEDULE

- Lack of Government understanding of the cost of producing many smart munitions programs (Cost and Schedule Estimates)
- Assessment of program cost risk by DoD is inadequate (Cost and Schedule Estimates)
- Competitive pressures lead to unrealistic expectations (Cost and Schedule Estimates)
- Ineffective cost estimating up-front (Cost and Schedule Estimates)

These difficulties lead to:

DIFFERENT GOVERNMENT AND INDUSTRY PERCEPTIONS OF COST AND SCHEDULE ESTIMATE INTENT

- Pressure for unrealistic schedule, cost, and performance (Cost and Schedule Estimates)
- Unrealistic program plans/schedules and associated funding profiles (Cost and Schedule Estimates)
- The Government forces contractor to buy in thereby increasing the risk (Cost and Schedule Estimates)
- Failure of contractors to propose realistic costing to RFP's (buying in) (Cost and Schedule Estimates)

These problems in turn, make it difficult to determine and manage risk

CONFLICTING RISK MANAGEMENT APPROACHES

- Management of the DoD acquisition process in not disciplined enough (Risk Management)
- Lack of early management focus (Risk Management)
- Imprecise risk management methodologies (Risk Management)
- Failure to know how to respond to risks even when known (risk/penalty/profit) (Risk Management)

The problems causal sequence fosters the two problems grouped below.

EFFECTS OF THE PRECEDENT CAUSAL CHAIN
• Failure to adequately describe performance verification and validation process by which success is measured (Contract Requirements Development)
• Data requirements (Contract Requirements Development)

8.5.5 Problems of program team performance

The program team has considerable difficulty because of instabilities which characterize acquisition activities. Six problems were grouped within this category.

PROBLEMS CAUSED BY ACQUISITION INSTABILITIES
• Leadership high turnover rate (Executive Decision and Policy Makers)
• Lack of acquisition training and experience of superiors (Inadequacy of Program Team)
• Loss of program focus due to program personnel rotations (Inadequacy of Program Team)
• Lack of contractor's ability to provide people resources as required (Inadequacy of Program Team)
• Inadequate resources outside the program office (Doing more with less) (Inadequacy of the Program Team)
• Barriers erected between defense and non-defense divisions of companies and sectors (Inadequacy of the Program Team)

8.5.6 Additional Consideration

There is one additional problem which stands apart from the 5 categorizations above: No OSD/Service policy on Concurrent Engineering (Program Execution). This problem is being addressed by DoD independently and was considered more of a management problem which is solvable through application of IPT and IPPD concepts.

8.6 SUMMARY OF THE ANALYSIS

The "System of Stewardship" which resulted from acquisition process redesign did not attempt to foreclose oversight. Indeed, all participants recognized the need for oversight. Rather, the process design attempted to limit the number of times that oversight was applied, and any negative influences of oversight on work in progress. Therefore those problems within the problem group "outside influences" that are unsolved were considered to be outside the reach of the workshop activities and will need to be addressed separately from acquisition process redesign.

The redesigned process did attempt to provide for tight linkage between the acquisition process and national security planning and strategy, but workshop participants clearly believed problems within that category of concern still needed attention.

Industrial base issues which affect program execution were also mostly untouched by the redesign process and may also be outside the reach of a redesigned acquisition process. It must be assumed that the requisite Industrial Base will continue to exist (either within or without the continental United States); but a functionally designed acquisition process would not preclude the industrial base issues which remain. The entire Industrial Base issue still needs attention.

Problems remain in achieving adequate integration of Government and Contractor activities. The problems are made more difficult by the body of legislation and regulation which institutionalizes mistrust between these two participants in the acquisition process. The issues cannot be resolved through good functional design. It might be that applying the methodology used to create the redesigned acquisition process could be used to come to grips with this issue. If such an approach were taken, workshops participants would need to represent the Legislative and Executive Branches of Government and also the Media. While some Legislative staff people might be receptive to a workshop held to explore these issues, prior requests for media workshop participation have been unsuccessful in generating either interest in or enthusiasm for media attendance.

Perceived problems of personnel adequacy and availability in both Government and Industry have been addressed in legislation and regulation. Providing for ease in performing functions necessary to move from ideas to deployed, fully supported effective weapon systems requires skilled and capable human resources; but an acquisition process which achieves that end can not, of itself, preclude the possibility of personnel inadequacy.

At the end of this analysis, it was concluded that the 66 problems which remain are problems mainly with the structure of the interfaces between the acquisition process and the U. S. culture. Those kinds of problems are the most difficult to solve. And while applying the methodologies used to derive a redesigned acquisition process might well make progress toward finding solutions to the real and legitimate concerns of the groups which create those problems, pursuing that course might require considerable investment of time and effort by other than acquisition community members. Chapter 9 will discuss these issues more fully.

CHAPTER 9
CULTURAL EMBEDMENT OF THE ACQUISITION PROCESS WITHIN THE U. S. SOCIETY: 1994

This chapter: (1) Discusses those entities which influence the Defense Acquisition System and the way in which they exert direct influence over the DAS structure and operation; (2) Discusses the U. S. Cultural condition at the end of 1994; (3) Discusses each of the 66 problems which remain after the redesigned process was evaluated and how those problems might be generated within the cultural environment; and (4) Describes the kinds of actions which might be taken by the stakeholders which would eliminate the remaining problems and simplify the interfaces between the acquisition community and the acquisition process participants.

9.1 DETERMINING THE INTERFACES BETWEEN THE ACQUISITION PROCESS AND THE SOCIETY WITHIN WHICH IT EXISTS

The evaluation (in Chapter eight) of the functional acquisition process (defined in Chapters six and seven) disclosed that 66 of the 679 problems which had been experienced with the then current version of the Defense Acquisition System (DAS) would not be solved or ameliorated by implementing the redesigned functional process. This Chapter seeks to understand why those problems remain unaffected and to use those insights to devise a plan to eliminate them.

Figure 2-1 (Chapter 2) described the Defense Acquisition process as it has been established within the U. S. Department of Defense (DoD). Figures 3.1 and 3.2 (Chapter 3) presented structures which showed: (1) how the Congress and the DoD hierarchy oversee the Defense Acquisition System (DAS); and (2) how two other foci of influence (the Media and Special Interest groups) influence the Congress and the Department of Defense on how to perform their oversight function. Figure 3.3 presented the structure of command authority for the DAS within DoD. All of those Figures indicate a direct, linear flow for those inputs which have effect on how the functional process works. Finally, Figure 8-1 (Chapter 8) shows how the remaining problems distribute within the DAS problem influence structure.

This chapter focuses on the direct interfaces between the acquisition process and the environment within which it functions. The 66 remaining problems were distributed within the categories defined in paragraph 8.5 to help in their re-examination from the perspective of how they appear at interfaces between the DAS and its environment.

The reason to look at interfaces in detail is that seeking solution to problems which arise from the culture within which a system is embedded requires understanding the relationships among both the direct stakeholders involved (i.e., DoD, the Congress, Industry) and those who influence the stakeholders (i.e., indirect stakeholders who interact with the stakeholders on specific issues). Entities which can affect direct stakeholder perceptions can markedly influence the way in which the DAS is constructed, maintained, and overseen. Thus, expanding the area of examination from a set of linearly arrayed direct influences to the broader concept of direct and indirect influences embedded within a larger, non-linear influence continuum may, as Ulrich [186] said, represent a better system approach.

However, looking at the media and special interest groups as homogenous entities will also mis-perceive the situation. These groups also include factions with differing points of view; and each of them seek to influence the DAS direct stakeholders.

In a larger sense, even interfacing entities are only part of a societal whole within which many involved forces exist and function. From that perspective, the examination of why the 66 specific problems remain, and what actions can be proposed to the direct stakeholders to eliminate them, might best begin with examination of the characteristics of the culture within which the DAS functions.

A major difficulty with inquiry of such broad focus comes about because "the whole" (culture) is a dynamic, changing thing: the ideas which appear to drive a culture can sometimes change rapidly over time. In the United States, the electorate in 1992 ended 12 years of conservative presidencies while retaining a more liberal Congress almost in its entirety. The electorate in 1994 reversed the Congressional direction. In the space of 2 years, both the Executive and Legislative branches of the U. S. Government had reversed their political direction. Because the DAS is a real-time operating system, it must respond in real time to any change promulgated by those who set its policies and oversee its operations. The need for the DAS to respond to changed perception about specific points of focus was shown clearly in Chapter 3 by the "point focus" concerns of the Congress and other organizational entities acting on their perception of DAS problems.

To introduce a system perspective, four interfaces between the DAS and other cultural entities were defined. They were interfaces between the DAS and:

1. Cultural elements external to DoD (problems caused by influences outside the Department of Defense);
2. Those responsible for defining national security objectives (problems with defining adequate interrelationships between acquisition and national security);
3. Industry (industrial base issues which affect program execution and problems of adequately integrating Government and Contractor activities) and
4. Those responsible for personnel policy issues both interior and exterior to Government (problems of personnel adequacy and availability in both Government and Industry).

Those who influence, directly oversee, or command the DAS are constrained by their own institutionalized methodology to respond in different time frames, to their perceptions of need for DAS change (e.g., legislative change generally takes longer than change to DoD and Service regulations or directives). Understanding participants' motives for introducing, or resisting, DAS change is necessary to devise acceptable DAS reform which could eliminate the remaining 66 problems.

9.2 A PERCEPTION OF U. S. CULTURAL CHARACTERISTICS: 1994

As used here "Culture" means "a) the ideas, customs, skills, arts, etc. of a people or group that are transferred, communicated, or passed along to succeeding generations b) such ideas, customs, etc. of a particular people or group in a particular period; civilization c) the particular people or group having such ideas, customs, etc." [187, p.336]. In his book "Megatrends 2000" [188] John Naisbitt refers to "content analysis" as a primary research tool used to measure cultural concerns and future directions. The term first appeared in books about intelligence activities during World War II and refers to the activity of observing the frequency of media articles on any subject matter. Content analysis indicates that over the last 20 or more years, the U. S. culture has acquired some characteristics which directly link both to problems experienced in defense acquisition and with increasing difficulty of implementing necessary change:

- <u>The society demands "solutions" to "problems" it perceives</u>. Increasingly, "problems" unsolved by institutions at their level of origin (town, borough, county, state) are referred to higher levels for "solutions". Moreover the preferred "solutions" are those which are permanent: "solve" the problem for all time. Most often, the solution takes the form of legislation aimed at behavioral modification: how individuals are constrained to act when the problem situations arise. Should the legislation be perceived as failing to produce the desired effect, it is strengthened or enhanced. Amending enacted legislation is increasingly preferred over repeal of poor legislation, or enacting new legislation which may take a different approach to correcting the perceived situation (the 1995 welfare reform debate). Over time, legislated behavioral constraints may foreclose behaviors useful to survive under changed conditions.

- **There appears to be increasing tendency to deny the possibility that legislation has failed or that plans have gone awry**. Almost any other course seems preferable. There has been a rapidly growing tendency to respond in politically correct ways to failed legislation and programs which do not produce results advertised for them. Most often those who defend the correctness of the failed action argue that the law, program concept, or implementation plan was correctly conceived, but the implementation was badly accomplished (insufficient law enforcement, funding, or time to permit it to work as advertised). Getting tough with repeat offenders is offered as the answer to increased crimes of violence. Higher spending is offered as the way to rescue the situation; the answer to failed programs. *There is little discussion of the possibility that the initial concept was in error, or that it might have taken long enough (to create the legislation, to formulate and execute a plan) that unplanned events have occurred which made the "solution" inappropriate to the changed situation.*
- **Failure, or error, is "intolerable"**. The possibility that even the most competent groups of experts cannot think of everything that "might" happen before the event occurs is left undiscussed. The precept that the learning process is continuous, and the understanding that exploring new territory is likely to create situations in which error is embedded in learning have been replaced by the view that all difficulty can be avoided through detailed planning before action is taken. Being "wrong" has become stigmatized to the degree that individuals can not (do not want to) admit to other than flawless behavior which produced precisely the expected results. Resistance to admission of error is exacerbated when legislation "criminalizes" error: A "mistake" is taken as *prima*

facie evidence of criminal motivation!

- A further cultural problem arises because of the perception that "technology" and "science" are the same thing. The view that all airplanes (civilian and military) fly, all ships (merchant tankers or destroyers) float, tanks (just like automobiles and trucks) run on the ground, permits the perception that creating a new airplane, ship, tank, or smart munition is just the exercise of scientific knowledge to produce a new product. The distinctions between invention, reducing new technology to practice, integrating complex elements into a working whole, and duplication of existing devices which have already been produced in large numbers are perceived only dimly if they are perceived at all.

These enumerated characteristics may be said to describe a society both ***analytical*** (for every problem there must be both cause and solution[s]); and ***adversarial*** (the causes or problems are individuals or groups who are at fault).

Although complete definition of a society's culture requires enumeration of many cultural characteristics, the simple listing presented above can help illustrate cultural embedment of a perception that wrong-doing and criminal intent are the root causes of those generic kinds of inevitable events associated with creating complex new systems (e.g., cost over-runs, schedule slippages, or performance short-falls).

- Attempts to explain that problems often arise from difficulties implicit in first use of state of the art technology (much of which has never before been reduced to practice) in a system which never existed before are seen as efforts to justify the poor performance (or dishonesty) of those involved with the program.
- When customer requirements change during the time period between initial statements of customer need and delivery of a system for testing, it is easy to perceive the problem cause as failure to use scientific methodology which can forecast requirements change accurately enough to synchronize them with system development. That kind of thinking creates serious difficulties; and there is an additional embedded difficulty: when changes to operational requirements are foreseen after a program begins, any attempt to make necessary program adjustments which can accommodate the requirements changes are widely perceived as "error". Change is resisted, and the motives of those who suggest it are often impugned.

An ***analytical-adversarial*** culture may be marked by the tendency to construct processes which are: (1) Costly (due to large amounts of oversight and checking); (2) Inefficient (because funds are diverted from **accomplishing** the program to **overseeing its accomplishment**); and (3) Ineffective (because the increased time required to fulfill the program objectives, increases the chance that a change in operational requirements during program execution will make the end product obsolete).

A possible explanation for unsolved problems even after implementing a functional Defense Acquisition process can be found by examining how an analytical-adversarial culture affects interfaces between the Media, Special Interest groups, Industry, the Congress, the Department of Defense, and the Defense Acquisition community.

9.3 DEFINING ENTITIES AND THEIR ACTIVITIES WHICH HAVE INFLUENCE ON THE DAS-CULTURAL INTERFACES

Before discussing interfaces between the Governmental and Cultural interfaces *per se*, it will be useful to define the entities, their activities and stated purposes. The major non-governmental entities which have interface with the DAS (and with each other) are: (1) "The Media"; (2) "Special Interest Groups"; and, (3) "Industry". The Government entities are: (4) "The Congress (and its sub-ordinate elements)"; (5) "The Department of Defense (including the Joint Chiefs of Staff, the Joint Requirements Oversight Council, the Major Operational Commands, the Services and Defense Staff Agencies, the Acquisition Corps); and, (6) "Other Government Agencies (such as the Environmental Protection Agency, the Occupational Safety and Health Agency); and, (7) "Other Cabinet Departments (including the Departments of State, Treasury, Commerce, Labor, and Interior).

9.3.1 <u>The Media</u>

As used in this discussion, the term "media" includes: (1) all activities which report to the public about events taking place anywhere in the world; (2) those activities which create popular or documentary entertainment; and (3) activities which present analysis or points of view on special subjects.

Within this usage, newspapers, magazines, television, cinematic production and distribution organizations, and institutions which routinely publish points of view (opinion) can be referred to as "media".

Increasingly over the past 70 years, the media have taken on two important societal roles; (1) arbiters of the public good; and (2) guardians of the public purse. In general, media are concerned with focused issues and tend to be unconcerned about either "system concepts" or defining linkages between individual issues and larger societal processes *except where such linkages serve to illustrate the point of view adopted by specific media*. The media has also displayed an increasing tendency to go beyond the traditional reporting elements ("What, Where, When, Who, Why") and introduce editorial policy into reporting. The language used by the media in its reporting as modifier to actions can suggest unintended "intent" for actions which the actions did not themselves imply. Enhancing reports of events which serve to bias them in favor of editorial positions not only (1) enlarges editorial commentary beyond editorial pages, but also (2) embeds singular perspectives within news reports as illustrated by the increasing use of unsupported allegations reported as "fact". This practice (widely used by the U.S.S.R's Tass) makes credible what may later be shown to be unfounded accusations of wrong-doing. An example of such practice was the accusation of fraud [189], brought first by the media (in 1985) and then by the Government, against the then director of the National Aeronautics and Space Agency, James Beggs. In 1987, the Government abandoned the case against Mr. Beggs [190]. The judge rebuked the Government for having pursued the case at all calling the charges "unfounded and baseless". Mr. Beggs remarked afterward that while he was gratified to have been judged innocent, he did not know how to retrieve his reputation.

While Members of Congress talk personally with their constituencies from time to time about particular controversial issues, and also get constituent opinions by telephone, facsimile, and mail, Congressional perceptions of public attitude are mainly derived from media reports. In the IM workshops, Congressional staff members explained that Congressional actions respond primarily to constituencies needs which are primarily derived through media reports and polls. Long term Media positions on defense issues have been consistent. Thus, over time, the media perception can become societal perception. It would take considerable effort to change media mind-set.

9.3.2 Special Interest Groups

"Special interest group" refers to organized collectives which seek particular objectives through legislative action. These groups may: (1) Visit legislators and staff(s) to present their point of view; (2) Publish papers which contain statistical analyses favorable to their objectives; (3) Engage in public activities (such as rallies or demonstrations) which seek to influence public opinion; (4) Provide funds to candidates who are likely to agree with group objectives.

Since 1960, controversy over U. S. Defense activities has resulted in formation of numerous special interest groups which either support or oppose particular Defense activities. Beginning in the mid 1960's, group demonstrations against Defense activities became popular; and they did affect U. S. policy in VietNam. Most recently, plans to continue with U. S. Anti-Ballistic Missile Defense program development ("Star Wars") and adverse Chinese reaction to that program has been widely publicized (c.f [191]). Opposition groups have proliferated to oppose that action and seek to slow or halt Congressional funding for the program.

There are a number of venerable special interest groups which concentrate on defense issues: (1) each of the Services has its own particular association (Navy League, Association of the U. S. Army, Air Force Association) which participates actively in defense policy discussions about personnel and materiel needs of that individual service; (2) the American Defense Preparedness Association, and National Security Industrial Association (NSIA) advise Congress and the public on defense issues; and (3) the Union of Concerned Scientists (UCS) provides Congress and the public with its position on national issues. All of these groups attempt to influence legislative actions and public policy. From time to time, they have also drafted and presented legislation to be introduced by Members of Congress.

9.3.3 Industry

In 1952, Congress enacted legislation [192] defining the U. S. Defense Industrial Base (DIB) to include not only organizations which have traditionally engaged in building complex weapons for defense, but also every organization in the United States and Canada which manufactures any product. The portion of the DIB commonly called "Defense Industry" is a particular group of large and small companies which have traditionally conceived, built and supported military equipment. The large firms are generally referred to as "Prime Contractors". They generally contract with the Government for end-product weapons and all of the research and development activities necessary for weapon design and production. DIB "Sub-Tier" contractors are the smaller industrial firms who contract with "Prime Contractors" to provide elements of a complete weapon system. In Fiscal Year 1993, contracts from the various defense activities to industry amounted to between three and four percent of the U. S. Gross Domestic Product (GDP) [193].

The DIB provides direct employment for tens of thousands of people, and creates servicing employment for one and one half times that number of people who support defense workers. DIB firms have always called upon their Members of Congress to help them obtain a share of the defense funding. Indeed, some of the special interest groups have been established by the DIB as spokespersons for their interests. The relationship between the DIB and Congressional delegations from their states has always been important in influencing defense legislative actions. But in recent years, because of the increasing attention given to "*the appearance of impropriety*" by Members of Congress, the relationship has become frayed. The DIB has undertaken a public relations effort in an attempt to overcome adverse publicity generated by widely publicized accusations of unlawful actions of a few individuals.

Since the Government has neither the skills nor the facilities to manufacture large numbers of weapon systems, the DIB is essential to national defense capability. The DIB has responded to rapid reduction in U. S. defense activity in two ways: (1) by increasing its attempts to diversify its markets by selling defense products to friendly Governments abroad; and, (2) by attempting to penetrate commercial markets with products derived from defense activities. These DIB efforts have had minimal success. Both the Department of Defense and the Congress are concerned about loss of DIB capabilities, and consequent increased dependence on foreign sources for U. S. defense needs.

The (1) concerns of Industry, transmitted to Congress directly and through industry's special interest groups; and (2) media perceptions presented to the public both shape legislative actions which affect the DAS structure and the way DAS operates.

9.3.4 <u>The Congress</u>

As used in this discussion, "Congress" includes all of its conglomerate organizations mentioned in Chapter 3. The Congress exercises responsibility for transforming the cultural fabric into legal code. It attempts to reflect society's majority opinion while protecting the interests of, and providing for, minority viewpoints.

9.3.5 The Department of Defense

"The Department of Defense" includes all of the organizations discussed in Chapter 3 which report to the Secretary of Defense. The executive responsibility for carrying out Congressional acts pertaining to national defense lies within the Department and its components. Organizations within the Department of Defense which perform functions that interface with DAS activities are:

- The Joint Chiefs of Staff (JCS) are responsible for providing professional military expertise to the Secretary of Defense; for formulating military plans and actions taken to implement those plans. The JCS is responsible for recommending establishment of major military regional commands as required to implement approved military policy. The JCS Vice-Chief is a DAB member.
- The Regional Commands (e.g., U. S. Forces within Europe, U. S. Forces within Asia, and U. S. Rapid Response Forces) are responsible for planning and executing military action within their command region. As part of the planning process, the force commanders will generate needs for materiel. Should they require a military capability which cannot be satisfied by equipment within the current armament inventory, they will transmit their needs to the JCS (and sometimes to the Service materiel development agencies) for action.
- The Joint Requirements Oversight Council (JROC). JCS is responsible for determining military equipment requirements through deliberations of the JROC. The JROC reviews regional commanders' requests for new and improved weapon capability and certifies need for new equipment through issue of a Required Operational Capability (ROC) document. The ROC is coordinated with the DoD staff offices (including the Secretary and Deputy Secretary of Defense when appropriate) and then sent to the appropriate materiel development activities within the Services for action.
- The Defense Staff Agencies include the Comptroller (responsible for all budgetary actions); Policy Analysis and Evaluation (responsible for force analysis, cost effectiveness analysis and maintaining balanced military capability among the armed forces); and the Undersecretary for Acquisition and Technology (responsible for both oversight of the Acquisition Corps and Defense Research and Engineering (technology development) activities.

- **The Defense Acquisition Corps** is that group of government (military and civilian) acquisition professionals whose activities are directly focused on acquiring Armed Forces materiel. It embraces all members of the Defense and Service Acquisition Corps: Government Program Managers, Contracting Officers, Program Office Technical Directors and Staffs, and Logisticians. When appropriate, Training and Maintenance personnel involved with acquiring new materiel are also included within the Acquisition Corps. Because the Acquisition Corps (1) executes policy which regulates how the U. S. Government buys materiel, and (2) is responsible for insuring its application during every phase of the acquisition process, the Acquisition Corps interfaces with a broad community of contractor counterparts. At that interface, the Corps is held responsible for maintaining acquisition process integrity and insuring that delivered products meet or exceed the stated operational requirements.

9.3.6 Other Government Agencies

Until very recently, Defense activities fell outside the purview and authority of most other Government agencies. However recent Congressional legislation has mandated DoD's full compliance with all Environmental Protection Agency (EPA) and Occupational Health and Safety Agency (OSHA) regulations. Achieving that objective has necessitated significant modification to a number of development programs currently underway. There have been resulting changes in cost and schedule which were unforseen at the inception of those programs. As military bases close, increased costs resulting from EPA "clean-up" regulations will have effect on acquisition programs.

9.3.7 Other Cabinet Departments

Growing emphasis on increasing weapon sales abroad has broadened the interfaces between the DAS and the U. S. Departments of State and the Treasury (through the Alcohol, Firearms and Tobacco Control Board). Attempts by the DIB to penetrate civil markets in the U. S. with new products and to sell military derivative products in foreign commercial markets have brought about increased interaction with the U. S. Department of Commerce. In addition, Congress recently made Defense activities subject to all Department of Labor regulations; it has also limited DoD authority to use U. S. public lands. These changes created very active interfaces between the Department of Defense and all of the entities newly involved with and interested in the outcome of defense acquisition activity.

9.4 HOW INTERACTIONS AT THE INTERFACES CREATE AND MAINTAIN THE SET OF PERSISTENT PROBLEMS

The remaining 66 unsolved problems will be discussed *seriatim* within the groupings indicated. The discussion will link the problem statements (printed in bold italics) together in a narrative to show how they may be perceived during the 1980-1994 time period by interfacing parties embedded within a rapidly changing, event-driven culture experiencing change to fundamental societal elements.

9.4.1 Influences on DoD from outside the Department

While all of the entities which interface with the DAS exert influence on the way the Acquisition Corps discharges its responsibilities, Congressional influences are arguably the most important to the DAS. Understanding why the 66 problems persist begins with an explanation of the processes on either side of the Interface.

The Congress is a political body and responds to the political realities it perceives. It is not surprising that Acquisition Corps members perceive ***"Political influences beyond the program manager's control"*** and ***"Political motives in the decision process"***. The effects of changed Congressional political positions are quickly felt by the Acquisition community. Congress creates the legal framework within which the DAS operates. Therefore change to Congressional perception of how well the DAS is working is a primary cause of new and amended legislation. Fed by media accounts of widespread wrong doing by Acquisition Corps members during the period between 1989 and 1993, Congress sought ways to preclude such actions in future acquisition programs. The Acquisition Corps perceived Congressional actions as reflecting ***"Congressional mistrust and meddling and language"*** and they experienced ***Interference from Congressional oversight"***. Because they felt the legislation was hindering their performance, they perceived ***"Adverse impact of well meaning but ineffective attempts to help improve the process"***, ***"Excessive procurement laws and regulations"***, ***"Constraining procurement laws and acquisition regulations"***. The Acquisition Corps also perceived some additional harmful effects of some legislation because of its ***"Mandate for competition of small business that may be unqualified to***

participate", and for requiring ***"Illogical Competition"***. Until 1994, passage of new legislation by the Congress was not accompanied by repeal of prior legislation. There was no "omnibus" legislation which sought to rationalize all of the numerous laws and regulations which affected the DAS. Congress' creation of the "Section 800 Panel" was an attempt to rationalize all prior legislation and introduce significant reform. However, during the period when constraining legislation grew at a rapid rate, the Acquisition community feel the unrestrained legislative activity was because of ***"Lack of regulation and historical approach to cleansing"*** - Congress was not looking to see whether the new legislation created problems to observing existing constraints. Increasingly, there was a ***"Tendency not to surface problems"*** as Acquisition Corps personnel responded to their perception of unwarranted and undeserved criticism of their activities. Congressional internal procedure was felt by the Acquisition Corps to impose severe restrictions on their actions. The Acquisition Community also felt the ***"Congressional authorization and appropriation process"*** caused continuing problems. Constitutional limitations to how Congress may appropriate funds does create problems which make the Acquisition Corps tasks more difficult. But the process used to do that: (1) is created internally by the Congress; (2) appears to serve overall Congressional functional needs quite well; and (3) is unlikely to change. The process works as follows: both the House of Representatives and the Senate have two Committees which involve themselves in Defense issues: the Committees on the Armed Services (HASC and SASC); and the Appropriations Committees (HAC and SAC). Each year, HASC and SASC authorize manpower and equipment levels of each service branch individually and of the overall Department of Defense for the coming Fiscal Year. The authorizations are then provided to the HAC and SAC. Only the HAC and SAC can generate appropriation bills which are approved by the House and Senate ***in camera***. Actual funding authorization is formalized in the joint Appropriation Acts for each Fiscal Year. In recent decades, the Congressional authorization-appropriation cycle has consumed increasing amounts of time; and in many instances is not completed prior to the start of the succeeding fiscal year. When no appropriation bill has been approved, the Congress will normally enact a resolution which permits continued operation of the U. S. Government (a "Continuing Resolution"). Except in extraordinary circumstances, continuing resolutions authorize spending in each quarter of the new fiscal year only at the same levels as were authorized during the same quarters of the prior fiscal year. The Congressional authorization and appropriation process (which provides single year funding only after separate agreement by two committees of each chamber and subsequent approval of both legislative bodies) combines with restrictions embedded within the continuing resolution procedures to generate a large number of serial opportunities to change actual funds available for acquisition programs. It is not unusual for individual program managers to be asked about the effects of budgetary changes on an almost monthly basis throughout the year. Finally, as Congressional legislation has become increasingly detailed, the accusation of "Congressional micro-management" is more often heard. When Congress enacts legislation, the mechanisms for its implementation are left to the governmental agencies on which the legislation has effect; that is DoD and the Services are charged with implementing Congressional direction. Most often, DoD and Service regulations are issued to insure that operating entities follow Congressional dicta. When DoD directs the Services to implement a Congressional mandate, it issues a Directive to its own agencies and to the Services specifying; (1) the reason for issuance of the directive; (2) what the directive will include; (3) the effective date of the directive; and (4) changes made to other DoD directives to align them property with the new Congressional requirements. The purpose of DoD and Service directives is to institutionalize legislated checks and balances created in response to concerns about DoD acquisition performance. Since the numbers and content of the laws and regulations which affect the DAS result from Congressional mandate, and since Congress tends to act in ways consistent with analytic-adversarial culture, it continues to issue new instructions so long as the desired effects are not achieved. Ignored is the possibility that those effects cannot be achieved in the circumstances which apply. Because the Congress has demanded an increasingly detailed set of information about acquisition programs both contemplated and in being, DoD has established complex chains of internal review. Unfortunately, the cumulative effect of introducing a complex system of legislated/directed checks and balances is to reduce responsiveness of the acquisition process. If the web of constraints on freedom of action is unchanged, the Acquisition Corps will continue to experience a number of problems with the review process: ***"Proliferation and lack of accountability of ankle biters"***, ***"No one can say 'Go' but everyone can say 'Stop'"***, ***"Too many participants***

can stop or slow [the] process without responsibility for delivering the product", ***"Too many nay-sayers...in the review chain"***, and ***"Inability to award timely contracts due to external controls"***. An important factor to be considered in understanding the interface between Congress and the DAS is that providing for the national defense is only one of many Congressional concerns. Congress is also concerned with the nation's social fabric and the well-being of the people. Since Congress spends funds it raises through taxation, opportunities to improve social conditions are routinely enacted. When spending public funds, one major Congressional concern is to direct them toward betterment of the public condition: (1) Federal funds spent in regions experiencing high unemployment help create jobs; (2) the purpose of directing all government contractors to make hiring decisions based on factors extraneous to individuals' capabilities to perform work is often meant to improve individual economic conditions of those perceived to be in need of help. The effects of these legitimate Congressional concerns can cause extreme difficulty for program managers.

The Media, through their reporting and commentaries on the news, can exert considerable effect on how Congress perceives acquisition needs and DAS integrity. For whatever reasons, content analysis of two of the daily news media considered to be "of record" in the United States (The Washington Post, and the New York Times) reveal a persistent tendency to publicize failure widely while often ignoring success. As an example: prior to U. S. military involvement in the Persian Gulf (the Gulf War), U. S. "smart munition" capabilities were called "costly failures" by many special interest groups (e.g., the Union of Concerned Scientists). Those negative comments were front-page news whenever they were issued. Often editorials were written to support the opinions expressed in the "news reports". When those same weapons performed well during the Gulf War, the same "of record" media were sparing in their positive comment about weapon performance in actual combat, and instead continued to print articles quoting "experts" assertions that stories of success were untrue, television evidence notwithstanding! Some acquisition process activities have fueled media tendency to focus on "bad news". During the course of an acquisition program, Congressional appropriation and oversight processes demand documentation and testimony about program progress to be provided to the Congress by DoD and the Services. As a condition of providing initial developmental funding, DoD and Congress require presentation of the program's Life Cycle Cost (LCC). LCC is the total of all costs anticipated for the program if it is to be pursued. LCC also includes all developmental costs and expected operational costs for some period of years after the new item has been deployed. Clearly, LCC estimate accuracies depend upon the accuracy with which the future can be forecast ***in detail***: (1) what will be the cost of converting "leading edge" technology into prototypical weapons which can be demonstrated?; (2) how much will it cost to convert a prototypical weapon into a weapon system which can be efficiently replicated many times at a fixed price?; and (3) how much will it cost to operate and maintain the final system? The kinds of events forecast and the time between the forecast and the actual events limit the accuracy of the estimates which can be produced. One type of Congressional action can even introduce error into an accurate forecast: if, after a prime contractor has been selected, Congressional direction causes a change either to the contractor or to the program, the program manager will be called to explain discrepancies between forecast and actual progress and cost. Often the Congress does not accept effects of directed change as legitimate reason for decreased performance or increased cost. Congress recognizes that there are ***"Political influences beyond the Program Managers' control"*** and ***"Political motives in the decision process"*** and it is Congress that must act to mitigate the effects of their actions on program managers by changing the environment within which the DAS functions. When inevitable errors in the initial LCC estimates become obvious, the media reports them through the lens of an analytic-adversarial society. The cause of error is usually assigned to incompetence or wrong-doing. Little is said about how either fundamental limits to forecast accuracy, or Congressionally directed change might affect the LCC estimates. Media influence is also felt by DoD. Whenever deviation from a weapon system development plan occurs for whatever reason, DoD and Service oversight and the Acquisition Corps provide explanation to the Congress. A great deal of pressure is placed on individuals who provide such information to avoid the appearance of error. In effect, for DoD and Service personnel involved in acquisition, the possibility of media attention is of great concern. In sum: the media have influenced the Congress and the DoD to create a legislated and regulated system of detailed checks and balances without concomitant establishment of an apportioned responsibility for program performance among all who participate in that process. If there is concern that all deviation from an initial plan is error, and that error is caused either by criminal intent, misfeasance or incompetence, then the institution will proliferate ***"ankle biters"***: ***"nay-sayers ... in the review chain"*** who ***"can stop or slow process without responsibility for delivering the product"***. The result of all of this to generate opportunities for participants with no responsibility for the outcome of their actions on the program to interject themselves into the process. In addition, the complex and often conflicting requirement is to be "right" all of the time rather than to make timely revision to cost and schedule estimates as necessary to reflect actual development progress. All of this creates a climate in which there is a ***"tendency not to surface problems."***

9.4.2 Problems in defining connections between acquisition and national security needs

The problems grouped within this category involve multiple interfaces between the Congress and DoD/Service entities and between DoD/Service entities and the Acquisition Corps-DAS. Seven problems involve interfaces between the Congress, the Joint Chiefs of Staff, the Service Secretaries and DoD Staff agencies.

The Congress acts to insure that U. S. military strategy is consistent with its own view of the world. As a deliberative body, it creates and modifies what it hopes will be a long lasting legal code. It does not deal very well with rapid change. It seeks to create stable environments for time periods that permit it to take its own actions in its own time. Given a choice, Congress prefers to limit its activities to broadly defined long term strategies which are more likely not to require change over reasonably long time periods. The post cold war concept of being engaged in two concurrent wars on separate continents is seen to provide a long term strategy to limit need for additional weapon development or production. It has been discussed with, and approved by Congress. Specifying a level of enemy capability rather than an unchanging enemy (as was done during the "Cold War" period) is seen as a way to achieve greater threat stability. The Congress looks to the JCS to respond to this kind of broadly defined threat and estimate personnel and materiel needs required to meet it in a time frame *consistent with Congress's own capability to respond.* The Congress adjusts the JCS estimates and authorizes-appropriates what it believes are rational programs and funding for the armed services. As discussed in Chapter 3, the JCS uses an extensive model set [12] to define the military needs it sends to the Congress.

JCS also develops and certifies a need for new weapon systems based on the needs of its area Commanders through action by the Joint Requirements Oversight Council (JROC). The JROC issues a Required Operational Capability (ROC) for action by DoD and the Services who take action to meet the ROC need. DoD and the Services initiate the acquisition process by authorizing activity which generates the ideas for new weapons. Since the dissolution of the U.S.S.R, defense needs have become less stable. Rather, they have experienced fairly rapid change as military actions are undertaken for purposes other than European defense. The process by which changes in world situation can be reflected in change to existing ROC's or issuance of new ones is much longer than the time it takes to perceive some new need which emerged from a changed world situation or world view. Thus, operational requirements have exhibited instabilities which cannot be easily accommodated by either the Congress or the DAS. The DAS experiences this situation and believes ***"there is no agreement between the Executive Branch and the Congress on the long-term budget projection"***.

There are a number of additional ways in which the difference in time required to respond to change becomes manifest through the network of organizational interfaces embedded within the DAS. In effect, change appears to the DAS as "***lack of, or undisciplined strategic planning***" which results in "***lack of clear military strategy and quantitative military requirements***". Change also involves the types and the numbers of existing and new weapon systems which will be required to pursue a changing military strategy.

The Congress sees the changing needs presented to it by the executive branch (DoD and the Services) as impediments which act to preclude making the longer term budgetary decisions it feels are necessary. Congress responds by changing its approach to providing funding for the National Defense. The DAS translates Congressional resource shifts as "***instability of DoD and Congressional support for programs***" it is pursuing <u>by direction</u>. From DAS's point of view, it has experienced "***changes in policy and specification***" which are reflected in (1) changed apportionments among national defense and other national objectives in general, and (2) between individual programs within defense in particular. When funding levels fluctuate at the program level, the acquisition community experiences ***"abrogation of commitment at all levels"***. In addition, Congress also reflects changed perceptions in national social needs which are experienced as changed policy and specification. Of course, the dynamics of change are pervasive and there is frustration in dealing with weekly or monthly change frequency when development program response times are of the order of years. As the DAS attempts to deal with unceasing changes to requirements, funding, and prospective end item quantities; it complains plaintively, ***"Its never over"***.

A great many problems which the DAS experiences generate from the great difference between the years it takes to complete the process of moving from ideas to prototypical weapons and from those prototypes to a deployed operational force and the almost instantaneous change experienced when dealing with real world events. Changes to operational needs can occur at any time. Such change focuses immediate concern on the weapon rather than on a consistent pursuit of total defense capability. The DAS complains that; (1) "***short-term planning dominates the decision-making process***"; (2) there is a "***lack of strong, consistent, and long-term user support for smart munitions programs***" which result in a (3) "***lack of priority by acquisition organization for weapon systems***".

The existence of interfaces between involved entities can create problems in managing change. They can occur when the time required to respond to change is different for each entity which interfaces with other entities. Problems that arise at interfaces between DoD and Service elements may be the most difficult to address. It is that difference in time required to take action which can cause a system "discontinuity" at the interface. As an example, if the DoD needs only a few days to respond to some necessary programmatic change, while the service requires weeks to accommodate to the change, it can appear to one of the participants at the interface that there is "***lack of fiscal planning***"; while on the other side of the interface, it appears that "***the acquisition process considers program/requirements on only an individual basis without considering larger investment context and trade-off***".

Finally, because DAS experiences no real stability of requirement either in operational need nor in numbers of items required, described as "***year-to-year instabilities in budget and procurement quantities***", DAS finds it difficult to "***synthesize a design the first time***" and implement that design through an orderly, efficient process.

9.4.3 Industrial base issues which affect acquisition performance

The interface between the Industrial Base and the DAS is the point of focus for a great many issues. There are many legislated dicta about how Government and Industry interact in developing weapons systems. Most of the issues center about the Congressional (and DoD) construction of an environment built on institutionalized mistrust between the parties at that interface. The 13 problems grouped within this category will later be combined with problems in integrating acquisition process activities of Government and Contractor participants. The following logic links these problems.

Although it has been stated that U. S. policy is to encourage sales of its military products to other friendly governments, "***foreign sales planning***" has not been required in most development programs. When it has been important, program managers have found that "***U.S. security and Customs regulation [are] not consistent with international co-development***". Since, in a number of instances, foreign sales alone have made the program profitable for the weapon manufacturer, the interface between Congress and other government departments (Treasury, Commerce, State) takes on great importance when the quantities of product required fluctuate greatly.

The analytic-adversarial culture within which the DAS exists creates a situation where "***present acquisition policies contain conflicting goals making it virtually impossible to strengthen the base***". DAS program managers perceive a "***need to formalize or institutionalize consideration of the industrial base***" to permit them to strengthen it. They also understand that "***intervention is not an administration policy***" in the period prior to 1992. DAS participants perceived that "***DoD fiscal management structure does not support and strengthen the industrial base (unit cost policy)***" and that "***lack of agreement on the crucial or cost elements of the industrial base that must be sustained***" were additional inhibiting factors to maintaining a sufficiently robust industrial base to respond to continuing defense needs. As a result of these problems, there has been "***outward migration of investment capital and skilled people***" from those segments of industry which deal with Government, and "***OSD [has become] a small customer of the general industrial base***". Further, the DAS believes that "***lack of a clear understanding of the consequences of some of the perceived industrial base pro-***

blems*" and "*failure to consider the industrial base early in the acquisition process*" has created a serious situation which becomes manifest when industry is asked to take on work involving new kinds of processes. "DoD [has been] unwilling to fund [an] industrial base improvement program***". Thus because of resource shifts away from defense industrial activity, there has been a real "***loss of industrial base***" which results in "***inadequate research and development***" specific to defense issues.

The issues at the interface between Industry and Government come about because of Congressional actions; actions, it can be argued, which result from an analytical-adversarial culture.

9.4.4 Problems of inadequate integration of Government and Contractor activities

The Government and its contractors have a Congressionally mandated mistrustful relationship. In their responses to competitive Requests for Proposal to develop new weapons, contractors are assumed likely deliberately to mis-estimate cost, performance, or schedule requirements in order to win the contract. Mis-estimation can take several forms: (1) underestimating development costs for the specified system; (2) overestimating the proposed system's potential; (3) proposing an unrealistic or unachievable schedule; or (4) citing cost, schedule and performance capabilities based on expertise or facilities the contractor does not possess. Further it is assumed that if contractors deliberately mis-estimate any aspect of their response, they will likely propose changes to the system they are developing to permit changed contract terms that will allow them to change performance, delivery and cost to fit their actual situation.

This assumption of contractor dishonesty is reflected in legislation which requires all who compete for government contracts to sign a certificate of price accuracy. The certificate is signed under penalties of perjury. Other mandatory certifications deal with information which may have been received from acquisition corps or other government personnel in the course of preparing a proposal or negotiating a contract. All provide sworn assurance that all contractor employees have not engaged in certain prohibited actions as defined by the Congress in its legislation. Further, any evidence of contact between contractor employees and any government personnel, other than the appointed contracting officer, is grounds for prosecution in

Federal court.

The acquisition community must evaluate all proposals and certify to the Contracting Officer that the contractor selected can perform in the manner proposed. Unfortunately, many acquisition corps members have neither worked in defense industry nor performed tasks equivalent to design, construction, test, and manufacturing which contractors routinely accomplish. **The level of experience of government acquisition corps members may be inadequate to provide an informed certification.**

At the interface of coordination between government and contractor, there are markedly different perceptions about what is necessary to achieve success. The following discussion treats the 14 problems grouped within this area that would remain after institutionalization of the redesigned acquisition process.

"***Competitive pressures [on both sides] lead to unrealistic expectations***". Thus the "***pressure for unrealistic schedule, cost, and performance***", "***unrealistic programs plans/schedules and associated funding profiles***" are perceived on the contractors part as "***the Government forces contractor to buy in thereby increasing the risk***" and on the Government's part as "***failure of the contractors to propose realistic costing to Requests For Proposals (buying in)***". At the same time, there is "***lack of Government understanding of the cost of producing many smart munitions programs***". That leads to "***ineffective cost estimating up-front***" by both sides, and the inexperience of Government personnel leads to inadequate "***assessment of program cost risk by DoD***".

Absent real agreement about cost and schedule risk, it is likely that "***data requirements***" will be difficult to define, and the parties will "***fail to adequately describe performance verification and validation process[es] by which success is [to be] measured***".

There are a number of consequences which result from this kind of situation: DoD's "***management of the DoD acquisition process is not disciplined enough***", and there is "***lack of early management focus***" on those risks. Moreover, Government is likely to use "***imprecise risk management methodologies***". There is also the problem that neither side "***know[s] how to respond to risks even when known (risk/penalty/ profit)***". "***Lack of Government understanding of the cost of producing many smart munitions programs***" leads to inadequate "***assessment of program cost risk***".

It may be that solving problems at this interface requires considerable change to the body of laws which has been institutionalized in the current analytical-adversarial environment.

9.4.5 Problems of program team inadequacy

In developing any new weapons, there is the need to build a team of individuals who feel deep responsibility to the program and are devoted to its success. Those teams must be built despite the legalized institutionalization of mistrust between the Government and its contractors. The most notable examples of complex programs displaying this kind of dedication are U.S. space activities. Development programs such as: (1) the Gemini program which put humans in space for the first time; (2) the "Man on the Moon program" which became known as "a small step for man, a giant step for mankind"; and, (3) most of the space shuttle activity are similar in many ways to DoD development programs. All demonstrated the kind of teamwork necessary for success.

But even assuming great change to the Government-Contractor interface, improvement to program teams on both sides is necessary. The Government will need to correct the "***lack of acquisition training and experience of superiors***" and reduce the "***leadership high turnover rate***" to insure against "***loss of program focus due to program personnel rotations***". Industry will have to remove "***barriers erected between defense and non-defense divisions of companies and sectors***" in order to overcome the "***lack of contractor's ability to provide people resources as required***". In terms of improvements to program management, organizational change may be required to correct the Government problem of "***inadequate resources outside the program office (doing more with less)***".

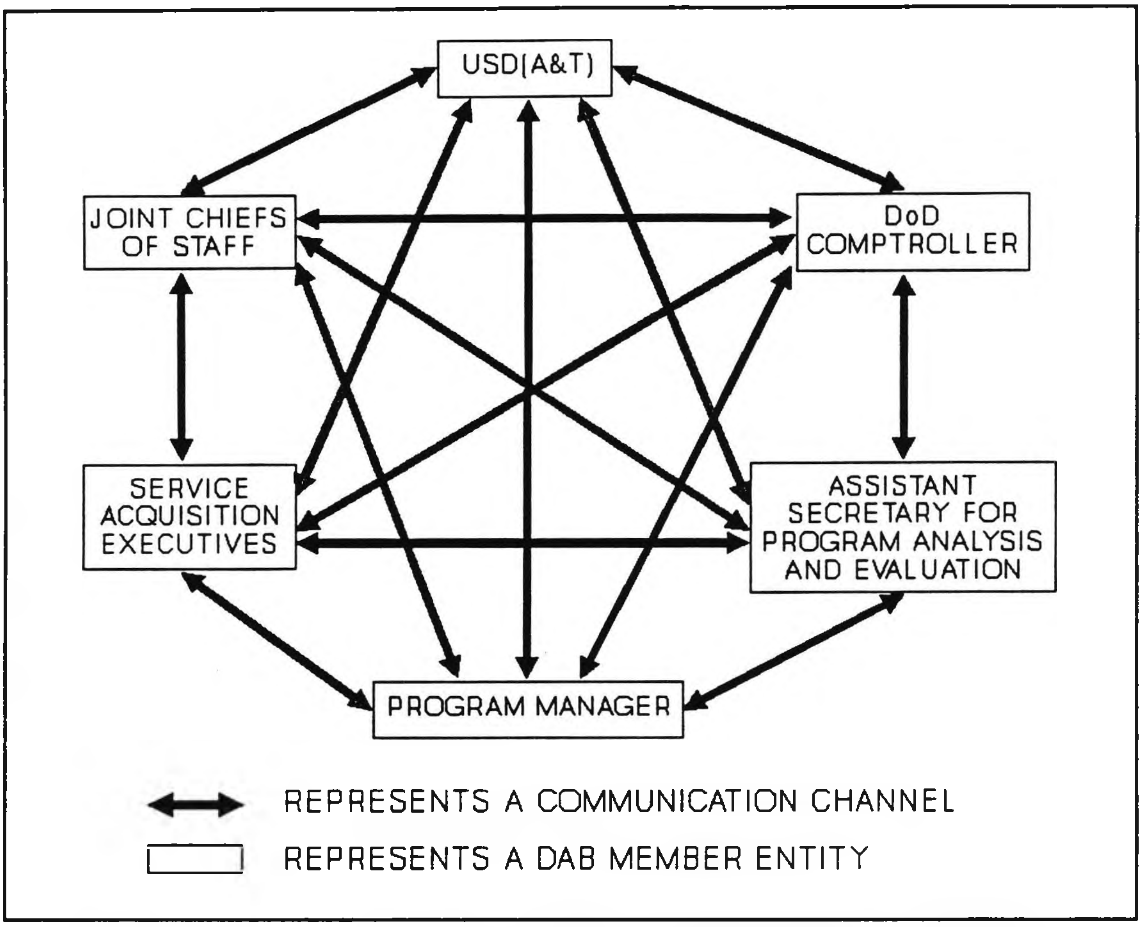
9.5 A CONCEPT OF INTERFACES BETWEEN PLAYERS

The interface structure which associates with the DAS is quite complex because there are multiple relationships among the many entities involved in Defense Acquisition. To illustrate the point consider the Defense Acquisition Board (DAB), an entity established within the Department of Defense to: (1) decide (at milestone zero of Figure 2-1) whether development programs proposed should be undertaken at all; and (2) certify (at Milestones 1, 2, 3, and 4 of Figure 2-1) that established programs have progressed sufficiently to enable their transition to the next stage of the development process.

As experienced by a Program Manager, the DAB consists of a number of permanent members and some members who attend particular meetings at the pleasure of the DAB chairman. The DAB permanent membership consists of: (1) the Undersecretary of Defense for Acquisition and Technology (USD[A&T]) as DAB Chairman; (2) the Vice Chief of the Joint Chiefs of Staff as DAB Vice Chairman; (3) the Assistant Secretary of Defense, Program Analysis and Evaluation; (4) the Comptroller of the Department of Defense; (5) appropriate Service Acquisition Executives; and (6) other OSD members as appropriate to the DAB purpose. **DAB functions are not the singular duty of DAB members and attendees: each is involved with full time duties that have their particular responsibilities.** When they act as DAB members each individual interfaces with all other members for the purposes of program review. But members may interface with each other in the course of their other duties as well. Therefore, relationships among DAB participants may have been shaped by a great many interactive experiences.

In short, there are multiple interfaces between DAB members that afford opportunities to form relationships.

Figure 9-1 is a visual representation of the numbers of interactive channels that can exist between DAB participants. There are six entities shown and there are 15 separate communication paths between them. Each path of communication provides a potential interface between the two entities involved. In general, if there are N entities involved in communicating, there are [N(N-1)]/2 possible communication paths (or interfaces) between them. Not only does establishing a DAB create a large number of interfaces between participants, the time continuum and priority of task performance is different for each participant. Thus the potential for change is different on either side of each interface. As an example, the Comptroller is fundamentally concerned with the appropriation and control of funds provided to DoD by the Congress. The Comptroller's view of time relates to those concerns. Program Managers are concerned with program progression from ideas to end items and their concerns focus on the time required for invention, engineering, production and support activities. Each DAB participant carries individual perceptions of the world into the DAB. Views on program issues and the time frames which they represent are different depending upon the participants' normal functional activities.

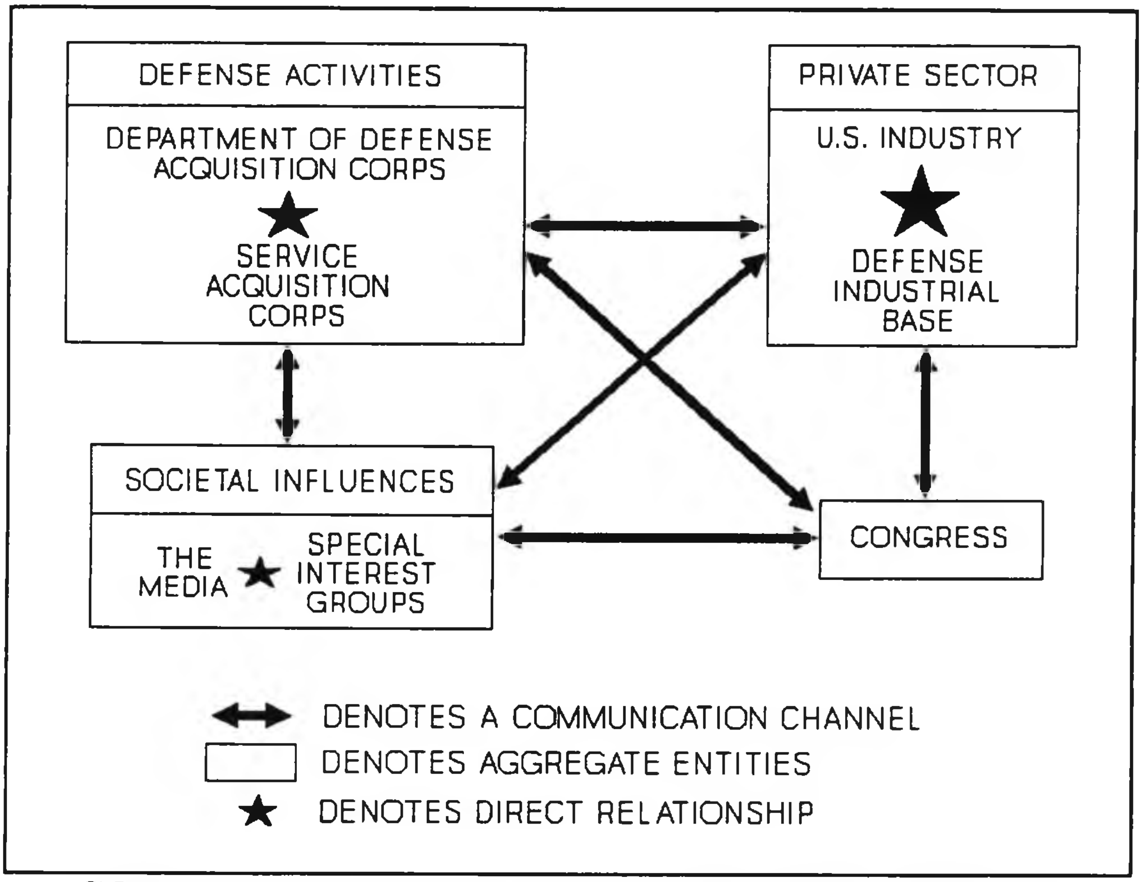


COMMUNICATION CHANNELS BETWEEN GENERIC ENTITIES ON THE DEFENSE ACQUISITION BOARD

Figure 9-1

Figure 9-2 is a representation of the relationships among the Defense Acquisition System participant entities. Figure 9-2 shows that within the genera entitled "Defense Activities" there are the Defense Acquisition Corps and the Service Acquisition Corps which are directly related, because all Service Acquisition Corps members are members of the Defense Acquisition Corps. Similarly, within the "Private Sector" of the U. S. economy, the Defense Industrial Base is that segment of U. S. Industry which supports Defense acquisition. The general "Societal Influences" aggregate category shows two entities which participate in DAS activities: the Media, and Special Interest Groups. In this instance, the media is viewed as a special interest group whose purposes are as stated in 9.3.1 above.

Figure 9-2 indicates six communications channels (interfaces) within the DAS.



COMMUNICATION CHANNELS BETWEEN GENERIC ENTITIES WITHIN THE DEFENSE ACQUISITION SYSTEM

Figure 9-2

Since use of the DAB to certify the worth and progress of programs is mandated within the Defense acquisition process, all of the relationships shown in Figures 9-1 and 9-2 are within the Defense Acquisition System. The interfaces among the entities involved are so numerous and intertwined, that reaching agreement about acquisition issues among all participants involves reconciling the considerable diversity of outlook arising from different cultural perspectives.

Given the cultural embedment of the remaining 66 problems, it was considered that the most promising approach to their elimination was to convince the Congress that repeal of much previously enacted constraining legislation ought to be considered. At the same time, a great deal of effort should be directed at shifting the perception of defense activities within the society. **If there were a cultural shift to the view that Defense**

activities make positive contributions to society by: (1) peacekeeping activities; (2) helping resolve problems resulting from natural disasters; and (3) providing skills necessary to make technology advances, then media and special interest groups might change their positions about the utility of defense acquisition activities. At the same time, the costs of legislated inefficiencies within the DAS would be made clear to the Congress in the expectation that reducing DAS costs while improving DAS performance would be seen as a worthwhile goal for acquisition reform.

9.6 SUMMARY OF THIS CHAPTER

The 66 problems which remained after redesign of the defense acquisition process were discussed in terms of their embedment within the U. S. culture. An argument was made that given an analytic-adversarial society in which error was both intolerable and *prima-facie* evidence of wrong-doing, the problems were likely to remain unsolved. The interfaces between the DAS and other societal entities which affect the acquisition process were described and discussed, as well as the complexity of the relationships among those involved with defense acquisition. An approach to solving the 66 remaining problems was derived which involved working to change the perception of defense capabilities and their worth to the society, while at the same time convincing the Congress that removal of much previously enacted constraining legislation was in the national interest because it could materially reduce the costs associated with technology advance and weapon acquisition. The next chapter describes the actions taken with regard to encouraging Congress to (1) support the redesigned acquisition process, and (2) to ease constraints which were costly and inefficient. If successful, these activities would essentially remove the remaining barriers to improved acquisition performance.

CHAPTER 10
HOW THE REDESIGNED PROCESS WAS INTRODUCED TO THE CONGRESS - AND THE RESULTS ACHIEVED

This chapter: (1) Discusses the changing characteristics of major stakeholders from the perspective of their interactions with each other; (2) Describes the Congressional legislative process and procedures from the perspective of introducing ideas for legislative change; (3) Describes the actions taken to present the results of the work reported here; (4) Describes how the work affected the legislation passed by the Congress; and (5) Presents the actions taken by the Department of Defense with regard to simplification of the acquisition process based on the legislation and how those actions will ameliorate problems.

10.1 INTERACTIONS BETWEEN THE CONGRESS, THE MEDIA AND SPECIAL INTEREST GROUPS

Influence and organizational relationships between the Media, Congress, and the Department of Defense were presented in previous Chapters (c.f. Figures 3.1 and 3.2 which presented influence structures of: (1) how the Congress and the DoD hierarchy oversee the Defense Acquisition System (DAS); and (2) how two other foci of influence (the Media and Special Interest groups) influence the Congress and the Department of Defense on how to perform their oversight function). In a sense those representations are shorthand notation which overly simplifies a complex multifaceted involvement. A much deeper understanding of stakeholder relationships is necessary to develop means to present information to Congress so they will be motivated to change the environment within which the DAS functions and eliminate many of the 66 cultural problems which remain. This discussion describes how stakeholders' characters have changed over time.

10.1.1 <u>The Evolving Congress</u>

The U. S. Constitution established three branches of Government: (1) **The Legislative Branch** (a bi-cameral entity consisting of the House of Representatives and the Senate together called "The Congress"); (2) **The Executive Branch** (consisting of the President, Vice-President, and the Secretaries of the various Departments); and (3) **The Judicial Branch** (encompassing the Supreme Court and subordinate Federal Courts). The constitutionally established system of checks and balances was founded on the concept that Congress would enact laws, the President would see to their enforcement, and the Supreme Court would ensure that the laws and their enforcement in no way were counter to the content and intent of the Constitution. The Constitution itself bounded Congressional legislative powers. Congress was constrained to legislate with regard only to very specific areas of concern which dealt with the U. S. as an entity: such as raising and sustaining armed forces to provide for the National Defense, and Commerce between the States (Interstate Commerce). Congress could not act in any areas not specifically identified in the Constitution. When Congress did act, it tended to legislate broad policy guidance rather than to enact detailed implementation instructions to the Executive Branch.

For almost 140 years, the Congress discharged its responsibilities by holding sessions only at specified times during the course of a calendar year. Initial selection of a 1 July date as the beginning of each U. S. Fiscal Year was because the Congress did not meet during the Summer Months nor did it meet during the period between Thanksgiving and the second week in January. A July 1 to June 30 fiscal year provided for Congress to attend to the budget during the period between February and May when Congress adjourned for it summer recess. Only when the U. S. was at war did Congress meet more or less continuously throughout the year. The Congress kept to its established routine until 1929. The economic crisis which followed quickly after the stock market decline was cause for national alarm. Congress increased the number of days in its sessions to try and deal with the severe national tension that had resulted in marches on Washington by groups in economic distress. The crisis was seen as having created a set of conditions which could destroy the Union. In March 1933, with the inauguration of Franklin Roosevelt as the 32nd President, Congress began its current practice of meeting throughout the year with only short breaks in legislative sessions (except for election years).

Before 1933 most Members of Congress maintained their homes and pursued their lives mainly within their constituencies. If a Member represented a constituency close to Washington, many week-ends were spent at home rather than in the Capital. In short, Members: (1) were in continuous communication with their constituencies; (2) immersed themselves in their constituency's activities; (3) knew their district's problems and the constituency-preferred solutions; and (4) maintained their non-Congressional lives in expectation that they would return to them at the expiration of the service in the Congress.

After 1933, as part of a political shift which was seen as the only way to prevent dissolution of established government and substitution of a more authoritarian regime, Congress began to define its constitutionally mandated responsibilities much more broadly. Problems left unsolved at the municipal and state levels were packaged for restructure within a constitutionally-mentioned Congressional area and brought to the Federal level for solution. Since the actions of Congress then involved other than Federal executive implementation, Congress began to provide more detailed instructions to implementing authorities. Initially there were strong arguments about Congressional actions encroaching on prerogatives constitutionally reserved to the States; but those arguments quickly became muted as the economic climate continued to deteriorate. Because members spent more and more time in Washington, communication with their constituencies became more difficult. By 1939, Members were seldom more than peripherally involved in the on-going life of their home communities. And when they did appear there, there was seldom time for interaction with a large number of individuals. Rather, they depended on community groups which represented points of view of constituents: (1) local political organizations; (2) the local citizens associations; (3) groups of citizens which formed to promote particular approaches to solving problems; and, (4) groups who presented perceived problems to members for action in Washington. Members became more dependent on organized communication - listening to intermediaries' interpretations of a constituency's needs and desires.

After 1947, the rapid development of television greatly influenced the Congressional culture. The opportunity for the public to be live witness to events in Congress provided increased capability for members to be seen, heard, and judged. Further, live event coverage television was un-mediated. It was a true account, free of biases introduced by reporter or editorial opinion. Members responded to this new opportunity to become known to their constituencies while working hard in Washington. There was a rush by members to take instruction on how to appear at one's best during interviews and when in committee sessions. Among the most notable achievements of televised committee meetings were the hearings into the conduct of the then Secretary of the Army (Roger Stevens) with regard to alleged communist penetration of the armed services. These hearings, known as the "Army - McCarthy Hearings" showed then Senator Joseph McCarthy in a most unfavorable light and were an important part of the decline in his power to influence events in the United States.

As Marshall McLuhan correctly foresaw [194] the capability to see and hear important events in real time has changed how the: (1) Congress perceives its functions; (2) Congress responds to issues; and, (3) Individual Members discharge their responsibilities, both within the Congress and external to it (in their personal lives). The net effect of instant media coverage is the most significant factor in the emergence of a Congress which, like Captain of a jet airliner, reacts at once to perceived difficulties and attempts to solve those problems in real time. Deliberative process does not thrive in such an environment.

In sum; for Congress, the years between 1987 and 1994 has seen its evolution from a body of part time "citizen" policy making body to a highly organized, full time group made up mainly of lawyers who involve themselves in legal minutia of daily real time decision making. The thinking that drives legislative content and the control systems necessary to oversee real time response are considerably different from those which are adequate to deal with long term change. The increasing detail of Congressional involvement in all aspects of Defense activities responds to the Congress' growing desire to control events rather than to provide broad, general guidance.

10.1.2 The Evolving Media and Special Interest Groups

Continuing growth in the capability to create and transfer increasing amounts of information quickly has changed Media perception of its responsibility to inform the public. When the United States became independent, information transfer across space was quite slow. Trans-atlantic passage was measured in weeks or months; Trans-pacific passage took longer; and even coastal sea passage between ports could take a week or more. Overland travel between distant points might take even longer; there was need to renew horses (or one's self). In general, one learned about events in distant places (either internal or external) too late to affect them. Similarly, major effort was required to organize so that forming a group or alerting a population about some feared event was difficult. One example of the early battle communication systems was recorded in Henry Wadsworth Longfellow's poem, the Midnight Ride of Paul Revere" (as quoted in Bartlett [195, 524a]). The route of march of British troops from Boston to Lexington, Massachusetts was signalled by lights in the tower of the old North Church - "one if by land, and two if by sea". Upon receipt of that information, Mr. Revere decamped from the South shore of the Charles river to "spread the alarm through every Middlesex village and farm"; to warn citizens of the impending arrival of hostile forces. Coding information to provide for its easier transmission (or to secure its content) was common practice for many years before Samuel F. B. Morse invented the telegraphic devices and his own Morse Code which permitted instantaneous long distance transmission of information over wires; or Guglielmo Marconi provided a wireless mechanism for doing the same thing using the same code.

As far as is known, *homo sapiens* has always communicated with each other by sound or using pictures. Long before town criers spread the local news with their own voice, messengers were used to transport written and spoken information between points at long distances from one another. Human messengers and carrier pigeons are reported in history as means of accomplishing point-to-point communication. The invention of the telephone and the growth of telephonic networks provided a mechanism for rapid communication of large amounts of information between individuals in real time. But the ability to transmit instantaneous events with both words and pictures *via* television and communication satellites, has caused major societal transformation. Individuals can now be present at events which occur anywhere in the world at any time of day or night. It is now possible to observe events and comment on them in real time, anywhere.

Invention of the printing press permitted mass duplication of written material. That capability ultimately permitted replacing the town crier with local and regional newspapers. The purpose of newspapers was to inform people about events which affected them. Reporting the news quickly became a kind of profession with its own rules. Reporters gathered factual information and tended to report it tersely. Commentary on events of the day was made by editors in a special place reserved for that purpose.

At some point during the U. S. "Great Depression", the media perception of its function began to change. Perhaps in the footsteps of Charles Dickens, American authors such as John DosPassos began to call attention to social problems. Quickly, weekly magazines and then daily journals began to report news differently. By the time the U. S. entered World War II, the media had become a catalyst for societal change. Today's media concept appears to have evolved into **news as a theatrical production with social messages**. The concept was clearly displayed during the VietNam war.

Media was used to influence the public policy with regard to that war. The successful use of protest actions as reported by the media during the Viet-Nam war encouraged formation of special interest groups which organize "events" that the media report as "news". Comment about the significance of the event is usually presented at the same time, often embedded within the report itself. Not only have media reports become very selective about commentary reported in "news reports", but they have also become selective about events which are reported as "news". The news selected for reporting is based on media evaluation of an event's societal "importance".

Finally, with increasing frequency, the media will quote another media source as authentication for a report. An event which occurs in the U. S. is reported in media abroad. Then the foreign version of the "news item" is quoted by U. S. media in the U. S. as "authenticated". During the so called "Cold War" years, the U. S. S. R. often saw to publication of its point of view as "news" in media outside of the U. S. S. R. When the U. S. media quoted the article, it took on credibility it would not have been afforded had it appeared only within U. S. S. R. controlled media.

It might be argued that the media have made a transition from news reporting to news producing; with commentary embedded within its news treatment. It may be further argued that media tendency to report favorable actions by groups which support the media position has encouraged formation of even more special interest groups which address actions toward gaining favorable media reports. In short, the changed perception of media purpose may have introduced considerable distortion into the way U. S. society perceives itself.

10.1.3 How Defense Acquisition is Affected

As individuals become more preoccupied with their work and the difficulties they experience in maintaining stability in their lives, they have tended to spend less time reflecting on issues: less time seeking to understand in detail the linkages between events and their causes. In addition, the population at large may lack motivation or even the requisite mathematical skills to perform such analysis themselves. Thus while there is recognition that "things have become more complex" and that every-day life is more difficult, there is also the tendency to leave the "details" to "experts" and assume that expert statements about linkages are correct. When special interest groups issue reports filled with statistical analysis, the conclusions are not usually disputed except by other groups having different, opposing positions on the issue.

In such circumstances, it is not surprising that the Congress tends to rely heavily on "expert" information when drafting and enacting legislation. But there is a problem implicit in such dependency: the legislative mechanism establishes institutional rules which respond to what might well be transient societal values. Statutes remain in force and effect long after they have been overtaken by events because, once enacted, legislation is often very difficult to repeal even when it is recognized as being in error or as having no further value. Since the great depression, there has been a growing tendency to seek legislated solutions for transient problem situations. The concomitant trend toward "federalization" of local issues and problems so they can be legislatively dealt with is one result of that cultural change. When: (1) there has been great change in conditions which affect complex issues that involve interaction of a number of entities; (2) most knowledgeable sources of information (***including DoD***) serve their own special interests; and, (3) decision makers are pressed to act but have insufficient detailed understanding of the issue's complexity and the linkages between those involved to make independent informed judgements, there may be a unique opportunity to achieve useful change. The time period between January 1993 and October 1994 provided an opportunity to modify the entire body of legislation which affected the acquisition process.

10.2 THE CONGRESSIONAL LEGISLATIVE MECHANISM

Legislative processes in the House of Representatives and the Senate have much in common. The system both bodies use to turn proposals into laws begins with introduction of proposed legislation (a Bill) by one or more Members of the body. When legislation is proposed by the Executive branch, it is usually introduced by a senior Member of the President's party. Once a bill has been introduced, it is normally referred to one or more of the authorized permanent committees (or in unique instances, to a committee created for the purpose of considering the bill). Committees generally have defined areas of concern within which they have broad powers.

Committees are authorized to employ staff to help them. Staff members are chosen by majority and minority parties and their appointments confirmed by the committee as a whole. Normally, a staff director apportions work among staff members. Usually, legal expertise is resident on the staff: a majority counsel and a minority counsel are appointed. Staff members serve at the pleasure of the committee and usually remain with the committee for long periods of time. Staff members develop information for the committee members, write the reports the committee issues, and often write the actual legislation which is reported from the committee to the entire legislative body for its action.

When committees are considering a bill, they normally solicit opinions from every entity concerned with or affected by that bill. Opinions are provided in writing and through oral testimony under oath at hearings. Committees have the power of subpoena to ensure their ability to explore a broad spectrum of viewpoints. There may be many hearings held before the committee reports the bill to the full legislative body (i.e., provides its recommendation for passage or rejection). Although a committee recommendation for passage is usually accepted by the whole body, proposals to amend the bill can be made from the floor during debate on the issue. There have been instances when a bill was amended during debate to the point where its sponsors withdrew it from consideration. Often, bills which are assured of passage are used as vehicles for enacting proposals which would not be favorably acted on otherwise. Special provisions added to a budget appropriation bill to assure funding for a particular Member's program in a particular district are examples of how the process is used.

Both the House and the Senate must act on a bill before it is sent to the President for signature. In many instances, the same bill is introduced at the same time into both bodies. The committees may change the bill to reflect committee members' positions. When both bodies have approved the legislation, differences between the House and Senate versions of the bill are resolved "in conference" among representatives of both bodies.

The "conference" version of the bill is again referred to both bodies. When passed, it is signed by the President after which it becomes law.

As discussed in Chapter 9 (P.221) defense appropriations are the primary concern of The Committees on the Armed Services and the Appropriations Committees, but numerous other Committees also involve themselves in Defense activities (see Chapter 3). All of the committees which have interest in legislation have the opportunity to collect information and hear testimony with regard to the bill.

10.3 HOW THE MATERIAL DEVELOPED BY THIS WORK WAS INTRODUCED TO THE CONGRESS

Presenting useful information to the Congress ultimately became the most critical issue in the DAS redesign activity. Congressional action was essential to create a climate conducive to the kind of change necessary to eliminate the remaining 66 problems developed through the work reported here. Three mutually supportive channels were used: (1) the report of the Section 800 Panel; (2) the inclusion of Armed Services Committee staff members in the workshop process; and (3) consultant services provided by DSMC directly to the Senate Armed Services Committee.

10.3.1 <u>The Section 800 Panel Activity</u>

The Section 800 Panel was chaired by the Commandant of DSMC. The panel's Executive Secretary and Task Force Director were also drawn from among DSMC's instructional staff. Before the panel's first meeting in October 1991, the author reviewed workshop activities with the Chairman, Executive Secretary and Task Force Director. At the first panel meeting held in January 1991 a set of workshop reports was provided for panel use. The panel adopted the problem structure of Figure 4-2 (p. 86) as a reference for use when considering the effect of enacted legislation on the DAS.

The Task Force Director was a participant in the redesign workshops and reported that work to the panel.

And finally, the panel used the problem structure as a factor in judging the effect on the DAS of panel recommended legislative change.

As a consequence of the close coordination between the redesign activity and the panel 800 work, the report advocated change to legislation which would reduce program management constraints and allow DoD to relax directives and regulations which had inhibited program managers from taking timely actions required during the weapon development.

10.3.2 <u>The Re-design Workshop Activity</u>

The congressional legislative process is well understood by those who work with it, and many "consultants" to industry and to government have developed expertise in presenting their client's points of view to the Congress. The Department of Defense has established its own group of experts within the Office of the Assistant Secretary of Defense for Public Affairs.

Normally, contacts between Defense agencies and the Congress are coordinated with and approved by the DoD Office of Public Affairs. However, the Defense Systems Management College charter permitted DSMC instructors to interact directly with congressional staff to develop instructional material for DSMC courses. Under that provision, Armed Services committee staff members were invited to participate in selected workshops and present the Congressional point of view to DSMC instructional staff and workshop participants.

The direct participation of Armed Services Committee staff in workshops had another advantage: it served to make workshop results credible to the committee Members. Participating staff members reported the workshop results to Members who could question their own staff about the work and be assured that the answers they received represented a Congressional (rather than a Defense) point of view.

As the redesign workshops proceeded, the Senate Armed Services Committee Majority and Minority Counsels were kept current on the process and its results. In addition, when the June 1992 workshop was convened to evaluate the probable effectiveness of the redesigned system, the committee staff was invited to observe that activity. The staff understood, in detail, the workshop results reported in Chapters 8 and 9 above and the importance of legislative action in enabling acquisition reform to succeed.

10.3.3 <u>Consulting to the Senate Armed Services Committee</u>

Three events which greatly influenced the defense acquisition process occurred during the legislative session of the Congress that began in January 1993: (1) the 800 Panel presented its report to the Congress; (2) a bill by Senator John Glenn of Ohio (the Glenn Bill) was introduced in the Senate to reconstitute the Defense Acquisition System; and (3) the former majority counsel to the House Armed Services Committee (a former workshop participant) was confirmed as UnderSecretary of Defense for Acquisition Reform.

The Section 800 Panel report was a landmark document. It organized all legislation that directly or indirectly affected defense acquisition into a coherent structure - a holistic overview of laws which influence the acquisition process. Further, it analyzed each law in detail to show their effect on the defense acquisition activities. It then recommended three kinds of legislation: (1) repeal of laws which were of no further value; (2) amend legislation to reflect changed relationships between Defense and the civilian market for highly technical product; and (3) enact particular legislation which would reform the acquisition process.

The 800 Panel report had been discussed with the Senate Armed Forces Committee staff and some Members prior to its official submission, and many of the provisions within proposed legislation submitted to the Senate were based on the panel report. The legislative package proposed repeal of a number of laws which had caused difficulty for program managers (this point will be discussed in some detail below).

The incoming Administration had appointed the Chairman of the House Armed Services Committee, Les Aspin, to be Secretary of Defense. Mr. Aspen, who had been responsible for appointment of the House Majority Counsel, chose that individual to become UnderSecretary of Defense for Acquisition Reform (USD[AR]) - a new position within DoD with broad responsibilities for bringing the DAS directives and regulations into conformance with any new legislation which affected the DAS. The newly appointed USD(AR) had been involved with the workshop process and had served as a workshop resource for presenting Congressional viewpoints.

Formal hearings on proposed legislation were scheduled for the spring and summer of 1994 before the Senate Armed Services Committee. Members had used the period between May 1993 and January 1994 to consider the 800 Panel report, review the initial version of proposed legislation, and do their own analysis of how the defense acquisition process related to their constituencies. Of great concern was how constituent industrial activities would be affected by severe reductions in defense spending that were proposed in the new budget. In March 1994, the Chairman and Ranking Minority Member of the Senate Armed Services Committee asked DSMC to provide anecdotal information about problems industry had experienced with the existing defense acquisition process. There was intense interest in how industry had been affected by the myriad of laws, directives, and regulations and DSMC was thought to be an "honest broker" capable of presenting information of value to the Committee.

The author was asked to help develop anecdotal information which would illustrate the effect of proposed legislation on industry. Other DSMC instructors were asked to provide information about its affect on DoD internal operations and on the interface between DoD and the Services, specifically the Service

Acquisition Executives and the military commands responsible for developing new weapon systems (see Figure 4-1).

Using the remaining problems as a baseline, small, medium sized, and large Defense Industrial Base firms and Service and Defense weapon development support activities (e.g., Naval Electronics Development Center) were asked about the kinds of difficulties recently experienced when involved with weapon development or production programs. At the conclusion of each visit, a summary of the discussion was produced and provided to the individuals interviewed so they could make any changes they felt necessary. The documented anecdotes were collected together and grouped according to size of firm (laboratory).

In July 1994, prior to the formal public hearings on the proposed legislation (which became Public Law 103-155 [1]), the anecdotal collection was indexed to provisions of the bill. The result was to provide the Members with a reference which related pertinent paragraphs and provisions within the proposed legislation with the difficulties experienced by those firms supporting defense weapon activities.

10.4 THE RESULT OF THIS WORK ON THE LEGISLATION ENACTED

Public Law 103-133, as amended by the Senate and the joint House-Senate conference committee became the "Acquisition Streamlining Act of 1994" [1] and was signed into law in October 1994. Its enactment helped considerably to consolidate and simplify the constraints within which program managers work. But it did not solve all 66 problems.

10.4.1 Rationalizing Acquisition Law

The legislation constructed a consolidated body of non-conflicting, codified law within which to redraw DoD and Service directives and regulations. By doing so at least 1000 pages of legislation was removed from the codex. In effect, the act provided a one-time ***"cleansing"*** of ***"excessive procurement laws and regulations"*** and removed some of the ***"constraining procurement laws and acquisition regulations"*** which epitomized ***"adverse impact of well meaning but ineffective attempts to help improve the process"***.

10.4.2 Simplifying Defense Directives and Regulations

The simplified legal structure permitted DoD to take a number of actions which materially help to create a more responsive, less costly acquisition process. One major effect was to permit the USD(A&T) to issue a draft paper on 11 January 1995 titled "Program Manager's Bill of Rights". The 10 statements it contains are in Table 10-1.

A PROGRAM MANAGER, BY VIRTUE OF HIS OR HER POSITION, IS ENTITLED TO CERTAIN INALIENABLE RIGHTS GRANTED BY THOSE THE PM WORKS FOR AND WITH. AMONG THESE RIGHTS ARE THE FOLLOWING:
1. The right to have a single, clear line of authority (as currently mandated in DoDD 50001.1)
2. The right to have authority commensurate with the responsibilities of a PM including:
3. The right to say "No" to those outside the acquisition accountability chain who make demands on his or her time.
4. The right (and obligation) to be candid and forthcoming without fear of career impact or retribution.
5. The right to have his or her judgements respected as coming from someone with the best, most reliable and complete information on the program. (And the related obligation to present to responsible decision-makers the most complete information on the program.)
6. The right to decide, or have a significant input regarding, who his or her key subordinates are.
7. The right to be the single spokesperson for the program to outside agencies when appropriate.
8. The right to have congruence between program content and financial resources (i.e., upon approval of the Acquisition Program Baseline (APB), the right to expect financial resources in accordance with that APB).
9. The right to be held accountable only for those actions of persons and for conditions over which he or she exercises direct control.
10. The right to adequate training and experience for the job prior to assignment.

THE PROGRAM MANAGER'S BILL OF RIGHTS

Table 10-1

The PM Bill of Rights deals with a number of the 66 problems. It effectively eliminates the ***"proliferation and lack of accountability of ankle biters"***, it deals with the perception that ***"too many participants can stop or slow process without responsibility for delivering the product"***, ***"too many nay-sayers in the review chain"***, and ***"no one can say "Go" but everyone can say "Stop"***. Further, it helps stabilize funding and in so doing treats the perception of ***"year to year instabilities in budget and***

procurement quantities". And finally, it eliminates the reasons for "***tendency not to surface problems***".

10.4.3 Encouraging an Evolutionary Weapon Development Process

The mechanisms originally established in DoDD 5000.1 provided for a continuous process of weapon development which demanded design of the complete system prior to program authorization. The Joint Logistics Commanders (JLC) are in charge of material development and support elements within the Department of Defense (see the command structure shown in Figure 3-3). In 1986, JLC asked DSMC to provide an alternative development process which would make it possible to change the design, construction, and support concepts of weapons being developed, so changes in threat and technology could be accommodated. The JLC Guidance for use of an evolutionary acquisition process was published in March of 1987. In July of 1992, the JLC requested DSMC to revise the 1987 guidance to reflect the new defense realities: shrinking budgets, few if any large weapon development programs, rapid technology change, and less influence of defense procurement on the industrial base in general. The revised JLC Guidance [196] had an issue date of March 1995 and contains a foreword which says:

> *"The Joint Logistics Commanders offer this updated Evolutionary Acquisition (EA) process as a tailored, streamlined acquisition strategy for acquiring weapon systems. The EA process is consistent with current guidance and can help shorten the time between requirement genesis and weapon system availability. We are publishing this guide to encourage consideration and use of the EA strategy for future weapon system development and when existing weapons are modified to improve their capabilities."*

The Undersecretary of Defense for Acquisition and Technology has directed DSMC to issue the JLC Guidance to every DSMC student regardless of the course taken. The evolutionary acquisition strategy will permit acquisition programs to plan for change and to respond to it expeditiously. The change to planning in shorter time increments which is characteristic of the EA process will eliminate much of the difficulty in dealing with the "***Congressional authorization and appropriation process***", "***year to year instabilities in budget and procurement quantities***", "***competitive pressures lead to unrealistic expectations***", "***ineffective cost estimating up front***",

"pressure for unrealistic schedule, cost, and performance", ***"unrealistic program plans/schedules and associated funding profiles"***, ***"the Government forces the contractor to buy in thereby increasing the risk"***, ***"failure of contractors to propose realistic costing to RFP's***, and ***"management of DoD acquisition process is not disciplined enough"***.

10.5 PROBLEMS TO BE ADDRESSED BY CURRENT INITIATIVES

The legislation enacted, and the changes made to DoD and Service Directives and Regulations to respond to that legislation treated 21 of the remaining 66 problems. Additional problems will be addressed in corollary actions stemming from responses still to be made to enacted legislation.

10.5.1 More Direct Involvement of the JCS and the JROC

Acting within the DoD in accordance with the legislation, SECDEF has initiated steps which aim at linking the requirements process with acquisition activities. Closer coordination between the JCS and the acquisition community will tend to reduce problems associated with the perception of ***"lack of or undisciplined strategic planning"***, ***"lack of clear military strategy and quantitative military requirements"***, ***"changes in policy and specifications"***, ***"inability to synthesize a design the first time"***, ***"lack of priority by acquisition organization for weapon systems"***, and ***lack of strong, consistent, and long term user support..."*** Furthermore, by consolidating the requirements review process within the JROC, there exists the likelihood that the practice of the ***"acquisition process consider[ing] program/requirements on only an individual basis without considering larger investment context and trade-off"*** will be eliminated and that it will no longer be true that ***short term planning dominates the decision making process"***.

10.5.2 Establishment of an Industrial Policy

In a concerted effort to consider an integrated group of industrial base issues as a part of the process of creating policy, both the Administration and DoD have begun to review policies which might inhibit continuing industrial participation in defense procurement. Specifically, the effort to devise an industrial policy addresses the ***"need to formalize or institutionalize consideration of the industrial base"***, and ***"failure to***

consider the industrial base early in the acquisition process". Moreover, the concern with science and technology issues can address the perception that ***"DoD [is] unwilling to fund industrial base improvement program"***, and come to grips with the ***"lack of agreement on the crucial or cost elements of the industrial base that must be sustained"***. In addition, because the Deputy Secretary of Defense has directed discontinuance of the practice of using Specifications and Standards except with special permission from that office, there is likely to be less reason to erect ***"barriers...between defense and non-defense divisions of companies and sectors"***. Addressing the latter difficulty will, in turn, remove much of the reason for ***"lack of contractors ability to provide people resources as required"***.

10.5.3 Re-engineered Acquisition Oversight

The Secretary of Defense chartered a Process Action Team to re-engineer the acquisition oversight and review process. In its final report [197], the team recommended formal establishment of the acquisition process presented in Figure 7-7. In making their recommendations, the team states its vision as shown in Figure 10-1.

VISION

To have a modernized oversight and review process, hard-linked to the national military strategy, responsible to the priorities of the war-fighting Commanders-in-Chiefs, sensitive to costs, and characterized by mutual trust, flexibility, teamwork and common sense.

ACQUISITION REFORM PROCESS ACTION TEAM VISION

Figure 10-1

The Process Action Team defines terms within their vision statement as follows:

- "Modernized" means a system in step with today's realities of diminishing resources - both people and dollars - yet takes advantage of opportunities from technology advancements and new ways of doing business in the commercial sector.

- "Hard-linked to national military strategy" connotes that the oversight and review process must be securely, explicitly and permanently bonded to military strategy at the national level (as contrasted to lower level strategies that may exist at the Service level or below).
- "Responsive to the priorities of the war-fighting Commanders-in-Chief" declares that the process should yield results...in accord with war-fighter priorities... which may subordinate those of the Services or acquisition agencies.
- "sensitive to costs" says that the process must especially focus on the costs of what we buy and provide for means of continually exploiting opportunities for reducing the cost by trading performance and schedule. It also means the process must be sensitive to both direct and opportunity cost of added oversight and review, adopting only those measures where the value added exceeds the cost.
- "characterized by mutual trust" leads to a process that presumes people at all levels can be trusted to behave rationally, reasonably, and honestly. The process need not, therefore, expend large resources in checking, inspecting, monitoring, and "second-guessing".
- "flexibility" decrees that the process should be easily adaptable (in both theory and practice) to the specifics of the program and decision makers' needs. Its framework should not consist of a set of universal templates, decision rules or processes that limit the flexibility of those in the accountability chain to tailor the process.
- "teamwork" abolishes the notion that oversight and review must be an adversarial process - those being overseen pitting themselves against the overseers. It envisions that oversight and review are collaborative efforts of people with diverse interests but unified by the common goal of working together to meet the war-fighters' needs.
- "common sense" pleads that the re-engineered process should pass the "man-in-the-street" logic test. It should be simple, consistent, practical, prudent and easily implementable.

The PAT provides, as overview of their work, a process that makes nine major contributions to increased acquisition program effectiveness: ***(1) Forges a Three milestone Process; (2) Trims milestone decision documents and activities: (3) Collapses the***

numbers of pre-milestone meetings to one; (4) Institutionalizes integrated product teams to do oversight and review; (5) Aligns program accountability and reporting; (6) Centralizes afforability decisions by placing them into the war-fighters' hands; (7) Consolidates the oversight and review process for joint programs and those requiring substantial inter-service harmonizing; (8) Revitalizes the Acquisition Program Baseline (APB); and (9) Strengthens program manager experience, tenure and selection requirements.

10.6 THE PROBLEMS WHICH REMAIN EVEN AFTER ALL THE WORK

As can be seen from this document, a large amount of effort has been devoted to determining which problems have grown up around the Defense Acquisition Process and seeking out mechanisms to eliminate them. Mechanisms included Congressional legislative action to re-write the complete body of acquisition law; DoD internal action to reformulate the acquisition process; and action by the Defense Industrial Base to change its *modus vivendi* to survive in a different defense environment. And, while it might be reasonable to expect that such an effort would eliminate all 66 of the problems which arise as the result of cultural (rather than functional) practice, at the end of this work, **19 problems, grouped within four problem categories remain.** The persistent problems are shown in Table 10-2.

CATEGORIES OF ACQUISITION PROBLEMS WHICH REMAIN
CATEGORY ONE (1) Political motives in the decision process; (2) Political influences beyond the Program Managers' control; (3) Interference from Congressional oversight; (4) Illogical competition; (5) Mandate for competition of small business that may be unqualified to compete; (6) Inability to award timely contracts due to external controls; (7) Its never over; (8) There is no agreement between the Executive Branch and the Congress on the long term budget projection; (9) Instability of DoD and Congressional support for programs.
CATEGORY TWO (10) Inadequate foreign sales planning; (11) U. S. security and Customs regulation not consistent with international co-development

UNSOLVED ISSUES
Table 10-2

CATEGORIES OF ACQUISITION PROBLEMS WHICH REMAIN
CATEGORY THREE (12) Outward migration of investment capital and skilled people; (13) OSD is a small customer of the general industrial base; (14) Lack of a clear understanding of the consequences of some of the perceived industrial base problems; (15) Lack of early management focus; (16) Imprecise risk management methodologies; (16) Failure to know how to respond to risks even when known (risk/penalty/profit)
CATEGORY FOUR (17) Leadership high turnover rate; (18) Lack of acquisition training and experience of superiors; (19) Inadequate program resources outside the program office.

UNSOLVED ISSUES
Table 10-2 (Concluded)

10.6.1 <u>Problems in the First Category</u>

These problems are inherent in the constitutional separation of powers. As the legislative body, Congress sees to the welfare of the country as a whole. It must consider the needs of all societal groups. Balance among members of the society is at the heart of the political process and Congress is constitutionally mandated to consider political implications of what it does. Moreover, the U. S. is a capitalist society with prohibitions against monopoly and associations which act to restrain trade (cartels and manufacturers associations which jointly control market prices). Competition is Congress's mechanism for both achievement of social goals of free enterprise and ensuring against price fixing for government purchases of any good or service. The Congress is bound by those principles and cannot abdicate responsibility for sustaining the competitive environment in all market places. From the perspective of the DAS, the price paid is to create situations where what the acquisition community might consider to be a simple, straightforward procurement, must be competed for among firms the program manager believes may be unable to perform if awarded the contract. Clearly, the Congress must also ensure that taxpayer funds are spent wisely. There must be Congressional oversight to give Congress such assurance. Finally, Members of Congress are individually responsible to their constituencies in particular and to the electorate in general to provide for all of the purposes of Government with the taxes it raises. When conditions change, the Congress necessarily reexamines the apportionment of its appropriated funds to ensure that their balance achieves the changed set of objectives. Since change occurs with great rapidity, the need to reassess funding distribution can be almost continuous. Because Congress has increasingly involved itself with individual program decisions, when there is rapid change in the world, Congress will tend to make individual program decisions which may appear to be, (and actually are) inconsistent with their support of previously funded programs which then suffer funding reductions. In a sense, when the Congress exercises such detailed control, it is exercising a kind of line-item veto of established acquisition programs.

There seems no realistic prospect of eliminating all problems in this category but the hope is that with a more responsive, evolutionary acquisition process, adjustments can be more easily made to funding fluctuations made necessary by changing world and national events.

10.6.2 Problems in the Second Category

The issues of foreign military sales and how the U. S. regulates foreign trade are embedded within the fabric of foreign policy. The degree to which U. S. foreign policy encourages international weapons co-development is outside the control of the DAS and will remain so. While industrial base needs might influence foreign policy to enable strategically beneficial co-development, in a more or less peaceful international environment, **there seems little likelihood that basic international trade laws will be changed to provide advantage for Defense co-development abroad. Once again, the problems will likely remain.**

10.6.3 Problems in the Third Category

Problems in this category are inherent in the way industry has traditionally performed its functions. Because of the network of special rules and regulations which Congress and DoD created to oversee the Defense Industrial Base, the collapse of the Soviet Union caused a paroxysm within the Defense Industrial Base. Since 1990, the contraction of the DIB has proceeded swiftly and defense Prime Contractor capability now resides in a very few firms. There is a need for industry to configure itself to flourish in a new kind of defense market - one in which commercial products are a preferred mechanism for incorporating new technology within existing weapon systems. As industry restructures itself, it must also review its concept of how to accomplish weapon development programs together with commercial activities. The degree of success industry achieves will determine whether or not it survives without subsidy. New accounting concepts which change the way development and production process costs are accounted for (e.g., accounting for cost by the processes used in development and manufacturing [known as "activity based costing"] rather than by use of the traditional direct, indirect, overhead, profit cost categories) are developed and awaiting application by DIB firms.

In short, the DIB challenge is to become competitive in the international commercial market quickly. Only by doing so will a firm ensure its continued capacity to fulfill defense needs.

10.6.4 <u>Problems in the Fourth Category</u>

The three problems grouped within this category have to do with how the U. S. political process works. Normally, all higher level individuals in every Executive Branch department serve at the pleasure of the President. For that reason, change in administration most often brings great change to the direction of the executive departments. Choices for Cabinet, Sub-cabinet, and high level supervisory leadership positions are very often made for political reasons. While care is exercised to ensure that the nominees have some knowledge about and experience in the areas for which they are nominated, the level of expertise is unlikely to be equivalent to that of career departmental staff members. Since the tenure of a Presidential appointee has historically been 18 months, it is unrealistic to expect those individuals to spend a great deal of time taking acquisition training. And, since the appointees are likely to be very sensitive to change in the political climate, they have tended to move out of appointive positions and into industrial jobs which they perceive to be of a more permanent nature. Unfortunately as the size of military force shrinks, and as fewer programs are authorized for new weapons, it is likely that Acquisition Corps members will tend to sell their talents outside of the defense environment.

Again, marked change to the situation is unlikely.

10.7 SUMMARY OF THIS CHAPTER

DSMC employed a number of mechanisms which were used to present to Congress the knowledge and understanding of Defense Acquisition Corps members' experiences as they worked to provide military equipment to the armed forces. Overall, that activity was quite effective: (1) Legislation incorporating many of the changes indicated in the redesign process reported here has become law; (2) The workshop redesign activities were communicated within DoD itself; and (3) Changes were made to DoD and Service directives and regulations which not only reflect the workshop redesign philosophy but also enable institutionalization of the workshop redesigned acquisition process.

Although there are nineteen specific difficulties which will remain to encumber acquisition corps members performance when providing new and improved weapons to the armed forces, most of those problems arise from the nature of the political system incorporated within the U. S. Constitution and are unlikely to be ameliorated by activities which focus on DoD weapon acquisition.

The following Chapter will discuss the lessons learned from the work performed to redesign the U. S. Defense Acquisition Process.

CHAPTER 11
DISCUSSION OF THE WORK PRESENTED

This chapter: (1) Presents information on the methodology used by the author to modify and expand Interactive Management (IM) and how the enhanced process was applied; (2) Discusses the lessons learned about applying IM to the study of complex systems; (3) Applies knowledge derived from this work to the Defense Acquisition Process; (4) Discusses the possibilities for using the enhanced IM methodology in other than DAS applications.

11.1 HOW THE INTERACTIVE MANAGEMENT METHODOLOGY WAS MODIFIED AND EXPANDED TO STUDY COMPLEX SYSTEMS

Warfield [3, i-xxxix] cites a large number of prior applications of Interactive Management over time. In some cases, a number of consecutive workshops were held which dealt with the same subject, (e.g., the continuing work being done by Professor Benjamin Broome with the U. S. Indian Tribes) or with closely related issues. In all of these cases, workshops provided an individual "snapshot" at a particular time. ***Until the author began the work reported here, IM had not generally been conceived of as a process methodology for use in continuing measurement and correction of complex systems; a process which generated integrated sets of recommended system changes using a single, continuously updated data base.*** The first step in actualizing this new idea was to state clearly the concept of exactly how IM would be used in such an undertaking.

Fundamentally, IM provides the catalyst for changing people's perceptions. Changed perception comes about because IM workshops provide an organized process for study and learning. As learning progresses during the workshop, the participants' perceptions change because of the stimulus provided through interaction. Conclusions reached at the end of a workshop are not easily reversed. When applied correctly, IM permits individual participants to join with other group members in building a unified group perception of the complex system under study thereby generating suggested actions which may improve system performance. Using IM workshops as a continuing control process presented a number of new challenges. The methodology must: (1) ensure that sufficient numbers of suitably qualified individuals participate in each workshop to clarify issues to any required level of detail and to suggest appropriate system change; (2) maintain a common perception among participants over extended periods of time;

(3) provide a means of understanding how change of any kind will likely affect the system; (4) define mechanisms to deal with anticipated change; and (5) maintain continued focus on the system as an entity rather than on individual problems which need to be overcome.

The author developed a number of extensions to Interactive Management methodology to address these issues.

11.1.1 Selection of Participants

The author established a sequential process to arrive at the numbers and kinds of workshop participants required to address the issues involved in: (1) understanding the existing DAS; (2) suggesting a DAS redesign; and, (3) stimulating change to the environment within which the DAS operated to permit achieving that redesign. The three major elements of importance to this activity were: (1) how long the IM workshops would continue; (2) the total number of participants required; and, (3) the specific sets and mixes of qualifications necessary to perform the work. To ensure that required participation was achieved, the author initiated the practices of:

- **Requesting biographical sketches of persons nominated to participate in workshops (Page 112, paragraph 1).** It was possible to select a group which contained a mix of participants, serving at appropriate organizational levels, who had both the breadth and depth of knowledge necessary to undertake the workshop.
- **Maintaining participants' currency with the ongoing process (Page 112, paragraph 2)** by holding larger group discussions periodically in which prior and potential future participants were included. And, finally,
- **Including within the workshops key individuals with responsibility for: (1) deciding to adopt proposed actions resulting from the workshops; (2) approving the decision to adopt them; and, (3) successfully implementing and executing them (Pages 109 through 111).**

11.1.2 Ensuring A Common Enquiry Focus

The author instituted the practices of:

- **Providing proposed trigger questions to participants well in advance of workshop dates (Page 92, First full paragraph).** The purpose was to encourage participants to discuss the appropriateness of that trigger question at length to elicit comments about, and agree on, workshop focus.

- **Maintaining workshop focus during the workshop proceedings through continued emphasis on and discussion of the workshop context.**

11.1.3 Defining Measures of Group Agreement and Holding To Them

The author developed definitions for 4 levels of group agreement (Page 93, third full paragraph). By insisting on reaching at least the level of group "consensus" whenever a group position was adopted, the workshop product integrity was maintained and "spread think" (as defined by Warfield [146]) was precluded.

11.1.4 Defining and Maintaining a Common Workshop Data Base

The author developed methodologies for:

- Integration of anecdotal information derived from multiple sources into a coherent (albeit a complex) whole (Page 249, last paragraph *et seq)*. This methodology was the fundament upon which proposed legislative packages were formed into coordinated sets of actions whose goal was to provide for a vastly improved DAS.
- Integrating data derived from numerous workshops into a single, cohesive data base which truly reflected system complexity. By having conducted workshops which focused on different aspects of the DAS and included within the workshops a broad spectrum of participant capability, it was possible to define a single integrated set of problems and their relationships to each other (Pages 126 through 134). The reduction of 679 problems (related as individual anecdotes) to 20 problem categories; and the further reduction of those 20 problem categories to 5 problem groups made it possible to compress the total system complexity into a more easily understood graphically presented entity.

11.2 WHAT WAS LEARNED ABOUT USING THE ENHANCED INTERACTIVE MANAGEMENT METHODOLOGY TO STUDY THE DAS AND OTHER COMPLEX SYSTEMS

Intensive use of the enhanced Interactive Management methodology over this six year investigation has led to several conclusions about IM in general and about its use as a control methodology: (1) The advantages of using IM to understand and modify complex systems are real and are uniquely associated with the IM concept; (2) Interactive Management methodology should evolve - new applications should be tried when appropriate, and modification to the methodology should be undertaken as necessary; (3) When possible, the numbers of individuals who participate in the work should be expanded until sufficient breadth and depth of knowledge within the group permits agreement on broad, general issues to be established; and, (4) Great care should be taken when defining the workshop focus, and the question(s) asked of participants, to ensure that workshops include consideration of direct interfaces between the system and the environment within which it exists and operates. These conclusions will be discussed in order.

11.2.1 The Inherent Advantages Of Using IM

Exploration of complex issues should not be done in an adversarial manner; consensus rather than confrontation is sought. The philosophical approach of "thesis, antithesis, synthesis" tends to divide groups not unite them. Unless groups are carefully facilitated, they may easily degenerate into factions and fail to reach consensus.

Exploring complex processes to understand the difficulties experienced by those who use them must be organized carefully and focused continually on the issues. The more complex the issues considered by the group, the more likely that peripheral issues outside the area of concern will draw participants' attention.IM methodology helps its practitioners to control the manner in which information is produced, considered, and processed to reach conclusions. Interactive management allows participants to raise issues and receive a hearing on their usefulness while controlling how much time is spent exploring those ideas. Frequently, during the course of the workshops reported here, participants would raise issues about which *they* felt strongly, but which were thought by many of the other participants to be extraneous to the workshop objective. The IM methodology encourages participants to self-select the information content carried forward in discussion: the process selects important information without giving offense to any participant who provides perceptions the group considers to be of lesser importance. In conducting and reporting the workshop results, ***the author encouraged inclusion of all participant contributions within the completed problem or opportunity structures***. Knowledge that all of their contributions would be retained helped participants establish and maintain group cohesiveness during the sessions.

At the conclusion of each workshop, a workshop report was made orally by the participants to the workshop sponsor and/or the Commandant of DSMC. In every instance, participants voiced their enthusiasm for the methodology, the way it was used, and the results achieved through its use. The decision to continue to use IM was made because it has been so universally praised by those who used it.

11.2.2 The Evolving IM Methodology

As discussed above, during the course of these workshops and based on the events experienced while engaged in them, the author expanded the IM methodology. An important lesson was learned about the need for change to the IM process even during conduct of a workshop series. A recommendation which resulted from Workshop #15 (see Page 114, Table 5-1) can serve to illustrate this point.

At the conclusion of Workshop #15, the then incumbent USD(A) spent 5 hours to review workshop conclusions and results with participants. Participants had constructed both a problem aggravation structure and a structure which indicated enhancing relationships between potential actions suggested to ameliorate problems. They then created a structure showing which potential actions would work to alleviate which specific problems. The USD(A) spent several hours attempting, without success, to understand the actions suggested, the structure, and how to use it. At the end of the discussion, he said he was unable to implement some essential actions because they were either (1) outside the limit of his own authority and he did not see how to get those entities who could take the required action to do so, or (2) he failed to appreciate why the action was necessary and what it could achieve quickly. In view of USD(A)'s reaction, participants volunteered to hold additional workshop sessions and redraft their recommendations to provide USD(A) with "implementable solutions". Three weeks later, having considered how their recommendations might be implemented, participants met with the Principal Deputy USD(A) to present a different focus for their recommendations. As an example: one workshop recommendation was "Disestablish the Defense Contract Audit Agency (DCAA)". The USD(A) reaction was that if he attempted to do that, the President and the Congress would call for his resignation. The reason for the suggestion was that an excessive number of audits and inspections made of contractor facilities, records, work in progress, and proposed future activities diverted both time and funds from their intended development use. Much would be gained if such activities were severely limited, or eliminated. During the workshops subsequent to the USD(A)'s visit, that suggested action was modified to represent the objective to be achieved rather than the singular action suggested to achieve it. The new recommendation was: "Limit the number of audits which can be made on programs during any consecutive 18 month period". The USD(A) agreed to adopt that suggestion. The lesson was that **recommended actions must not only be understandable to those who implement them, but must also be executable within their own authority.**

This, and other similar experiences caused the author to modify the IM mechanism to ensure that potentially helpful changes/actions were presented in a form which would be easily implemented. Doing that effectively achieved linkage between actions and problems in a manner much more easily understood by higher level managers who might have little experience with practical day-to-day DAS system activities.

11.2.3 Expanding the numbers of individuals involved in the work

One of the difficulties of working to understand problems associated with large complex systems, is that gaining sufficiently detailed system understanding may require eliciting information from a great many individuals. The dynamics of group interaction limits the numbers of people who can participate in an individual IM workshop.

When a broad spectrum of participation is necessary to understand system detail, but the workshop mechanism imposes limits on the numbers of direct participants, at least two approaches can be taken to enlarge workshop participant numbers.

First: multiple, concurrent workshops can be held to focus on the same problem (or the same portion of a large problem) with different participants attending each workshop. To be sure that the resulting insights represent the contemporary viewpoints of all participants, the workshops should be run at the same time. When this approach is taken, IM practitioners need to ensure that all of the information developed is integrated within a final product, and that all workshop participants are fairly represented by the end product. As discussed in Chapter 5, the "parallel workshop" approach was used to examine issues of Concurrent Engineering (Table 5-1, workshops #20 and #22).

The parallel workshops are intensive, and have some real advantages. Work is focused within a short time period. Participants in all workshops view the system concomitantly: thus a true snapshot results. In addition, provided a sufficient number of participants are involved, the complete system can be represented as it is perceived at the moment of the workshop. The disadvantages are that the view which emerges is less detailed, and changes which occur in the system over time are not revealed.

Second: serial workshops can be held with each workshop focused on some particular system issue, perception of system operation, or facet of system design. All information developed within the complete set of workshops is then synthesized into an integrated and unified perception of the entire complex system. This process takes much longer to complete, but provides a very detailed system overview, which can be carefully analyzed to show how continuing change effects the system.

Because the serial workshop approach takes so much time, problems can arise in several areas.

- ***It can be difficult to arrange for all of the individuals who must participate to spend the time required to do so.*** Although the DAS redesign activity, and the workshop activity which preceded it was held under the sponsorship and with the support of the incumbent USD(A)'s, they did not participate directly in the workshops. They simply could not devote the number of hours required for full participation. Therefore, their understanding of the detail of how the system under study is constructed, and how it operates had to be developed in short, concentrated periods when discussion of the work was followed by summarized information. At the conclusion of these briefings, almost all "policy making officials" were enthusiastic about the insights they gained and all believed the workshop sessions worthwhile. But, in almost every case, workshop proposed problem solutions had to be referred to other individuals (usually those involved in administering the parts of the DAS which would need change) for comment about the practicality of implementing them. This was because, as in the case of the USD(A), it was difficult for the individuals who bore current responsibility within DoD for: (1) deciding when policy changes were needed; (2) constructing implementable problem solutions, or, (3) approving recommended policy changes for implementation to spend the amounts of time necessary for full workshop participation.

Because workshop participants did not bear direct responsibility for *deciding that a recommended action was implementable*, and *how to effect necessary changes to the Defense Acquisition System*, further discussion with those responsible individuals was required.

There were many difficulties in translating group wisdom into information upon which USD(A) could take immediate action (see Page 265 above).

- ***Completing the required work can extend over a time period long enough to create the opportunity for considerable change to the environment within which the system functions.*** To gain deep understanding of the workshop results, sufficient time must be spent to provide the necessary education to everyone involved in effecting change. The workshop participants (who generated that understanding) become the focus for broadcasting their knowledge to others involved.

In the DAS re-design process, oversight organizations, public and private, usually have a hierarchical structure. The more supervisory layers there are, the more time it takes to provide each individual in the "chain of command" with sufficient understanding of what has been discovered in the workshops. The process can become even more difficult if the supervising individuals have little experience in the special areas which are causing the problems. They may require considerable exposure to the problems of technical processes (for purposes of this discussion, manufacturing, production, financial, and even legal problems are referred to as "technical problems") to gain the level of detailed understanding required to appreciate both the problems and the necessary characteristics of implementable solutions. While all of these discussions are taking place, the environment within which the system is embedded is likely to change.

In the case of DAS re-design, there are many reasons for such changes. One obvious example is the action taken by Congress within the Legislative cycle. Each year, Congress responds to their sense of constituency by reviewing and modifying the policies under which the DAS operates. In the authorization and appropriation bills (Chapter 3, Pages 32 and 33), Congress indicates the things which Defense needs to address; and perhaps the form that such change must take. In addition to normal yearly oversight review by Congress, some past "drivers" of change have been: (1) Change to National policies either through the electoral process or because there has been significant world or national change; (2) Change in public perception of "what is needed"or "what is right"; (3) Difficulties in the availability of money; (4) Trade difficulties involving products (e.g., computer chips) which change the direction and magnitude of the entire acquisition program; or (5) A particular set of circumstances has arisen which makes change to the acquisition process necessary. Events which drive change can occur within very short time periods. Consequently, when using sequenced IM workshops, the length of time required to: (1) Explore problems; (2) Inform those who need to be closely involved; and, (3) Define and begin to implement problem solutions may be long enough to permit major environmental changes (see below). Should that happen, implementation of even very reasoned changes can be overtaken by events.

In short: *it may take so much time to develop and suggest implementable actions that either the problem and/or the environment changes before those action can be taken!*

- ***Effecting change to organizations may require enough time that opposition to the change builds beyond control.*** Most technologists are introduced to the concept of "time constants" when they learn about electrical or mechanical system behavior. Others learn about "perturbation theory", "elastic behavior", or "inertia". Whatever the context, the concepts which describe how systems respond to change over time can provide insight into the types of problems observed during this attempt to modify the DAS.

  In theory, changing direction of motion of an isolated body in free space (e.g., an entity independent of all other entities and subject to no constraining forces even gravitational attraction) would require almost no energy and the response to the stimulus would be instantaneous. This situation describes an object that exists **in the absence of an environment**. Changing the direction and speed of real objects influenced by many other objects at varying proximity is a much different process. "Inertia", which causes bodies to resist any change in their *status quo*, is characteristic of all bodies. When an object is separate from other objects and is in motion (e.g., a ship moving across the ocean surface or an aircraft in flight) the energy required to change its path and the time required for that change to become apparent can be computed. If one looks at a single portion of a whole object (e.g., a portion of a steel girder) as it is subjected to an impulsive force (perhaps a perturbation caused by something dropping on the girder from above) which acts to change the position of that portion of the object with respect to the whole object, the forces interior to the girder which bind its structure together act similarly to an inertial force and resist deformation which would occur were those binding forces not present. It may be possible to gain insights into behavior of organizations when subjected to forces which attempt to change them by constructing an analogy using the purely "physical" world of stationary and moving objects which are subjected to perturbing forces.

Organizational entities are created to enable achievement of goals which require performance of sets of related activities. They are crafted to (1) ***Facilitate*** orderly performance of tasks necessary to achieve required goals; and (2) ***Prevent*** performance of necessary tasks in ways which do not conform to established norms, and performance of tasks outside the defined task set. Because organizations accumulate experience, they "learn" how various task performance norms help achieve organizational goals. Organizations may continue to refine the "rules" to sharpen the focus on achieving the goals they were established to fulfill. Refinements may take the form of "<u>prohibitions</u>" against doing some tasks in certain ways, or "<u>enablements</u>" which permit exercise of new insights gained.

Whatever the reasons for generating new standards for task performance, their effect is to constrain actions which can be taken by the organization within an increasingly complex set of "do's and don'ts". Making provision to perform additional functions generally further complicates that web of rules and regulations.

The complexity increases when more than one aspect of performance is surveyed; and is again increased if more than one entity is involved in process oversight. This line of thought lead to the conclusion that the DAS organization has a very long "time constant"; it may take a relatively long time to promulgate change within the "system". Some reasons for this might be the relatively long time period required to: (1) Select the problems which require solutions and create appropriate actions; (2) Assess the consequences which will arise from implementing suggested actions which have multiple effects on many elements of the complex DAS; (3) Evaluate whether the suggested changes have potential benefits greater than any potential problems which might result from its introduction, (a relatively long period of time might be required to introduce and fully implement them); and (4) Overcome the fear and resistance of those who perceive themselves threatened by the proposed changes (and who may resist them totally or be less than enthusiastic in assisting their implementation). The DAS is not the only example of a system having a long time constant of change. The same problem is characteristic of all systems which derive from, or are described by, a complex network of interrelated and interacting laws, rules and regulations; or of <u>any large system</u>. If one pursues these ideas, one might conclude that there is some construct of system complexity beyond which real system change becomes very difficult (perhaps even impossible) to achieve! *As problem solutions begin to be developed; as implementation plans are created, and certainly by the time change begins to be pursued, the system may have had sufficient lead time to begin resisting that change!*

- ***The time necessary to make required organizational change may exceed the tenure of the individuals who perceive the need for change.***

This problem became evident during the course of the workshops. During the period between June 1988 and January 1994, four individuals served as USD(A): (1) Dr. Robert B. Costello was incumbent during the period from June 1988 until February 1989; (2) Mr. John Betti served from February 1989 until January 1991; (3) Mr. Donald Yockey was confirmed as Under Secretary during the week of 20 May 1991 and served until February 1993; and (4) Dr. John Deutch served from February 1993 until January 1995 at which time Dr. Paul Kaminski assumed the position of Undersecretary for Acquisition and Technology. During that same period, there were two changes of Administration and four Congressional elections. Because the 1994 election changed the party controlling both houses of Congress, the environment within which the DAS operates became very turbulent starting in January 1995.

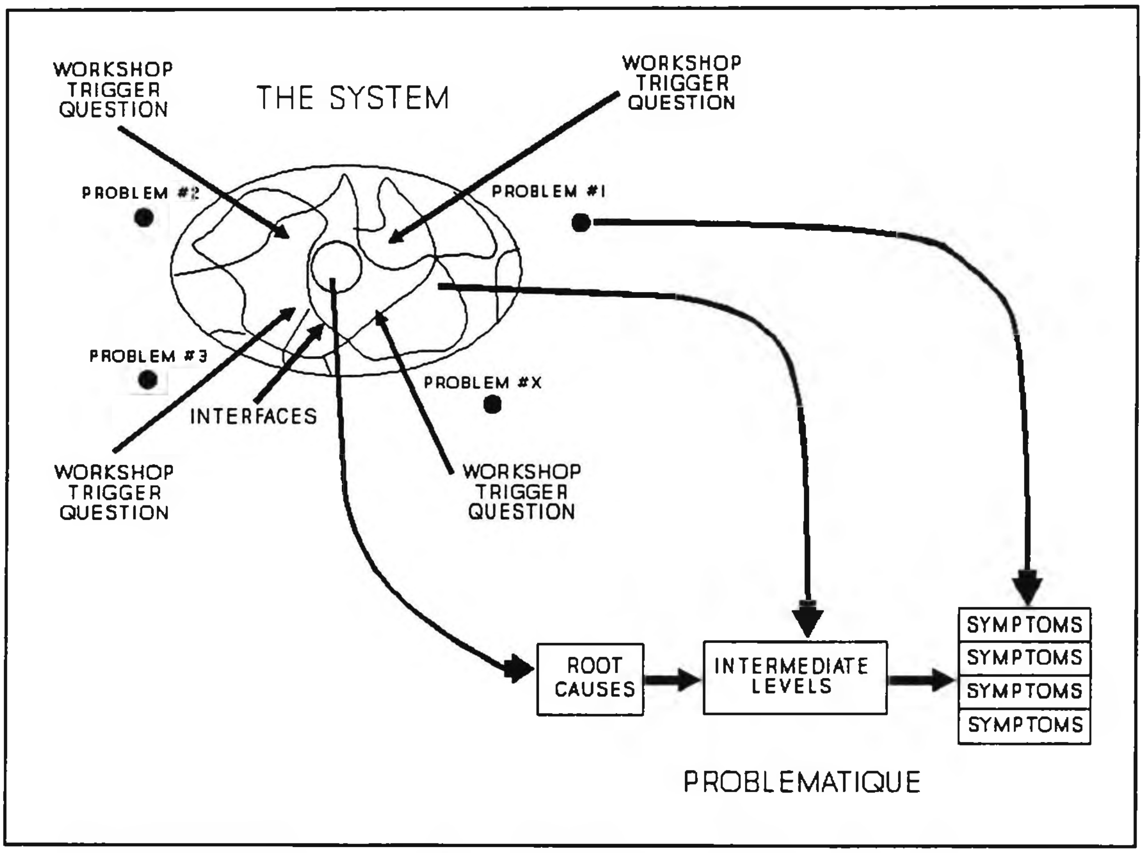
Even after recognizing the potential difficulties which associated with the serial workshop approach, the author used it to re-design the DAS. Each IM workshop focused on one aspect of the many difficulties experienced in using the DAS as it existed at the time of the workshop.

11.2.4 Ensuring That Workshops Focus on System Interfaces

From the beginning, the author recognized that a good deal of the complexity associated with the DAS resulted from its large number of internal and external interfaces. The author conceived the DAS as an entity embedded within a complex environment. Both the environment and the entity were assumed to change over time. Thus if one wished to understand the entity, one would need to view it from many different perspectives. Each perspective would reveal a different DAS perception. Combining all of those perceptions would permit a reasonable estimate of how the DAS functioned and interfaced with its environment. Thus, the 28 workshops reported in Table 5-1 each represented a different perspective on the nature and function of a single DAS: from the first workshop which viewed the kinds of things program managers did, through others which looked at the DoD Inspector General's perception of the DAS and the perceptions of the industry which supported the DAS, until finally, the group of workshops which explored the issues important from the perspective of the USD(A).

If one convenes a series of workshops over time, it is essential to integrate the workshop results into a coherent whole. Ideally, the complete synthesis of all of the information will reveal an ordered set of problems. The set will include a complete set of problems and will reveal which of them make all other problems worse (problems which one USD(A) called "root causes" and another called "core problems") and which of them have no effect on other problems (symptoms). Unless some logical structure results, there is an over-richness of detail which tends to cause cognitive overload. ***In this work, the integrative activity did produce a consistent and useful system overview while maintaining the detail of relationships among the many particular problems that participants described.*** In the end, results of this work indicate that the serial workshop approach can be used successfully to arrive at a broad understanding of a very detailed DAS problem structure that describes inter-relationships between difficulties experienced.

Figure 11-1 presents a visualization of how the results of the workshops were used to construct an integrated view of the DAS and its interfaces both internal and external.



SYSTEM STRUCTURE, PROBLEM ROOT CAUSES, AND PROBLEMATIQUE

Figure 11-1

In Figure 11-1, the DAS is represented in the upper left by an elliptical shape containing a set of interfacing sub-elements. Each workshop focused on a different perspective of the DAS established by the trigger question (e.g. Why are firms leaving the industrial base?, What problems do we have in program alignment?). The problems generated by, and examined within, each workshop are shown in Figure 11-1 by arrows leading from the ellipsoid to one of three boxes; ("root causes"; intermediate levels"; and "symptoms"). Figure 11-1 shows only four of the 679 problems developed by the workshops. Each individual workshop produced a number of insights into why the problems discussed within that workshop exist. The individual workshop problem sets which are structured into a "problematique" (an aggravating relationship) using the IM methodology. The typical form of a problematique is shown in Figure 5-2 (Page 133).

The aggravating problem structure is read from left to right as described in Chapter 5 *et. seq.* When a direct connection is shown between problems, a problem aggravates all problems to its right. Since the problems at the extreme left of problematiques (such as Figure 5-1) aggravate all problems to their right to which they are connected, they can be thought of as "root causes" for the difficulties described. Problems in the problematique central portion are intermediate problems in that they are aggravated by some problems and aggravate others.

The problematique in Figure 5-1 fits the concept described by Figure 11-1. The representation in Figure 11-1 indicates that if there are indeed core issues, they will become clear as the various perceptions which resulted from the sequential workshops are formed into a single data base. In the work reported here, the problems which aggravated all other problems were those having to do with Test and Evaluation. An operational test and evaluation plan was not provided at the time the operational requirements for system development were released. The details and schedule for operational testing was typically produced only after the production system had been achieved. One of the workshop participants described this situation as, "being asked to tailor make a suit for a generalized person and have it suit a set of unknown environmental conditions!"

The enhanced IM methodology as applied in serial workshops has permitted definition of the complex DAS both as an entity made up of sets of inclusive interlocked entities, and also made it possible to understand how the DAS interacts with the environment within which it operates.

11.2.5 <u>Summary of What Was Learned</u>

The research reported here shows that:

- The enhanced IM methodology, when properly applied, can facilitate discovery of issues of particular importance to complex system function, and make it possible to suggest of sets of actions which can ameliorate problems experienced when using the system.
- IM practitioners should be careful to set proper goals for the numbers of workshop participants, and the numbers and timing of workshops. The experience reported here indicates that: (1) participant numbers can be increased by conducting either serial or parallel workshops; and (2) that the individual

workshop results can be aggregated to provide a broad yet detailed understanding of the complex system.

- The amount and detail of data required to develop understanding of complexity as it exists within large systems and between those systems and the environment can create problems of timeliness for the investigator. Based on the results reported here, it appears that: (1) the process of (a) learning what the problems are; (b) disseminating that knowledge among those who need it to plan for orderly change; and (c) creating a plan and beginning its implementation takes a long time; (2) upon hearing of proposed changes, the organization to be affected immediately begins its work to modify those plans to ensure minimal change takes place; and (3) there continues to be rapid change in those appointed to direct the DAS. Given those circumstances, even if: (1) those who need to understand the problem could be encouraged to take the time do so; (2) adequate solution sets could be devised and action plan developed in a short enough time to preclude large scale environmental changes; and, (3) organizational reluctance to change could be overcome, it may be that the individual who recognized the need for change and was the prime mover in promulgating it may have to leave before the process of change can be completed. Even though a successor might continue to promulgate change, that change might not necessarily be in exactly the same direction. In short: *the time required for affecting change may exceed the tenure of those who perceive the need for it!*

11.3 USING THE ENHANCED IM METHODOLOGY IN OTHER GOVERNMENTAL AND INDUSTRIAL SITUATIONS

An obvious question which arises from this work is: "Having spent so much time and effort in exploration of the Defense Acquisition System, is their any evidence that the concepts can be applied successfully to other Government and industrial systems?" The author would answer that question in the affirmative. To support that position, one can look at the characteristics of other complex systems to see similarities among them.

11.3.1 Characteristics of Government Systems

Like the DAS, other Federal Governmental mechanisms are created by the Congress through legislation. Increasingly, the legislative vehicle tends to be very detailed and proscribes severely actions which can be taken by those involved with administering the system.

In the years prior to 1950, Legislative vehicles tended to be rather terse. A section on legislative intent was included followed by a section which describes the bill's content. The actual bill was kept to a very few pages, with the understanding that the implementing agency would write detailed regulation and instruction. To illustrate the point: In 1958, the author wrote a bill for the Science and Technology Committee of the House of Representatives. Its purpose was to provide funding to establish a set of regional technology libraries which would gather all unclassified technical information, place it within appropriate categories, and provide for easy access by any who wanted to do so. The bill: (1) assigned implementation and operation of the new libraries to the Department of Commerce; (2) provided initial funding for establishing the library locations, acquiring facilities, gathering, processing, and maintaining information current; (3) provided funding for establishing accessing methodology and devising a user fee structure; and (4) established a mechanism for the new organization to submit its yearly funding requirements to the Congress. The bill provided for publication in the Federal Register (by the Department of Commerce) of information about the establishment of the new system, and how it would operate. The bill was 34 pages, most of it in the sections on "Congressional Intent" and "Legislative History".

The most recent proposed legislative vehicle for establishing a new health care system required 1400 pages of rules and regulations written into the legislation by the Congress. Little flexibility was left to the implementing agency!

The Congressional power to write law, see to its implementation, and constrain those who apply it is the same regardless of the purpose of the legislation. So far, only a few areas of Congressional action have been subject to the kind of intense scrutiny which gives rise to severely constraining, detailed legislation. But as Congressional concern deepens about the uses to which appropriations are put, and as problems which were once thought to be "solved" by legislation continue to exist, there will be more cases of detailed management by legislative action.

The author contends that there are at least three additional areas of Federal concern which would derive considerable benefit from the kind of work reported here: (1) Health Care Reform; (2) Environmental Cost Benefit Analysis; (3) Mechanisms for

Certifying Safety of New Medicines and Drugs. (IM activity has already begun to devise a new system - see Chapter 12).

11.3.2 **Characteristics of Industrial Systems**

There are numerous parallels between Industrial product development processes and the DAS process. Indeed, it is remarked (Page 17) that "one might equally well produce automobiles, television sets, or any other complex product" using the four functional blocks shown in Figure 2-1. On Page 26 the statement, "the reasons for difference between government and commercial acquisition processes appear to derive mainly from the way the defense procurement process evolved into its present state". The functions performed in both processes appear to be the same; certainly both processes have as their purpose the efficient acquisition of products (either existing or to be developed).

A more concrete example might be in the institutionalization of Integrated Project Teams and Integrated Product and Production Development teams first in Industry which supported defense activities as Concurrent Engineering (CE) and Computer Aided Life-Cycle Support (CALS) (Table 5-1, Pages 114, 115, and 178), and now throughout industry (Pages 72 *et. seq.*).

Another set of parallel issues are the requirements placed on material purchasing executives to adhere to a rigid set of rules in purchasing. Like decisions made by acquisition corps personnel, industrial purchasing decisions are reviewed after the fact (Page 117); and like the DAS, wrong-doing by individuals at interfaces between the vendor and the purchasing agent is assumed (Page 123 and Page 230).

To attempt to improve the purchasing process, industry has established its own set of oversight procedures. Concern has been expressed in industry as well, "that the cost of oversight might be more than the potential savings which result." (Page 121) Indeed, it is quite possible that in industrial activities, the oversight impeded the timely performance of necessary activity (Page 159) and absorbed funds better spent to further the work (Page 216).

Industry also experiences shifts in policies and practices when executives move to other organizations. Just as the DAS has had difficulty with shifting perceptions of incumbent executives, so does industry (Pages 132, 233, and 271). An additional similarity is that just as when the National or Congressional leadership changes, executive leadership changes in industry cause policies and acceptable practice to changes as well.

Like Government, industrial directives may define goals which cannot be met within the available technology, resources, or skill levels. Congressional legislation of performance in the absence of knowledge about how that performance level can be met has a parallel in industrial direction. Industry too has instances where inability to meet a management objective has resulted in continuance of issue of "new instructions so long as the desired effects are not achieved." (Page 224). Attempts to explain that problems are caused by difficulty in "first use of state of the art technology" (Page 215) are met with extreme skepticism (Page 215). Just as Congress takes great pain to see that funds are used as appropriated, so industry also attempts to ensure funding integrity. But unlike government appropriations, industry is not necessarily constrained to single year funding authorization.

And finally, if one looks at table 8-6 to see which problems were thought to be unsolved by the re-designed acquisition process, and estimates which are likely to be experienced in industry, 45 of the problems might apply equally to industry and defense. Table 11-1 lists those problems.

COST AND SCHEDULE ESTIMATES

- Unrealistic program plans/schedules and associated funding profiles
- Pressure for unrealistic schedule, cost, and performance
- Ineffective cost estimating up-front
- Competitive pressures lead to unrealistic expectations
- Assessment of program cost risk by DoD is inadequate
- Failure of contractors to propose realistic costing to RFP's (buying in)
- The government forces contractor to buy in thereby increasing the risk
- Lack of government understanding of the cost of procuring many smart munitions programs

PROGRAM EXECUTION

- No OSD/Service policy on concurrent engineering
- Inability to award timely contracts due to external controls

COMMON DEFENSE AND INDUSTRIAL PROBLEMS THOUGHT TO BE UNSOLVED BY THE NEW FUNCTIONAL DESIGN

Table 11-1

STATUTORY-REGULATORY INFLUENCES

- Mandate for competition of small business that may be unqualified to participate
- Changes in policy and specifications

FUNDING INSTABILITY

- Year-to-year instabilities in budget and procurement quantities

EXECUTIVE AND POLICY MAKERS

- Leadership high turnover rate

LONG RANGE PLANNING

- Lack of clear strategy and quantitative requirements
- Short-term planning dominates decision making process

IMMUTABLE

- It's never over
- Executive mistrust and meddling and language

PROGRAM MANAGER AUTHORITY

- Interference from executive oversight
- Proliferation and lack of accountability of ankle biters
- Political influences beyond the program managers' control
- Too many nay-sayers ... In the review chain
- Tendency not to surface problems
- Too many participants can stop or slow process without responsibility for delivering the product

INADEQUACY OF PROGRAM TEAM

- Loss of program focus due to program personnel rotations
- Lack of contractor's ability to provide people resources as required
- Lack of acquisition training and experience of superiors
- Inadequate resources outside the program office (doing more with less)
- Barriers erected between defense and non-defense divisions of companies and sectors

TECHNICAL REQUIREMENTS MANAGEMENT

- Inability to synthesize a design the first time
- Changes in policy and specifications

RISK MANAGEMENT

- Failure to know how to respond to risks even when known (risk/penalty/profit)
- Imprecise risk management methodologies

INDUSTRIAL BASE

- Loss of industrial base (inadequate R&D)
- OSD is a small customer of the general industrial base
- Outward migration of investment capital and skilled people
- DoD is unwilling to fund industrial base improvement program
- Lack of a clear understanding of the consequences of some of the perceived industrial base problems
- Lack of agreement on the crucial or core elements of the industrial base that must be sustained
- Failure to consider the industrial base early in the acquisition process
- DoD fiscal management structure does not support and strengthen the industrial base (unit cost policy)
- Need to formalize or institutionalize consideration of industrial base

CONTRACT REQUIREMENTS DEVELOPMENT

- Adverse impact of well meaning but ineffective attempts improve the process
- Data requirements
- Failure to adequately describe performance verification and validation process by which success is measured

COMMON DEFENSE AND INDUSTRIAL PROBLEMS THOUGHT TO BE UNSOLVED BY THE NEW FUNCTIONAL DESIGN

Table 11-1 (Concluded)

11.4 SUMMARY AND CONCLUSIONS

This Chapter has described how the author advanced the state of knowledge by devising enhancements which make the Warfield Interactive Management methodology more powerful in resolving complex problems. The innovations introduced in IM application provided a means to examine the extremely complex Defense Acquisition System and to achieve that system's re-design. From the work accomplished with the enhanced IM methodology, the author was able to gain and document insights into DAS behavior which could be turned to immediate use. Specifically, the author was able to use the enhanced IM process to create a suggested DAS system re-design which the Congress found useful in pursuing their work to provide legislative basis for a better DAS.

Considerable original system design activity resulted from this work. Workshop participants learned about the then current DAS and were empowered to devise meaningful change to the acquisition process.

The author provided the Department of Defense Management with an understanding of how their actions to implement Congressional mandates had affected DAS performance. The insights developed by the author played a large part in helping to modify the DAS command process to achieve more efficient, less costly acquisition programs.

In addition, the concepts and structure of the DAS has undergone substantial change during the course of this work: change that has in great part, been guided by the work reported here. The evidence collected in this work drove the joint DoD and Congressional conclusion that for the Government, complex processes such as the DAS must be designed to minimize negative effects associated with performance of necessary oversight.

CHAPTER 12
CONCLUSIONS

This chapter: (1) Discusses the how achieving the two research objectives set forth in Chapter 1 has enhanced the potential to use IM to gain understanding of complex systems; (2) Comments on the contribution to knowledge made by this work; and (3) Discusses future work.

12.1 ACHIEVEMENT OF THE OBJECTIVES STATED IN CHAPTER 1

There were two objectives sought:

(1) Provision of a detailed functional description of the Defense Acquisition System (DAS) and use of that understanding to develop a set of detailed suggestions for DAS re-design; and

(2) Determine how knowledge gained from the DAS analysis could be applied generally to other complex systems.

12.1.1 Detailed functional description of the DAS

In its broadest sense, the work reported here concerned: (1) performing a detailed examination of an existing, complex system, established for the purpose of turning ideas into products; (2) designing a new, much less constrained system which would achieve the same objective; (3) evaluating the new system to determine whether problems reported with the old one would be precluded by its installation; and, (4) if any problems remained, determining why they had not been precluded when the new system was adopted.

This work took a step-by-step approach to developing system understanding. First, the broad outline of system function was developed through workshops which asked what individuals who worked within the process did, how they did it, and what difficulties they experienced. Second, workshops were convened to explore particular areas of difficulty which were said to have greatly encumbered DAS performance. Third, workshops were convened to design a revised DAS capable of performing the same functions without embedding the same difficulties. Fourth, workshops were convened to scrutinize the revised DAS to determine whether it would eliminate the difficulties said to have been present in the original DAS.

As with any products provided to customers, the IM workshops reported here produced information which satisfied the customers needs. But the uniqueness of the totality of information which resulted was possible because of the diversity of workshop sponsorship. The major portion of this research was supported by the Defense Systems Management College (DSMC), the Office of the Secretary of Defense (OSD), and the UnderSecretary of Defense, (Acquisition) [USD(A)] and entities within his office. Thus, the subject matter treated was of importance to those agencies. However, there were other sponsors as well who explored different aspects of the DAS. Because those sponsors brought their own perceptions about the DAS to their workshop, there was sufficient breadth of perspective available to gain unique understanding of the process required to develop weapon systems which use "state of the art technology". But even more important: support of the work by those at the Department of Defense Secretarial level ensured that workshop participants were individuals most qualified to examine the issues under discussion; and that participants devoted themselves to the work for as long a period as necessary to achieve the workshop objectives.

The results of this work were recognized by all of the sponsors, and finally by the Congress, as accurate representation of the DAS and its problems. The re-designed system was accepted as the basis from which to legislate a revised DAS. This was accomplished when: (1) the "Acquisition Streamlining Act of 1994" became law [1]; and, (2) the USD(A) issued directives which in effect adopted the re-designed process as defined in this document.

12.1.2 **How the knowledge can be applied to other systems**

There were a number of things about this work which appear to be significantly different from other complex system design activities known to the author.

- A comprehensive, holistic investigative approach: Although many different groups had examined the DAS with the objective of suggesting its modification, no group had adopted an investigative strategy which: (1) Examined the complete DAS structure from many different perspectives to gain a very detailed understanding of the whole system; (2) Integrated within their work, detailed study of the environment in which the DAS functioned; or (3) defined interfaces between the environment and the DAS.
- Support of work over an extended time period: Using this investigative strategy, required a coordinated, continuing effort over a time period long enough to study and understand the ever-changing detail of system infra-structure. It required six years to complete the research. Long term, executive level support

was required to ensure appropriate participation by program managers, high level DoD and Service staff members and specialists working together with their counterpart industrial program managers and specialists.

- Participation by all concerned parties: For the first time, the Senate and House Congressional staff participated directly in a defense research program as working members of a group of investigators.
- Defining likely consequences of actions: This work included meticulous evaluation of the likely result of legislating changes proposed to a complex government system (the DAS) when those changes were institutionalized by translation into departmental regulations. No previous study of proposed legislative action made by Congressional staff or by DoD departmental staff had focused on the issue of whether or not proposed legislation, as institutionalized, would have the desired results.

The experiences reported here and the acceptance of the work within DoD and its industrial support partners indicate that the enhanced IM design methodology can be very widely applied to complex systems. It may even be said that the enhanced IM methodology discussed in Chapter 11 should become the singular methodology of choice for use when designing complex systems. Although Warfield [3] proposed such use, it was the enhancements to IM reported here which made possible the successful application of IM to DAS re-design. Proof that the enhanced methodology can be used successfully to re-design the DAS can stimulate others concerned with such problems to use the same design methodology.

As discussed in Chapter 11, there is much commonality between complex commercial processes and the process represented within the DAS. Thus, it can be argued that successful development of a re-designed DAS indicates that the knowledge of systems linkages and behaviors developed in this application provides a body of knowledge generally applicable to complex system design. In a sense, Warfield and Staley's continuing efforts to install the IM process within Ford Motor Company confirms that what has been learned in DAS re-design is applicable for design of complex systems generally.

12.2 CONTRIBUTION TO KNOWLEDGE

Three distinct contributions to general system design knowledge have resulted from this work.

12.2.1 Complex systems, because they must be capable of timely response to change, should not be placed into effect through detailed legislation.

Increasingly, there has been a tendency in the United States to legislate detailed solutions for almost every kind of perceived problem. The Congress views the process as one of continuous improvement. But since the legislative process seeks to constrain responses which are perceived as "bad" or "wrong" the result is not necessarily an "improved" system. Work reported here has shown that legislation, over time, tends to create an ever more confining set of constraints on response to change. For the DAS, the result was to make it almost impossible to respond to ever more rapidly changing threat, funding, and technology. Only after the problems generated by years of accumulated narrowly focused individual legislative acts became stifling was there any attempt made to adopt a system rather than a political perspective in correcting an unresponsive system. The enhanced IM process used to gain a DAS system overview permitted analysis of why the system was unresponsive to change; and facilitated development of remedies for that set of conditions which could be enacted in a legislative package. The legislation removed many constraints. But there is still comfort felt by providing for extensive oversight, and much of the benefit resulting from the "Streamlining Act of 1994" may soon be lost.[1]

It can be argued that industrial organizations, too, suffer from an accumulation of non-holistic, individual actions which degrade their capability for adequate, timely response to change. It follows that what was found to be true in the DAS (even in Government generally), is likely to be true for industry as well.

12.2.2 The DAS re-design process can be used to design or re-design all complex systems

The DAS re-design process had a number of features which made it possible to design a system configuration which met user needs effectively, was capable of timely

[1] A bill (S-646) was introduced into the U. S. Senate on 29 March 1995 which would "strengthen reporting requirement(s)" throughout the acquisition system thus restoring much of the DAS former rigidity.

response to change, and provided insight into how difficulties could arise when the system was institutionalized. The enhanced IM methodology developed by the author provided a vehicle which permitted extended application of the focused expertise of that broad set of skills and experience required to gain detailed system insights. As previously discussed, the DAS system design sequence contained six process steps: (1) determine the functions/tasks involved to meet objectives for which the system is to be designed; (2) determine the relationship among the functions/tasks (i.e. the system structure); (3) determine how individuals now perform those functions/tasks; (4) determine the problems currently encountered in performing the functions/tasks; (5) restructure the functions/tasks to eliminate problems and ensure adequate system capability to respond to change; and (6) scrutinize the effectiveness of the re-designed system specifically to determine which of the problems currently experienced will remain after re-design has been implemented. Incorporating the sixth process step is a new concept in design of legislation and regulations which implement it.

Although following these process steps will lead to better system design, there is no assurance that all potential problems will have been precluded. Change beyond anticipated limits, or change which occurs at more rapid pace than was designed into the system structure can still create great difficulty. The painstaking attention to the kind of detail shown necessary for this kind of work will make for a much more useful and effective system.

12.2.3 System design must consider, detail, and address cultural issues

The re-designed DAS addressed cultural issues in detail. The *zietgeist* is embedded in legislation or regulation when it is written. In this work, recognition of how the culture affected the system and how cultural rigidity limited permissible system change was a necessary step in DAS re-design. As discussed in Chapters 8, 9, and 10, the Congress has acted as if there were few limits to the numbers and extent of complex social systems which could be enacted to serve social goals. In this work, that premise was not supported.

From an engineering system perspective, creating a new weapon involves working with a set of unchanging, universally recognized technological "facts": The scientific methodology at the core of the engineering process ensures data reproducibility across space and time. Material strengths change in known ways when subjected to various kinds and intensities of stress. Lift and drag associated with particular wing configurations can be computed with the assurance that those values will obtain whenever the situations for which they were computed arise. In a manner of speaking, the engineering design process deals with particular kinds of certainties and may ignore environmental and interactive effects which have significant effect on the work's final outcome.

From a social system perspective, systems like the DAS are constructed to facilitate human endeavor. How such systems actually operate is heavily dependent on the capabilities of those individuals who undertake the tasks within them. Unlike machines, individuals are not fungible assets. The same tasks, performed by the same individual at different times can produce quite different results. There is no assurance of either reproducibility or performance invariance when individuals rather than machines are the system components.

But even more important, the culture within which the social system must operate places severe limits on what can be achieved through system design. If a culture exhibits the characteristics of the analytical-adversarial society, defining and institutionalizing system structures which do not recognize and address the culture's basic mistrust among its citizens and provide severe penalties for making errors will soon come under attack no matter how well they function most of the time. There will always be some event that can be used as illustration that the system does not protect society against wrong-doing or incompetence. However, the point of this discussion is to recognize that in complex system design, the *culture* within which the system operates may play a most important role in defining how effectively a system can be designed and how well it will perform its functions when institutionalized.

12.3 FUTURE WORK

Since completing the work reported here, the author has been assigned two significant work areas:

- The author has been chartered to direct a newly established two week course for very senior program managers and system engineers. The "Advanced System Program Research, Development, Test and Evaluation Course" (ASPRDTEC) objective is to educate individuals about how to design, develop, test, and field complex weapon systems. It will draw heavily on knowledge produced in the work reported here. Classes have begun to use the IM methodology to address sets of typical situations which require students to devise structured actions in response to change at interfaces between the system components and between the system and its environment. The course stipulates that change is the norm and establishes that IM methodology is the most effective way to define actions which can deal effectively with change. As courses provide understanding of how program managers and systems engineers can best develop procedures useful in responding to change which impacts system development activity, guidelines for achieving program stability through response to change will be developed and published. In effect, these course offerings have become the vehicle for continuing research into complex system design.

- The author has been appointed as focal point for policy guidance on certain kinds of system development planning. The methodology for planning new (and revised) weapon systems is based on the work reported here; devise a system architecture which specifies system interfaces in ways that anticipate change, and permit easy response to changes which do occur. These principles are incorporated within [196]. In the application of these concepts, Acquisition Corps members will be instructed on how the enhanced IM methodology developed can help them in designing systems which are accepting of change.

Others are also using the IM process to design complex systems. In particular Dr. Alexander N. Christakis (Christakis, Whitehouse & Associates) has undertaken to assist the U. S. Food and Drug Administration in designing a new system for speeding the drug approval process. And Dr. Scott Staley (Ford Research Laboratories) has used IM methodology in design activities at Ford Motor Company. Mr. Stanley Crognale (At DSMC) has done extensive problem definition and system design work for the U. S. Navy Sea Systems Command and Air Systems Command. The growing number of IM practitioners who are using the methodology to examine and ameliorate complex system problems indicates its practical utility and its worth. But there are two areas of deficiency in the current Interpretive Structural Modeling (ISM) process software:

- Although several software packages have been developed to help practitioners determine relationships between elements which appear in influence structures, none of them provides for easy printout of the resulting structural models; and

- A mechanism is needed to permit continuous recording and analysis of participants' individual voting actions so that: (1) the degree of divergence in thinking among participants during workshops can be determined ("spread think"); and (2) the results of voting can be made immediately available.

Efforts to remedy both deficiencies should be undertaken with dispatch. When that has been accomplished, the resulting IM software will make for easier, more expeditious application of the enhanced IM methodology defined by this work.

APPENDICES

APPENDIX A
MAKING "SIMPLICITY" COMPLEX CAN BE HARMFUL TO YOUR SYSTEM: THE DETAILS OF ACQUISITION REDESIGN

This appendix: (1) Presents the context of the author's concern with how detailed analysis has come to be presented in the U.S. Government decision making process; (2) Records the individual functional/task statements which, in their totality, describe the specific actions required to move from ideas to fully supported, fielded weapon systems as those tasks were determined in IM workshops; (3) Details how those individual statements proceeded through three levels of aggregation; and, (4) Discusses the richness of detail lost in the aggregative process. This discussion provides the basis for discussion in Chapter 9 of the text.

A.1 THE CULTURAL EMBEDMENT OF "SIMPLICITY" - INSTITUTIONALIZED SIMPLE MINDEDNESS

There is a growing need for individuals who make policy decisions to understand more than they do about the complexity of the systems with which they are involved. It has become almost a truism that to get the attention of busy executives, one must reduce the problem and its solution to a single page which can be read in about the time a 15-second television sound bite can be heard. In many cases, the decision makers are harried beyond their capacity to respond to or concentrate for long periods on intricate relationships between activities involved in the processes for which they are responsible. Understandable though that might be, the reality is that more and more, policy decisions aimed at solving seemingly simple problems have many unintended consequences which act to undermine the benefits which were sought by making the decisions.

The re-design of the acquisition process resulted in development of a great deal of detailed information about how that process had been structured over the years. By attacking the individual functions/tasks to be performed during the process *which were specific to and necessary for successful achievement of the process objective*, it became clear that there was a very logical functional/task structure fundamental to the process. It also became clear that there were many functions/tasks being performed, which not only were unrelated to achieving the main objective, but were impediments to doing so efficiently, effectively, and in a timely manner.

The DAS imbedded within DoDD 5000.1 established a series of very simple, highly aggregated steps in moving from ideas to a fully supported operational system. Those steps were: (1) "Concept Exploration and Definition", (2) "Demonstration and validation", (3) "Engineering and Manufacturing Development", (4) "Full Scale Production", (5) "Deployment and Operational Support". In 1991, modifications were made to the concept of a continuous acquisition process to accommodate changed perception of world threat. Whereas the policy enunciated within DoDD 5000.1 envisioned taking accepted ideas to deployed, supported systems, the new policy divided the process into two parts:

- Concept to Prototype: During the first part of the process, weapons development would proceed from concept through construction of one or more prototype units. The units would be tested for operational performance and suitability. When devices had been declared "suitable for operational use", one of two decisions would be made: (1) If there was no immediate requirement for production quantities, the prototypes would continue to be used in the field, but no production units would be procured; or (2) If there was need to produce more units, full scale production, deployment and support would proceed for the quantities deemed appropriate.
- Re-equipping Fighting Units: When it became necessary to re-equip active fighting units, one of the prototype weapon system designs would be chosen and produced in quantity.

This policy separated "production, deployment and support" components of the process in Figure 2-1 from the generation of ideas and production of prototype systems. *At the heart of the policy was the assumption that a prototypical system could be quickly placed into production and that production items built from information sufficient to build a successful prototype would be producible and supportable with only a minimum of additional work.* The assumption had not been tested by those who made the decision to institutionalize it. This series of workshops demonstrated that prototypical systems would require a very great deal of re-engineering before they could be produced in quantity. The technology available for use, and the production mechanisms available might have changed during the period between the time the prototype was tested and placed into limited use and the time it was decided to undertake production. In addition, the operational experience gained would almost certainly influence the desirability of making at least some changes to the prototypical system. In short, the complexity of the acquisition process was ignored, and the issues which should be considered in making policy were not developed *because they were too deeply embedded in details.*

What follows is a detailed development of the individual functions/tasks which, taken together, aggregate within the umbrella of "the defense acquisition process". Each task will be identified, as will the process of aggregation used to develop the simplified process presented by the author to decision makers in the Department of Defense.

A.2 MOVING FROM IDEAS TO PROTOTYPICAL WEAPON SYSTEMS

A.2.1 Individual Functions/Tasks

Workshop participants responded to the question:

"What functions should be accommodated to move from initial concepts to prototypes?"

After all initial responses had been made, there was a discussion of what each response meant. Clarification statements responded to participants questions. As the discussion proceeded, additional responses to the question were contributed and they too were modified and clarified as necessary to achieve understanding. In all, 122 responses were recorded and clarified as necessary. Participants then combined and deleted statements they felt were contained within other statements. The remaining 96 functions/tasks were then structured. All 122 responses are presented in Table A-1 below.

A.2.2 Voting For The Most Important Individual Functions/Tasks

Workshop participants responded to the question:

"Which five functions are the most important functions in moving from ideas to prototypes?"

Table A-2 reports the voting. In Table A-2, votes as "most important functions/tasks" are shown by noting a "1" beside the task number. Similarly, second most important is noted as "2", 3rd most important by "3", and so on. Table A-2 reveals a typical degree of consensus on the most important functions/tasks involved in moving from ideas to prototype systems. The result of the voting shows that 28 of the 96 statements received votes: stated another way, 28% of the functions/tasks were considered to be important. Five participants thought the first function, "*Clearly defined need*", was of primary importance. Three participants believed that "*Up-front risk evaluation*" and "*Contract definition*" were important, and two participants believed "*Use seamless program management...*", *Test and evaluate operational prototypes*" and

1. CLEARLY DEFINED NEED. [ORIGINAL ITEM: DEFINE THE NEED]

   Suggestion to incorporate with #7 ("evaluation"). I want to define my need. I don't care how you evaluate it. It's defining the military. To define the need I have already evaluated what I have and I know that I need something. I have defined that I need something else. I've already gone through the thought process. I define my requirement. Someone else has to decide what to do with it.

2. CONTRACT DEFINITION.[1] [ORIGINAL ITEM: CONTRACT FORMATION]

   Generic set. The detail of contract formation, mainly price, is buried in some of these other statements; Some of which are sub-sets of this.

3. DEFINE THE TECHNICAL SPECS AND CONCEPT OF SYSTEM INTEGRATION.

   Well, it's what the words say--how the pieces are going to fit together. You have the existing technology to perform these specs. Separate into two parts or include both parts? I would like to keep them together. First, you have to perform the function. I've got to have specs and how it's going to fit together. I can do this without any contractor in mind. I can do this and then go out and find a contractor.

4. UP-FRONT RISK EVALUATION. [ORIGINAL ITEM: RISK EVALUATION]

   Technical and cost and schedule and all the elements of risk. The risk of producing what you're trying to produce. The accountability is a separate issue. Is it just program risk, or is contractor risk included? My intent there is that it is program risk. You don't have a program without a contractor. Element #95 added out of this.

5. [DELETED - INCORPORATED IN ANOTHER ELEMENT] CONTRACTOR CASH FLOW.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1

[1] Use of the words "CONTRACT" or "CONTRACTOR" can refer to intra-government agency relationships as well as government-contractor relationships.

6. DEFINE PROGRAM OBJECTIVE. [OLD ITEM: GENERATE PROPOSAL FOR PROGRAM] [ORIGINAL ITEM: GENERATE PROPOSAL].

   The proposal on how to satisfy the need. Is that part of the evaluation? No. I'm talking about the response to the need. This is the proposal for the program. My proposal for what I want to do with my program.

7. ANALYZE/EVALUATE NEED. [ORIGINAL ITEM: EVALUATE MILITARY NEED]

   After the need is defined, and before the proposal, in that never-never land we would look at training, technology. Indicate basic needs.

8. [DELETED] [OLD ITEMS: 1) DEFINE THE CRITERIA BY WHICH VALIDATION OF NEED/CONCEPT IS MET. 2) DESIGN A CLOSEOUT RULE FOR THE VALIDATION PROCESS. [ORIGINAL ITEM: DESIGN AN IDEA CLOSURE]

   "Design" has been chosen on purpose. Actually not what you already have in mind, but trying to invent the responses. Stress an active attitude.

9. REVIEW EXISTING AND REQUIRED TECHNOLOGIES.

   Identifies the voids and required technology.

10. WRITE STATEMENT OF WORK.

11. CREATE A (PAPER) DESIGN. [ORIGINAL ITEM: (PAPER) DESIGN]

    Simply lay out elements of system on paper. Detailed enough so that you can go the next step and lay out a mock-up. Very precise on size, weight, etc.

12. PERFORMANCE EVALUATION.

    I'm talking about, "Does the system you built meet your requirement(s)?" Evaluation of the system.

13. COMPLETE "BUILD TO" PACKAGES. [ORIGINAL ITEM: DEVELOP "BUILD TO" PACKAGES]

    The design, paper, planning, tooling--everything we need. An integrated approach. Development "build to" packages. Beyond engineering design. It's the planning and tooling.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

14. ORGANIZE DESIGN TEAM.

    Why only design--why not management and everything else? What does it take to do the design? I'm talking about, "what does it take to do the job?" So I put together a team to do that job. A design process. #96 stemmed from this conversation.

15. DEMONSTRATE TECHNOLOGY.

    There will be needs to demonstrate existing technology. Include parts and/or whole system.

16. DEVELOP APPLICATION SCENARIOS.

    Develop a special case to use as a yard stick. A design of a context. Something which you can present to the user to see what you meant. Application of operational artists.

17. BEGIN RESEARCH ON NEW TECHNOLOGY.

18. CONTRACTOR PROPOSE PRICE. [ORIGINAL ITEM: PROPOSE PRICE]

    Price for what's being required. Price in the sense of cost to the government as well as contract price. A set of proposals. An estimated cost and responses. Negotiations. Not budget. Not subsumed in life cycle costs. This includes the cost to the government, negotiations and profit. This price includes profit.

19. BUILD A MOCKUP/MODEL.

    Full scale. Next step would be to experimental test. Helps you refine your design. Computer or paper design.

20. EVALUATE OPPORTUNITIES FOR INSERTING NEW TECHNOLOGY.

21. DEFINE R&M REQUIREMENTS.

    Design is part of define. R&M = Reliability & Maintenance.

22. [DELETED (SUBSUMED IN #121)] VALIDATE NEED STILL EXISTS.

    Really mean continuously.

23. INDEPENDENTLY TEST AND EVALUATE (TECHNOLOGY) DEMONSTRATOR.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

24. DEFINING INTEGRATED SYSTEM BOUNDARIES.

    You can't change everything. You have to decide what you're going to keep the same. Isn't that a requirements process? Yes.

25. TEST TO THE REVALIDATED NEED. [ORIGINAL ITEM: TEST TO EVALUATE DESIGN NEED]

    Make sure you meet the requirement.

26. SELECT SUPPLIER SECTOR.

    Private vs. public sector. Identify the resource sources. There's competition between labs and someone's got to choose.

27. DETERMINE STAGE FOR TECHNOLOGY FREEZE.

    Related to #20. To me #20 is self evident. Like the stopping rule. I meant this in terms of design freeze.

28. EVALUATE PRODUCIBILITY.

29. [DELETED (Subsumed in #41)] PROGRAM OFFICE OVERSIGHT OF CONTRACTOR.

    The same as #71 and #41.

30. REASSESS CONCEPT.

    It's a function.

31. TELL INDUSTRY WHAT IS NEEDED, HEAVY ON PERFORMANCE AND LIGHT ON MILITARY SPECS.

32. SECOND ORDER EFFECTS (TECHNOLOGY). [ORIGINAL ITEM: REVIEW INTERFERENCES WITH CURRENT TECHNOLOGIES].

33. COMPLETE DESIGN OF TOOLING. [ORIGINAL ITEM: DESIGN TOOLING]

34. [DELETED] ANALYZE PRICE.

35. FABRICATE THE EXPERIMENTAL PROTOTYPES.

    This is real hardware. We might even fly one of them. In terms of large systems.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

36. [DELETED] DEFINE END USER NEEDS.

37. SELL PROPOSAL.

38. IDENTIFY MOST CRITICAL MATERIALS, PARTS, HUMAN INTERFACES, ILS, MANUFACTURING PROCESSES, AUTOMATION, ETC.

    Refer to #7. A subset of #7.

39. EVALUATE OPERATIONAL AND EDUCATIONAL REQUIREMENTS.

    Not only training, but ground knowledge which goes along with this new technology.

40. COMPLETE PRODUCTION ENGINEERING DATA.

41. SELECT TYPE OF CONTRACT.[2]

42. TEST AND EVALUATE THE EXPERIMENTAL PROTOTYPES.

    Rigor and vigor.

43. ASSIGN RESPONSIBILITY FOR CONGRESSIONAL LIAISON. [ORIGINAL ITEM: CONTINUOUSLY SELL THE PROGRAM TO CONGRESS]

44. INITIAL VALIDATION OF NEED. [ORIGINAL ITEM: VALIDATE NEED]

    Validating the need against national strategy, resources. This is an acquisition function, not an R&D function.

45. USE PRE-PROD MODEL FOR FINAL TEST EVALUATION.

    Demonstrate the technology. Test the low-rate production model without going through the step of the prototype model.

46. [DELETED] CONTINUOUSLY REPACKAGE.

    A different package for Congress, a different package for DoD.

47. [DELETED - FOR #54] BUILD THE PROTOTYPE.

    #35 is experimental. This is for field test. How does this relate to the pre-prod in #45. The same thing.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

[2] Program Manager has responsibility to select appropriate contractual procedures.

48. DECIDE WHETHER TO ESTABLISH COMPETITION.

49. [DELETED - BECOMES PART OF #22] RE-EVALUATE THE THREAT AND NEED.

50. DEFINE PRODUCTION QUANTITIES.

51. INCLUDE TRAINING AND SIMULATION NEEDS. [ORIGINAL ITEM: MAXIMIZE COMPUTER MODELING THROUGHOUT PROGRAM.]

52. LIFE CYCLE COSTING.

    Have to include costing of whatever function mentioned here. Also, entire life cycle of product. Specifically, the cost of destroying it when we replace it, and how it would be distributed.

53. CONSIDER MULTIPLE PRIME ASSOCIATE CONTRACTORS. [ORIGINAL ITEM: DECIDE HOW MANY PRIME SUPPLIERS].

    A matter of who's got control of the program. It's two questions: Question of program control, and how do I use multiple supplier to maintain control? #97 stemmed from this.

54. BUILD THE OPERATIONAL PROTOTYPES.

    Same thing under #47. Stage after experimental.

55. PREPARE ACQUISITION BUDGET. [ORIGINAL ITEM: PREPARE DESIGN BUDGET].

56. USE SEAMLESS PROGRAM MANAGEMENT INCLUDING MAJOR DECISIONS MINIMIZING PROGRAM DELAY. [ORIGINAL ITEM: USE SEAMLESS PROGRAM MANAGEMENT INCLUDING MAJOR DECISIONS WITHOUT DELAYING ANY PROGRAM MILESTONES]

    Not a function, is it? "Seamless" means continue on without interruption. no discontinuity.

57. DESIGN ORGANIZATIONAL AND MANAGEMENT SUPPORT FOR OPERATIONAL SYSTEM. [ORIGINAL ITEM: DESIGN ORGANIZATIONAL AND MANAGEMENT SUPPORT]

    Does that mean the team to do that? From the very beginning you have to decide who is carrying the role of decision maker, etc. Not necessarily a team.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

58. ESTABLISH PROTEST AND DISPUTE RESOLUTION PROCESS.

59. TEST AND EVALUATE OPERATIONAL PROTOTYPES AND SYSTEM INTEGRATION.

    Here you put everything together. Testing integrated system. Same as under #45.

60. TEST PROPOSAL.

    Taking the proposal and putting it to the test. Our system should included a validation of what it is doing. This is testing the proposal and if it fits the need. Looking at the front end process - the proposal.

61. MAXIMIZE USE OF INDUSTRY BEST PRACTICES.

62. ESTABLISH CHANGE PROCEDURE AND AUTHORITY.

    Engineering change orders. Contract change orders. Includes engineering change orders.

63. [DELETED] PREPARE PRODUCTION BLUEPRINTS AND DRAWINGS.

    Probably a part of #40.

64. ORGANIZE ENGINEERING TEAM.

    Recognize #57 as a part of this.

65. [DELETED (Subsumed under #41)] GIVE CONTRACTOR MUCH LATITUDE TO CONTINUOUSLY IMPROVE.

66. FEASIBILITY TESTING.

    Economically feasibility. Not just operational.

67. ESTABLISH CONFIGURATION CONTROL PROCESS AND ACCOUNTABILITY.

    Transition from development to production. It's in the shop. ECP controls change and configuration. Broader than #62. Pertains to how the thing is built. They're not unrelated.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

68. OPTION TO FORM OPERATIONAL EXPERIMENTAL UNIT. [ORIGINAL ITEM: IF "HIGH-TECH", FORM OPERATIONAL EXPERIMENTAL UNIT]

    Small batch production for field testing. A way of getting high confidence for something that will work.

69. DESIGN OF DEMONSTRATION PROCESS.

    Design is the verb. Demonstration of the model and the results. The function is to design a process to demonstrate that your program is valid.

70. [DELETED] PLACE TRUST IN PROGRAM MANAGEMENT PEOPLE.

    All the way from concept development to final production. It's not a function. Increased authority, not final authority.

71. DEFINE BUYER INVOLVEMENT IN CONTRACTOR PERFORMANCE (OVERSIGHT, INSPECTION, GFE, GFP, FACILITIZATION, WHOLE SYSTEM INTEGRATION).

    Performance by the contractor.

72. MAKE GO - NO GO PRODUCTION DECISION. [ORIGINAL ITEM: GO-NO GO PRODUCTION DECISION]

73. PRODUCE ENGINEERING UNIT.

74. [DELETED] INCLUDE TRAINING/SIMULATION NEEDS.

    Similar to #39.

75. DEFINE INTELLECTUAL PROPERTY RIGHTS.

    Rights in data. Can you take my drawings without paying a royalty?

76. DEMONSTRATE THE IDEA.

77. [DELETED] USE APPROVED SOFTWARE LANGUAGE. [ORIGINAL ITEM: USE ADA SOFTWARE LANGUAGE]

    Not a function, but understood.

78. DEFINE RIGHTS AND OBLIGATIONS WHICH SURVIVE DELIVERY AND ACCEPTANCE.

    Warranties.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

79. ENSURE SYSTEM SUSTAINMENT AND INFRASTRUCTURE NEEDS.

80. DETERMINE PAYMENT PROCESS.

81. CONTINUOUS CONTROL: SCHEDULES, PERFORMANCE RELATIVE TO GOAL, COST AND BUDGET, AND RISK ASSESSMENT.

82. IDENTIFY/DEFINE INTERFACES.

    All encompassing. Different than #32. This system with other systems.

83. DEFINE APPLICABLE GROUND RULES (FAR, DFAR).

84. ASSIGN PUBLIC INFORMATION RESPONSIBILITY. [ORIGINAL ITEM: ASSIGN PUBLIC OPINION RESPONSIBILITY]

    Think about this up-front as you design your strategy.

85. CONSIDER EXTERNAL FEDERAL, STATE AND LOCAL LEGAL CONSTRAINTS.

    Includes environmental impact. I.e., waste disposal.

86. CONSIDER SOCIO-ECONOMIC BURDENS ON PERFORMANCE. [ORIGINAL ITEM: CONSIDER SOCIO-ECONOMIC BURDENS ON CONTRACT PERFORMANCE]

    On both contract performance and award.

87. [DELETED] ESTABLISH ETHICAL GROUND RULES.

88. ESTABLISH MAKE OR BUY DECISION PROCESS.

    #53 is similar.

89. [DELETED - INCORPORATED IN #90] CONSIDER INTEROPERABILITY NEEDS.

    Permitting high flexibility in the field.

90. CONSIDER RATIONALIZATION, STANDARDIZATION, INTEROPERABILITY NEEDS. [ORIGINAL ITEM: CONSIDER STANDARDIZATION NEEDS]

    Standardization for commonality. Efficiency in production. Mil standards/mil spec needs.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

91. UNDERSTAND THE OPERATIONAL ENVIRONMENT. [ORIGINAL ITEM: IDENTIFY THE OPERATIONAL ENVIRONMENT]

    Related to #16 and #39.

92. [DELETED - SUBSUMED IN STRUCTURE] CONSIDER INTERNATIONAL NEEDS, COOPERATION, TECHNOLOGIES, ETC. [ORIGINAL ITEM: INVOLVE INTERNATIONAL NEEDS, COOPERATION, TECHNOLOGIES, ETC].

93. EVALUATE COUNTER MEASURES.

    Subset of #49.

94. [DELETED] CONSIDER ROBOTICS IN LIEU OF HUMAN OPERATORS.
95. CONSIDER BUSINESS RISK OF CONTRACTOR.
96. ORGANIZE PROGRAM MANAGEMENT TEAM.
97. FINALIZE ACQUISITION STRATEGY. [ORIGINAL ITEM: DEVELOP ACQUISITION STRATEGY]
98. EXECUTE AND REFINE THE DEMONSTRATION PROCESS.
99. COMMUNICATE NEED EFFECTIVELY TO INDUSTRY.
100. [DELETED(Subsumed under #41)] MINIMIZE GOVERNMENTAL CONTROL OF CONTRACTOR PURCHASING SYSTEM.
101. [DELETED] RE-EVALUATE NEEDS/CAPABILITIES.
102. FIRST CUT DEFINITION OF PRODUCTION QUANTITIES.
103. [DELETED - SUBSUMED IN STRUCTURE] ESTABLISH APPLICABILITY OF EXISTENT TECHNOLOGY.
104. JOINT SERVICE/MULTI-NATIONAL CONSIDERATIONS.
105. INDUSTRIAL BASE VIABILITY (KEEP COMPANY ALIVE).
106. [DELETED] PREPARE RESPONSE.
107. PERFORM COST TRADE-OFF STUDY.
108. INCENTIVE SANCTIONS (CARROT & STICK).

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Continued)

109. GOVERNMENT ANALYSIS OF CONTRACT PROPOSAL.

110. CONTRACT NEGOTIATION AND AWARD[3].

111. SOURCE SELECTION.

112. [DELETED] PLAN WITHIN RESOURCE CONSTRAINTS.

113. [DELETED] OPERATIONAL LINKAGE TO PRESIDENTIAL NATIONAL STRATEGY.

114. VERIFICATION OF NEED.

115. VERIFICATION OF TECHNICAL APPROACH.

116. DEVELOP TECHNICAL APPROACH (RESPONSE).

117. DEVELOP THE ESSENTIAL ELEMENTS OF INFORMATION.[4]

118. PROGRAM MANAGER APPROVES ACQUISITION STRATEGY.

119. [DELETED] DEFINED AND USE SAME (PROCESS UNIQUE) WORDS THROUGHOUT TO INSURE THOUGHT FLOW BETWEEN PHASES.

120. PROVIDE ESSENTIAL ELEMENTS OF PROGRAM INFORMATION ROUTINELY TO "DECISION MAKERS".

121. CONTINUOUS REVIEW OF PROGRAM BY PROGRAM MANAGER; STILL VIABLE? (E.G., NEED, TECHNOLOGY, COST EFFECTIVENESS).

122. DETERMINE IF THERE IS AN APPROPRIATE INDUSTRIAL BASE AVAILABLE.

STATEMENTS OF FUNCTIONS/TASKS THAT MUST BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-1 (Concluded)

the system integration", "*Performance evaluation*", and "*Finalize acquisition strategy*" were of importance. 21 other functions/tasks were important to one of the participants.

A.2.3 Grouping Functions/Tasks

Workshop participants responded to the question:

---

[3] Use of "contract" or "contractor" can refer to intra-gov't agency relationships.

[4]. Not in stone

1. 1, 1, 1, 1, 1	32. 5	63. DELETED	93.
2. 5, 1, 3	33. 5	64.	94. DELETED
3.	34. DELETED	65. DELETED	95.
4. 2, 2, 2	35. 4	66. 3	96. 1
5. DELETED	36. DELETED	67. 2	97. 3, 2
6.	37.	68.	98.
7. 2	38.	69. 3	99.
8. DELETED	39.	70. DELETED	100. DELETED
9. 2	40. 3	71. 4	101. DELETED
10.	41.	72.	102.
11.	42.	73.	103. DELETED
12. 5, 5	43.	74. DELETED	104.
13.	44.	75.	105.
14.	45. 5	76.	106. DELETED
15.	46. DELETED	77. DELETED	107.
16. 4	47. DELETED	78.	108.
17.	48.	79.	109.
18. 3	49. DELETED	80.	110.
19.	50.	81.	111.
20.	51. DELETED	82. 4	112. DELETED
21.	52. 2	83.	113. DELETED
22. DELETED	53.	84.	114.
23.	54. 3	85.	115.
24.	55.	86. 5	116.
25.	56. 3, 4	87. DELETED	117.
26.	57. 5	88.	118.
27.	58.	89. DELETED	119.DELETED
28.	59. 4, 4	90.	120.
29. DELETED	60.	91. 1	121.
30.	61.	92. DELETED	122.
31. 4	62.		

VOTING FOR MOST IMPORTANT FUNCTIONS THAT SHOULD BE ACCOMMODATED TO MOVE FROM INITIAL CONCEPTS TO PROTOTYPES

Table A-2

"In the context of moving from weapon system concepts to weapon prototypes, does function

"A"

belong in the same functional grouping as function

"B"?

Table A-3 lists the 7 aggregate functional/task groups which participants formed and the individual functions/tasks within them. Participants derived aggregate functional group titles by considering the functions within each group and naming it appropriate to the aggregate group functional focus.

CATEGORY A - IDENTIFY NEED
(9 Functions)

1. Clearly defined need
16. Develop application scenarios
21. Define R&M requirements
24. Defining integrated system boundaries
44. Initial validation of need
50. Include training and simulation
82. Identify/define interfaces
93. Evaluate counter measures
104. Joint service/multi-national considerations

CATEGORY B - ANALYZE NEED AND DEFINE PROGRAM OBJECTIVE
(16 Functions)

6. Define program objective
7. Analyze/evaluate need
9. Review existing and required technologies
17. Begin research on new technology
32. Second order effects (technology)
38. Identify most critical materials, parts, human interfaces, ILS, manufacturing processes, automation, etc.
39. Evaluate operational and educational requirements
55. Prepare acquisition budget
90. Consider rationalization, standardization, interoperability needs (RSI)
91. Understand the operational environment
102. First cut definition of production quantities
107. Perform cost trade-off study
114. Verification of need
115. Verification of technical approach
116. Develop technical approach (response)
122. Determine if there is an appropriate industrial base available

CATEGORY C - DEVELOP ACQUISITION STRATEGY
(18 Functions)

4. Up-front risk evaluation
14. Organize design team
20. Evaluate opportunities for inserting new technology
26. Select supplier sector
27. Determine stage for technology freeze
37. Sell proposal
41. select type of contract
48. Decide whether to establish competition
52. Life cycle costing
60. Test proposal
68. Option to form operational experimental unit

AGGREGATE FUNCTIONAL/TASK GROUPINGS
Table A-3

CATEGORY C - DEVELOP ACQUISITION STRATEGY (Continued)

69. Design of demonstration process
85. Consider external federal, state and local legal constraints
86. Consider socio-economic burdens on performance
96. Organize program management team
97. Finalize acquisition strategy
117. Develop the essential elements of information
118. Program manager approves acquisition strategy

CATEGORY D - IMPLEMENT STRATEGY
(25 Functions)

2. Contract definition
3. Define the technical specs and concept of system integration
10. Write statement of work
18. Contractor propose price
31. Tell industry what is needed, heavy on performance and light on military specs
53. Consider multiple prime associate contractors
58. Establish protest and dispute resolution process
61. Maximize use of industry best practices
62. Establish change procedure and authority
67. Establish configuration control process and accountability
71. Define buyer involvement in performance (oversight, inspection, GFE, GFP, facilitization, whole system integration)
75. Define intellectual property rights
76. Demonstrate the idea
78. Define rights and obligations which survive delivery and acceptance
79. Ensure system sustainment and infrastructure needs
80. Determine payment process
83. Define applicable ground rules (FAR, DFAR)
88. Establish make or buy decision process
95. Consider business risk of contractor
99. Communicate need effectively to industry
105. Industrial base viability (keep company alive)
108. Incentive sanctions (carrot & stick)
109. Government analysis of contract price
110. Contract negotiation and award[7]
111. Source selection

CATEGORY E - DESIGN, TEST, & EVALUATION (DOING)
(19 Functions)

11. Create a (paper) design
12. Performance evaluation
15. Demonstrate technology
19. Build a mockup/model
23. Independently test and evaluate (technology) demonstrator

AGGREGATE FUNCTIONAL/TASK GROUPINGS
Table A-3 (Continued)

CATEGORY E - DESIGN, TEST, & EVALUATION (DOING) (Concluded)

25. Test to the revalidated need
28. Evaluate producibility
30. Reassess concept
35. Fabricate the experimental prototypes
42. Test and evaluate the experimental prototypes
45. Use pre-prod model for final test evaluation
54. Build the operational prototypes
57. Design organizational and management support for operational system
59. Test and evaluate operational prototypes and system integration
64. Organize engineering team
66. Feasibility testing
73. Produce engineering unit
81. Continuous control: schedules, performance relative to goal, cost and budget, and risk assessment
98. Execute and refine the demonstration process

CATEGORY F - DEVELOP OUTPUT
(8 Functions)

12. Performance evaluation
13. Complete "build to" packages
33. Complete design of tooling
40. Complete production engineering data
50. Define production quantities
72. Make go - no go production decision
81. Continuous control: schedules, performance relative to goal, cost and budget, and risk assessment
98. Execute and refine the demonstration process

CATEGORY G - CONTINUOUS MANAGEMENT FUNCTIONS
(5 Functions)

43. Assign responsibility for congressional liaison
56. Use seamless program management including major decisions minimizing program delay
84. Assign public information responsibility
120. Provide essential elements of program information routinely to "decision makers"
121. Continuous review of program by program manager - still viable? (e.G., Need, technology, cost effectiveness)

AGGREGATE FUNCTIONAL/TASK GROUPINGS
Table A-3 (Concluded)

A.2.4 <u>Ordering Functions/Tasks</u>

For convenience, the individual functions/tasks appear in Table A-3 in order of the number assigned to them when they were contributed: the lowest numbered statement begin the listing, and the highest ends it. Participants were asked to structure the tasks within each category to show which of them ought to be performed together with or as parts of others. The result of this structuring appears as Table A-4.

Table A-4 indicates participants' feeling that a considerable number of functions/tasks ought to be thought of as parts of an integrated whole. For example, "Implementing Strategy" involves a number of functions/tasks among which is the function/task of "Contract Definition". The Contract Definition Task was considered to have inclusive within it nine subordinate functions/tasks. Thus the single block "Strategy Implementation contains two levels of subordinate functions/tasks consisting of four major functions/tasks within which are contained the remainder of that category's functions/tasks.

When single functional blocks which appear in flow charts include three or more levels of structure, it is easy to understand why decisions taken without regard to that structure can lead to unintended consequences. Most decision makers will not examine the complexity of the structure which is derived below.

In the process of defining the aggregation structure presented in Table A-4, participants changed wordings of some of the functional/task statements which appeared in Table A-1. They also eliminated some of the functions/tasks which had been initially aggregated in Table A-3, and substituted others they felt more pertinent to the group of functions/tasks. There were also instances where one task was inserted within more than one aggregate functional/task group. For these reasons, the functions/tasks within the major aggregate groupings presented in Tables A-3 and Table A-4 do not always correspond exactly.

A.2.5 **Time Phasing of Grouped Functions/Tasks**

Workshop participants responded to the question: *"In the context of identifying need, does function/task "A" need to be performed prior to or at the same time as function/task "B"?*

Using ISM, participants time sequenced all functions/tasks within the aggregate groupings. Figures A-1 through A-7 present their understanding of how functions/tasks within aggregate groups should be sequenced.

The structures in Figures A-1 through A-7 are simplified so they can be more easily understood, and they do not make specific details of how the functions/tasks to

NEED IDENTIFICATION (9)

Develop Application Scenarios (16)
- (104) Joint Service/Multi-National Needs

Clearly Defined Need (1)
- (24) Define Integrated System Boundaries
- (82) Identify and Define Interfaces
- (93) Evaluate Countermeasures

Define Resource and Manpower Requirements (21)
- (50) Include Training and Simulation Needs

Validate Need (44)

ANALYZE NEED (15)

Analyze/Evaluate Need (7)
- (91) Understand the Operational Environment
- (122) Determine if there is an appropriate industrial base available
- (90) Consider Rationalization, Standardization, Interoperability Needs
- (39) Evaluate Operational and Education Requirements
- (114) Design an Idea Closure

Identify Most Critical Materials, Parts, Human Interfaces, Integrated Logistics System, Manufacturing Processes, Automation, etc. (38)
- (9) Review Existing and Required Technologies
- (115) Establish Applicability of Existent Technology
- (32) Second Order Effects (Technology)
- (17) Begin Research on New Technology
- (122) Determine if there is an appropriate industrial base available

First Cut Definition of Production Quantities (102)

Perform Cost Trade-Off Study (107)

Prepare Acquisition Budget (55)

Prepare Response (116)
- (6) Define Program Approach

DEVELOP ACQUISITION STRATEGY (16)

Risk Evaluation (4)
- (14) Organize design team
- (96) Organize Program Management team
- (20) Evaluate Opportunities for Inserting New Technology
- (27) Determine Stage for Technology Freeze
- (52) Life Cycle Costing

Develop Acquisition Strategy
- (86) Consider Socio-Economic Burdens on Performance
- (85) Consider External Federal, State and Local Legal Constraints
- (26) Select Supplier Sector
  - (48) Decide Whether to Establish Competition
- (41) Select Type of Contract
  - (117) Determine essential elements of information
- (69) Design of Demonstration Process
  - (68) Option to Form Operational Experimental Unit

Generate Proposal for Program (97)
- (118) Program Manager approves acquisition strategy

Test Proposal (60)

Sell Proposal (37)

STRATEGY IMPLEMENTATION (25)

Communicate Need Effectively to Industry (99)
- (3) Define the Technical Specifications and Concept of System Integration

RELATIONSHIPS BETWEEN FUNCTIONS/TASKS PERFORMED IN GOING FROM IDEAS TO PROTOTYPES

Table A-4

STRATEGY IMPLEMENTATION (Continued)

(10) Write Statement of Work
(31) Tell Industry What is Needed, Heavy on Performance and Light on Military Specifications
(95) Consider Business Risk of Contractor
  (105) Industrial Base Vitality
  (53) Consider Multiple Prime Associate Contractors
(61) Maximum Use of Industry Best Practices

Contract Definition (2)
(88) Establish Make or Buy Decision Process
(83) Define Applicable Ground Rules (FAR, DFARS)
(108) Incentives/Sanctions (Carrot and Stick)
(62) Establish Change Procedure & Authority
(71) Define Buyer Involvement in Performance Oversight, Inspection)
(58) Establish Protest and Dispute Resolution Process
(67) Establish configuration control process and accountability
(75) Define Intellectual Property Rights
(80) Define Payment Process
(78) Define Rights and Obligations Which Survive Delivery and Acceptance

Contract Negotiation and Award (110)
(18) Contractor Propose Price
(109) Government Analysis of Contract Price
(111) Source Selection

Demonstrate the Idea (76)

Ensure System Sustainment and Infrastructure Needs (79)

DESIGN, TEST AND EVALUATION (19)

Create A Design (11)
(64) Organize Engineering Team
(15) Demonstrate Technology
  (23) Independently Test and Evaluate (Technology) Demonstrator
(60) Feasibility Testing

Build a Mock-Up/Model (79)
(28) Evaluate Producibility
(20) Reassess Concept

Fabricate the Experimental Prototypes (35)
(73) Produce Engineering Unit

Test and Evaluate Experimental Prototypes (42)
(25) Test to evaluate Design to Need

Performance Evaluation (12)
(54) Build Operational Prototypes
(59) Evaluate Operational Prototypes and System Integration
(45) Use Pre-Production Model for Final Test Evaluation

Execute and Refine the Demonstration Process (98)

Continuous Control: Schedules, Performance Relative to Goals, Cost and Budget, Risk Assessment (81)
(57) Design organizational and management support for operational system

DEVELOP OUTPUT (8) [5 Original 3 Augmented]

Performance Evaluation (12)
(81) Continuous Control: Schedules, performance relative to goal, cost and budget, and risk assessment
(98) Execute and refine the demonstration process

Complete "Build To" Packages (13)

Complete Production Engineering Data (40)

Complete Design of Tooling (33)

Define Production Quantities (50)

Make Go-No Go Decision (72)

RELATIONSHIPS BETWEEN FUNCTIONS/TASKS PERFORMED IN GOING FROM IDEAS TO PROTOTYPES

Table A-4 (Continued)

MANAGEMENT/ORGANIZATION (11)
(5 Original) + [6 Added]

Use Seamless Program Management Including Major Decisions Minimizing Program Delay (56)

Organize
- [96] Program Management Team
  - [57] Design Organization and Management Support for the operational system
- [14] Design Team
- [64] Engineering Team

Establish Configuration Control Process and Accountability [67]

Assign Public Opinion Responsibility (84)
- (43) Assign responsibility for Congressional Liaison
- (120) Provide essential elements of information routinely to "decision makers"

Continuously:
- [114] Verification of need
- (121) Continuous review of program by program manager - still viable? (need, technology, cost effectiveness

RELATIONSHIPS BETWEEN FUNCTIONS/TASKS PERFORMED IN GOING FROM IDEAS TO PROTOTYPES

Table A-4 (Concluded)

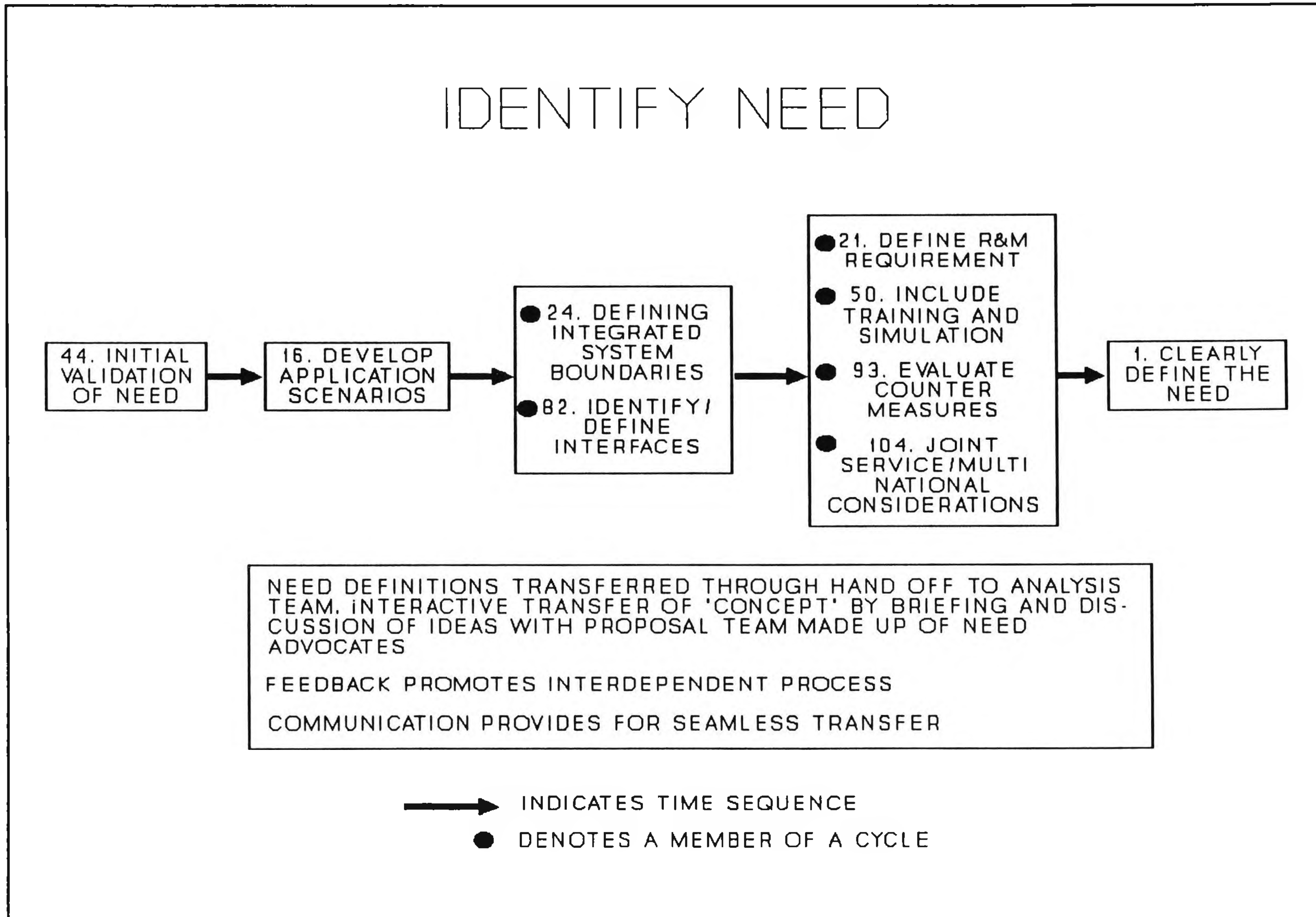
be performed relate to each other; detail which is, arguably, essential to successful attack on problems which arise when the system is in operation.

The discussion in Chapter 3 points out that attempts to "correct" problems with action are generally taken absent the kind of deep understanding which is presented here. In fact it can be argued that because decision makers are not obligated to understand the details, the courses of action they take are likely to cause other problems to arise.

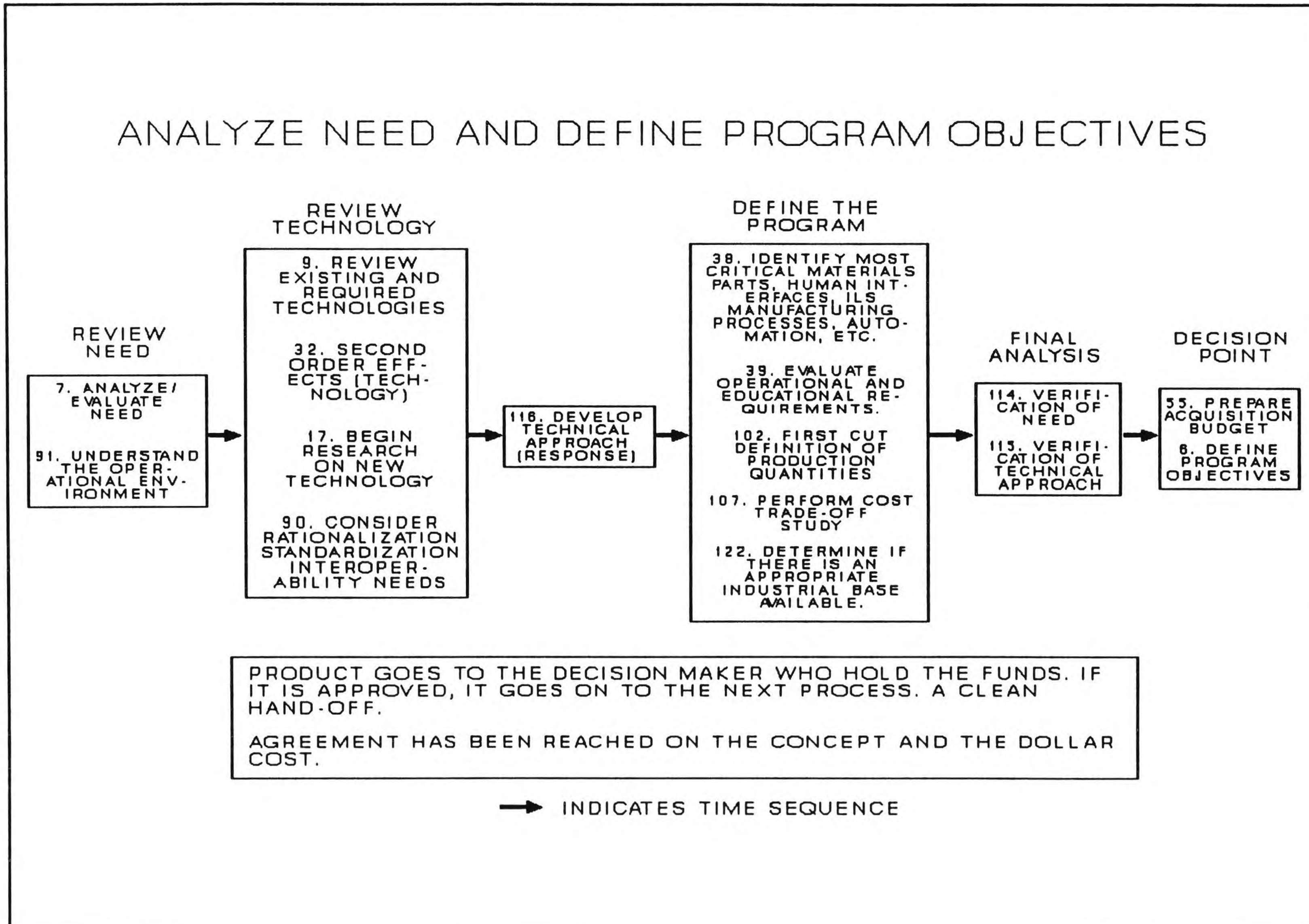
The term "micro-management" really describes the practice of focusing decision making attention on system change at a level of detail considerably finer than the level of micro-manager's understanding.

A.2.6 The Functional/Task Grouped Task Time-Line

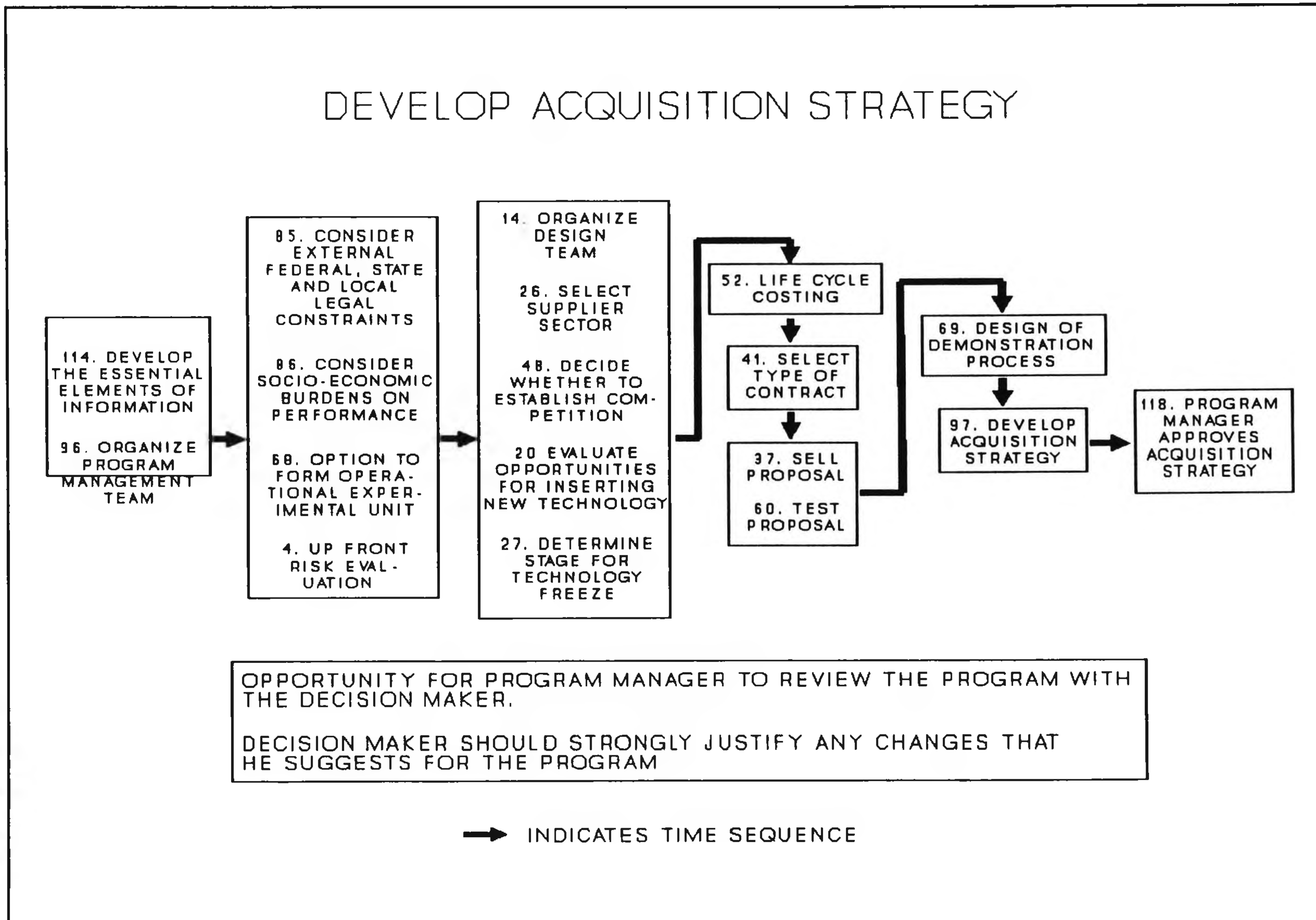
When detailed structure of functional/task groups had been determined, participants were asked to consider the groups as units and to determine their sequence of performance. Participants achieved consensus on the structure shown in Figure A-8 below (Figure 6-2 in Chapter 6).



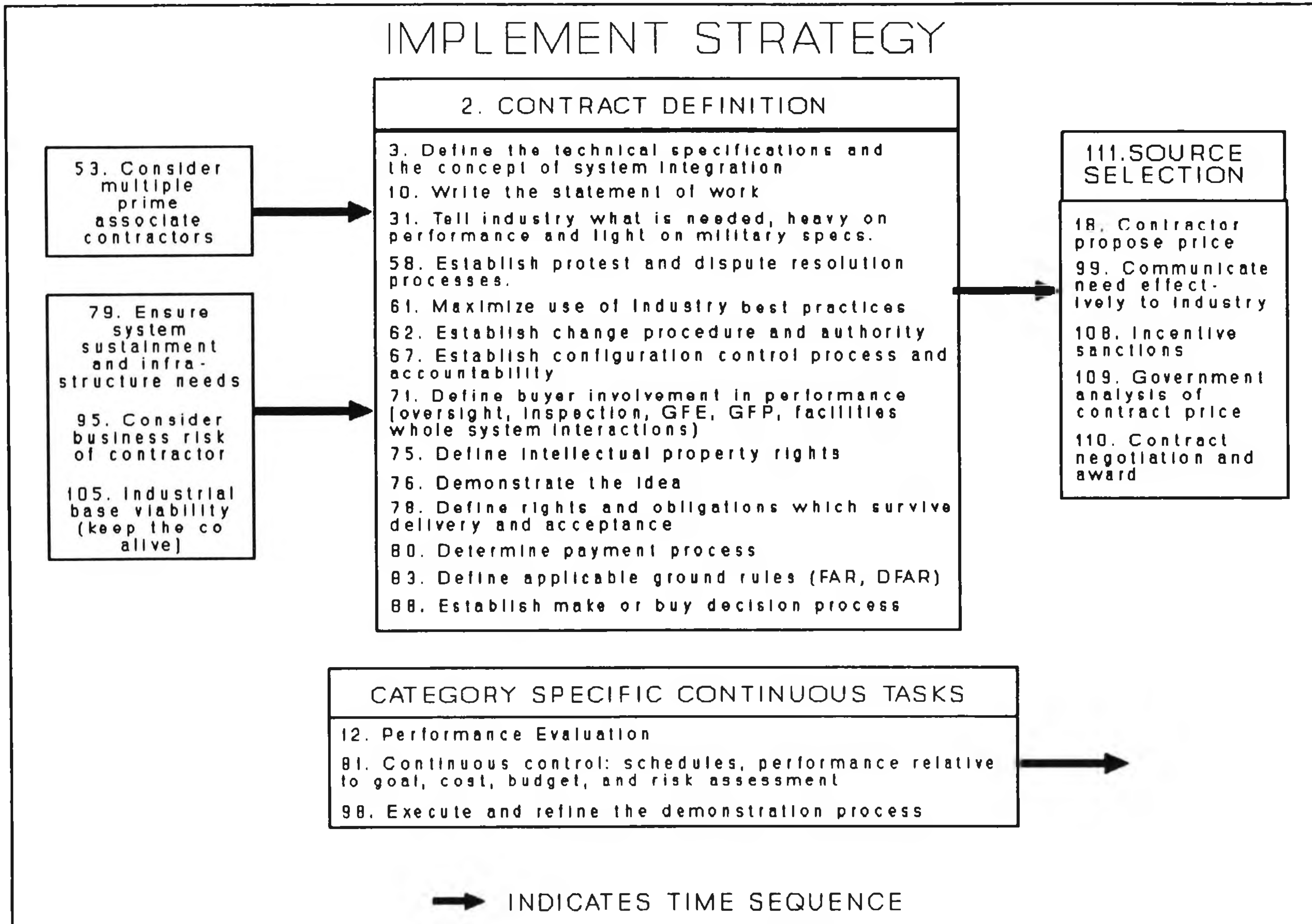
SEQUENCE OF FUNCTION/TASK PERFORMANCE
IDENTIFY NEED
Figure A-1



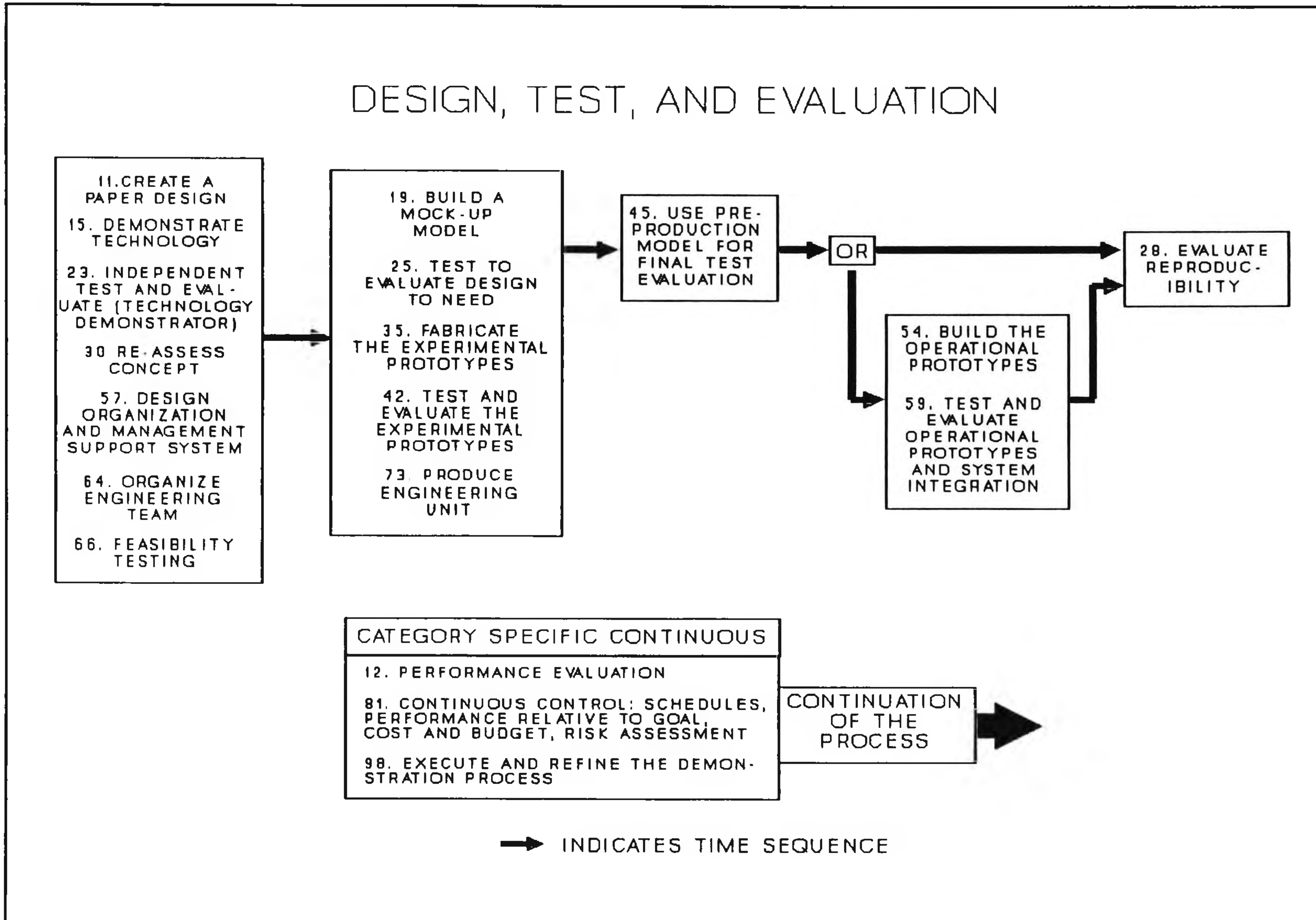
SEQUENCE OF FUNCTION/TASK PERFORMANCE
ANALYZE NEED
Figure A-2



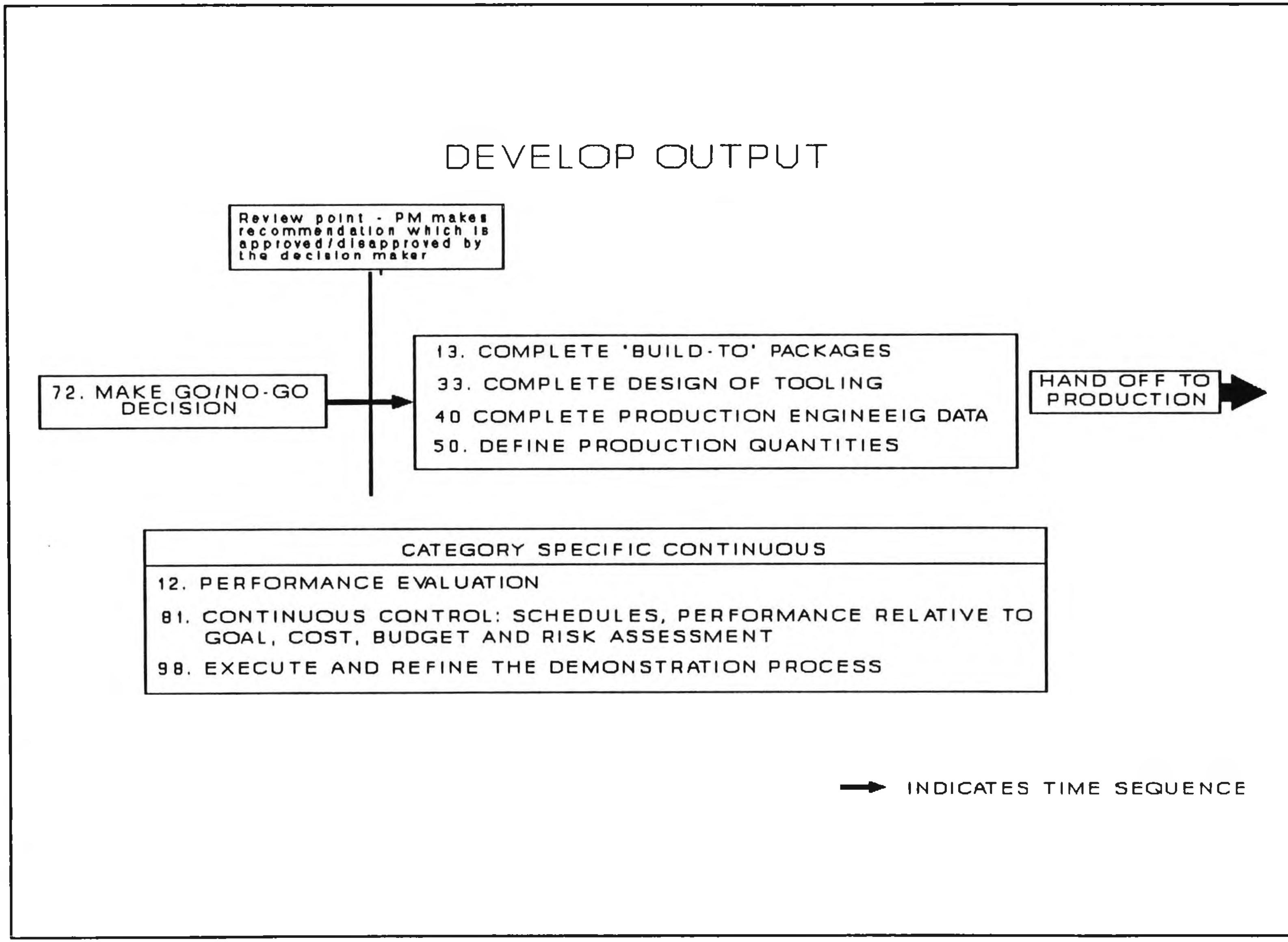
SEQUENCE OF FUNCTION/TASK PERFORMANCE
DEVELOP ACQUISITION STRATEGY
Figure A-3



SEQUENCE OF FUNCTION/TASK PERFORMANCE
IMPLEMENT ACQUISITION STRATEGY
Figure A-4



SEQUENCE OF FUNCTION/TASK PERFORMANCE
DESIGN, TEST, AND EVALUATION
Figure A-5



SEQUENCE OF FUNCTION/TASK PERFORMANCE
DEVELOP OUTPUT

Figure A-6

MANAGEMENT / ORGANIZATION

56. USE SEAMLESS PROGRAM MANAGEMENT INCLUDING MAJOR DECISIONS MINIMIZING PROGRAM DELAY

ORGANIZE

96. PROGRAM MANAGEMENT TEAM
    57. DESIGN ORGANIZATION AND MANAGEMENT SUPPORT FOR THE OPERATIONAL SYSTEM
14. DESIGN TEAM
64. ENGINEERING TEAM

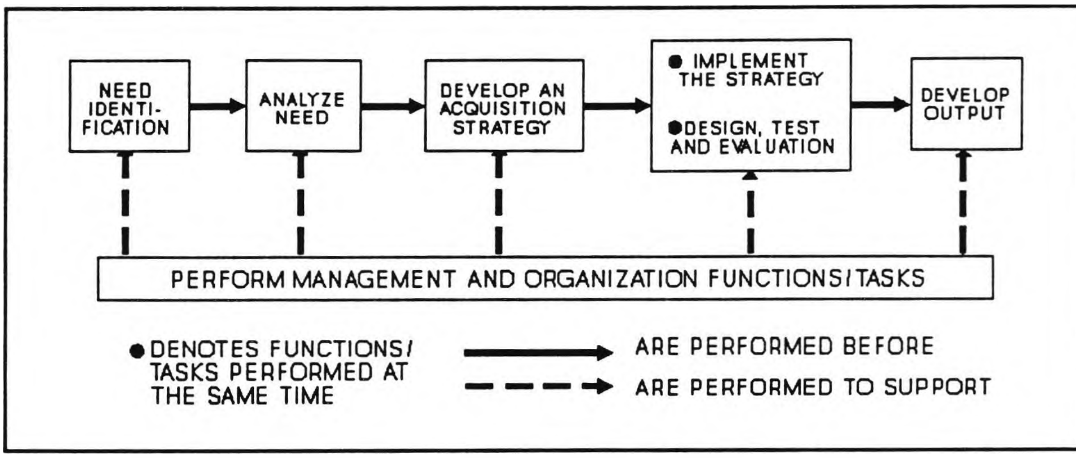
67. ESTABLISH CONFIGURATION CONTROL PROCESS AND ACCOUNTABILITY
84. ASSIGN PUBLIC OPINION RESPONSIBILITY
    43. ASSIGN RESPONSIBILITY FOR CONGRESSIONAL LIAISON
120. PROVIDE ESSENTIAL ELEMENTS OF INFORMATION ROUTINELY TO DECISION MAKERS

CONTINUOUSLY

114. VERIFICATION OF NEED
121 REVIEWPROGRAM VIABILITY BY PM (NEED, TECHNOLOGY, COST-EFFECTIVENESS)

SEQUENCE OF FUNCTION/TASK PERFORMANCE MANAGEMENT/ORGANIZATION

Figure A-7



FUNCTIONS/TASKS TO GO FROM IDEAS TO PROTOTYPES
Figure A-8

Figure A-8 indicates an intuitively logical structure among functional categories. It shows that (1) need identification must be completed before (2) needs can be analyzed; then (3) an acquisition strategy can be developed and (4) the implemented strategy, after adequate testing, can produce the output prototype weapon systems. When decision makers look at Figure A-8, they can easily determine the interfaces between major functional/task groups and the sequence of those groups along a time-line is logical. What is lost is the detail of the relationships between the functions/tasks in all of the groups, and the relationships between performance of the functions/tasks within the groups.

It is the loss of the detail which sets the stage for problem solving at the macro-level with oversight requirements which impact the system performance at the micro-level . The requirement to support the oversight needs is often at cross purposes with the requirements for performance of the total set of functions needed to insure system operation at reasonable levels of performance.

APPENDIX B
THE COMPLEXITY OF THE FUNCTIONS/TASKS REQUIRED TO TRANSFORM PROTOTYPICAL SYSTEMS INTO USEFUL WEAPONS

This appendix: (1) Presents the functions/tasks necessary to convert prototypical systems to systems producible in quantities which can be deployed and supported; (2) Shows how those functional/task statements were aggregated first into functional/task groups, then into major functional areas; (3) Derives the structure of individual functions/tasks within the aggregate functional/task groups; and (4) Defines the temporal relation of the major aggregate task groups. The purpose of this appendix is to make clear the process of functional/task aggregation and to emphasize the detail lost in the aggregative process. This discussion provides additional basis for discussion in Chapter 9 of the text.

B.1 THE DIMENSIONS OF THE PROBLEM

The development of a deployable, supportable weapon system from an operating prototype is a complex process. And once again, the process complexity is likely to be lost in the decision making process. When the process of developing complex weapon systems was divided into two parts, an important assumption was implicit in that decision: items reduced to practice indicated that further invention was unnecessary to enter into full production. A further, linked assumption was that logistic support functions could be derived for production items from operating the prototype.

The development of functions/task required to move from prototypical systems to production systems revealed flaws in the assumptions. Participants believed the process of converting prototypes to producible systems was not simple. They showed that the longer the time elapsed between the original prototype fabrication and the decision to produce and deploy the system, the more likely it was that a substantial amount of system redesign would be necessary before preparations for production could even begin. In addition, because the re-design and re-engineered system would likely differ significantly from the prototypical item, the support functions/tasks could not be determined until after the production configuration had been developed. *Once again, there were a very large number of functions/tasks specific to and necessary for successful achievement of the process objective: transforming prototypical systems into effective deployed and supported weapons.*

This portion of the work was specific to steps three ("Engineering and Manufacturing

Development"), four ("Full Scale Production"), and five ("Deployment and Sustainment") of the DAS imbedded within DoDD 5000.1; as before, it was revealed that these very simple, highly aggregated steps contained a large number of individual functions/tasks.

Once again, what follows is a detailed development of the individual functions/tasks which, taken together, aggregate within the umbrella of "moving from prototypical systems to deployed, supported weapons". Each task will be stated, as will the process of aggregation used to develop the simplified model of the process presented to the decision makers in the Department of Defense.

B.2 MOVING FROM PROTOTYPICAL WEAPON SYSTEMS TO FULLY SUPPORTED OPERATIONAL WEAPON SYSTEMS

B 2.1 Individual Functions/Tasks

Workshop participants responded to the question:

> *"What functions should be accommodated to move from prototypes to producible, supportable systems?"*

As before, after all initial responses had been made, there was a discussion of what each response meant. Clarification statements responded to participants questions. As the discussion proceeded, additional responses to the question were contributed and they too were modified and clarified as necessary to achieve understanding. There were 260 responses were and clarified as necessary. All 260 responses are presented in Table B-1 below. Participants then combined and deleted statements they felt were contained within other statements. The resulting group of 247 functions/tasks were then structured.

B.2.2 Voting For The Most Important Individual Functions/Tasks

So many individual functions/tasks were developed that it was decided to vote on their importance in stages. The first 53 tasks would be voted on first. Additional sets of tasks would be selected for voting until all tasks had been considered.

Workshop participants responded to the question:

> *"Which five functions are the most important functions in moving from prototypes to producible, supportable systems?"*

1. VERIFY THE OPERATIONAL REQUIREMENT DOCUMENT

   Goes back to the original process that produced the operational requirement. That requirement needs to be verified.

2. SYNTHESIZE, SIMPLIFY AND PURSUE INTEGRATION IN THE DESIGN

   This doesn't mean just *sub-system integration or physical integration.* What is meant is to look for those things you can combine. Look for ways you can select common connectors, cables, etc. Synthesize means looking for synergy; merging and poly-functional integration.

3. DETERMINE THAT THE TECHNOLOGY IS STILL CURRENT

   This assumes a time lapse between having built the prototype and beginning production.

4. DETERMINE THE DIFFERENCES OR SHORTFALLS BETWEEN THE PROTOTYPE AND THE ITEM TO BE FIELDED

   This means finding value added improvements. It means a judgement about whether there is any change to the item and does it differ from what you expect to field.

5. REVIEW ALLOCATION OF FUNCTIONS BETWEEN HARDWARE, SOFTWARE AND OPERATIONS

   Functional allocation means looking at functions to be performed and deciding whether they will be performed by people, software or hardware. You attempt to perform all functions most efficiently through the way they are allocated: Laying them out in the most functionally efficient way. This is done throughout the life cycle.

6. ANALYZE PRODUCIBILITY

   Can the system be produced?

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1

7. ACHIEVE DESIGN STABILITY - VERIFY THAT DESIGN MEETS PERFORMANCE/OPERATIONAL REQUIREMENTS

   It looks like two different items. Design meets performance requirements. Stability means a stable design. Complete data package available. The statement now reads I am ready to complete the package. Procurement funding. A prototype using development funds.

8. ANALYZE SKILL, FACILITY, SUBCONTRACTOR SUPPORT AND TOOLING AVAILABILITY

9. REEXAMINE CRITICAL MATERIALS, PARTS, HUMAN INTERFACES, IFS, MANUFACTURING PROCESSES, AUTOMATION, ETC.

   Verify that they're current. In terms of availability. You have availability and risk in the same thing.

10. FINALIZE THE TEMP

    Is finalize the same as approval? This would be the last update. I could have said update.

11. DETERMINE IF REQUIREMENTS ARE BASED ON USER REQUIREMENTS

    I guess I mean have the user requirements changed? Compare current performance with user requirements.

12. PREPARE/UPDATE MANUFACTURING PLAN

    Facilities requirements, personnel. Application of all resources.

13. DEVELOP PROCUREMENT STRATEGY

    What is a procurement strategy as compared to an acquisition strategy? I don't think there are any differences. Big picture.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

14. ESTABLISH IN-HOUSE PRODUCTION/SUBCONTRACTOR MIX

Same thing as a make or buy decision. Who's house? Those who are making the decision. They know what is their house.

15. HIRE/TRANSFER/TRAIN/CERTIFY WORKFORCE

Contractor only.

16. VERIFY SECDEF'S/DEP. SECDEF'S DEFINITION OF "PROTOTYPE" [ORIGINAL ITEM: VERIFY MR. ATWOOD'S DEFINITION OF "PROTOTYPE" (DID HE REALLY MEAN WHAT HE SAID?)]

1. Verify production processes.
2. Plan adequate production numbers to deploy and develop training and operational doctrine.
He's really saying verify the process. Is this policy?
Develop the production process.
Verify cost effectiveness.
Develop and improve the production process.
Doctrine.

17. PURSUE REUSABLE, RE-APPLICABLE, MODULAR APPROACHES TO SUPPORT ENVIRONMENT (i.e, DO NOT GIVE A NEW SET OF TEST EQUIPMENT ETC.)

Don't give us a whole new set of tests. What do we already have that we can use?

18. DETERMINE IF TECHNOLOGY IS RELEASABLE IN FOREIGN SALES

19. REASSESS OPERATIONAL SUITABILITY [ORIGINAL ITEM: VALIDATE OPERATIONAL SUITABILITY]

20. REVIEW AND IMPLEMENT RISK MANAGEMENT PLAN [ORIGINAL ITEM: REVIEW RISK MANAGEMENT]

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

21. REVIEW THE TRAINING REQUIREMENTS

All inclusive. Whatever training we can dream of needs to be covered. Includes trainers and things like that.

22. COMPLETE THE REQUIRED ENGINEERING DRAWING PACKAGE

In our vernacular, this is level three drawings. This includes required by contract. Especially important if we are going to shelve the item

23. REVIEW STATE OF EXISTING CONTRACTUAL AGREEMENTS [ORIGINAL ITEM: REVIEW STATE OF EXISTING CONTRACTUAL RELATIONSHIPS (SEE FOOTNOTE, PAGE 18)]

Shelving the product will require contractual techniques such as options. Keep this type of agreement alive so that we can come back and reactivate the contractor for production.

24. DEFINE PRODUCTION QUANTITIES

25. REFINE AND FINALIZE REQUIRED SYSTEM SPECS

There needs to be some agreements passed to the contractor. Freeze the requirements to control changes and improve the process.

26. PERFORM PRODUCTION READINESS REVIEWS

Multiple.

27. DEFINE FACTORY TEST EQUIPMENT

Is this something that would be required in a statement of work? It is normally required. Isn't that normally part of production proposal?

28. DEFINE THE SKILLS OPERATORS-USERS NEED [ORIGINAL ITEM: DEFINE OPERATOR NEEDED SKILLS]

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

29. DECIDE ON MODULARITY AND ASSEMBLY REQUIREMENTS

    This would include maintainability requirements.

30. ORDER RAW MATERIAL AND SUBCONTRACTED SUBSYSTEMS TO SUPPORT TOOLING

    This is ordering the materials for tooling.

31. CONCUR IN GO - NO GO DECISION (BLOCK 72)

    Is this where we start?

32. DEFINE/REFINE APPROACH TO LOGISTIC SUPPORT [ORIGINAL ITEM: DEFINE APPROACH TO SUPPORT]

33. DETERMINE SYSTEM AFFORDABILITY

34. VALIDATE THE SOFTWARE PRODUCTION PLAN [ORIGINAL ITEM: VALIDATE THE SOFTWARE DEVELOPMENT (MANUFACTURING) PLAN]

    Why is there a parenthetic? We always plan for one software evolution There's still a lot of software to be developed. Validate the software development with emphasis on manufacturing. Your software development would have to include the mechanics. I'm talking about actual production of the code for the system.

35. REVIEW/REVALIDATE SYSTEMS INTERFACES

36. REVIEW THE HUMAN FACTORS ENGINEERING

37. COMPLETE SUBCONTRACTOR MANAGEMENT PLAN

38. CREATE AND IMPLEMENT SKILL RECRUITMENT/RETENTION STRATEGY

    Where? All over. Skill = human resources skill. Critical skills. Preserving a critical mass. Develop a set of techniques within the overall strategy.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

39. DETERMINE LONG LEAD ITEM RELEASE [ORIGINAL ITEM: DETERMINE LONG LEAD ITEM RELEASE DATE]

40. COMPLETE MANUFACTURING ENVIRONMENTAL IMPACT STATEMENT

    Why is it limited to manufacturing?

41. PREPARE SYSTEM INTEGRATION & TEST PLAN

42. COMPLETE R&M TESTS

    Reliability growth testing. Reliability, maintainability tests. Covers demonstration and growth tests.

43. ESTABLISH MAINTENANCE PHILOSOPHY

44. DESIGN MODIFICATION PROCEDURE AND EVALUATE MODIFICATION SCOPE

    Aren't these two different things? The outcome, perhaps, yes, but you can't do it separately. Modification = modification of the product.

45. DOCUMENT TRAINING & VALIDATE TRAINING PLAN

    Primarily, training for the purpose of maintaining the product. I was trying to get all the training in here.

46. DETERMINE IF FUNDING IS AVAILABLE

47. INCENTIVIZE TO GET ORGANIC SUPPORT EARLY WHEN APPROPRIATE [ORIGINAL ITEM: INCENTIVIZE TO GET ORGANIC EARLY]

    We have to give the contractor incentive (make it worth while). Organic = user or service self sufficiency.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

48. DEVELOP PQI PROGRAM

49. DELETED. [PURSUE REUSABLE, RE-APPLICABLE MODULAR, COMPUTER RESOURCE SUPPORT ENVIRONMENT]

    Duplicative of #17.

50. REVIEW SAFETY CONSIDERATIONS & FACTORS

    Including hazardous and disposable materials.

51. DEVELOP A FOREIGN MILITARY SALES PLAN

52. DELETED [COMPLETE PRODUCTION/MANUFACTURING PROCESS DESIGN PLAN]

    Incorporated into #12. [Original Clarification: That's design of the process.]

53. CREATE & IMPLEMENT CONTRACTUAL BASIS FOR CONTINUING PRIME AND SUBCONTRACTOR COMMITMENT (ASSUMING GAP BETWEEN DEVELOPMENT AND PRODUCTION)

    If we're past the gap, this is not meaningful. Assured availability. Does it include data rights? Yes.

54. COMPLETE QUALITY ASSURANCE PLAN

    Included in #155.

55. REVIEW AND UPDATE LIFE CYCLE COST ANALYSES

56. MAINTAIN PARTS PROGRAM

    Every program we have, we have a preferred parts program.

57. ESTABLISH PRODUCTION FACILITY

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

58. DECIDE LIMITS ON SYSTEM AND SOLUTION ADAPTABILITY [ORIGINAL ITEM: DECIDE ON PROGRAMMING/TUNING MIX]

From the very beginning decide what sort of leeway you are allowing yourself. Yes, flexible manufacturing, too. An on-going continuous function. It's a question of deciding how much is preprogrammed. What about: decide on latitude for appropriate allocation of functions? He's got everything in there. What about: define limits on adaptability? On system and solution.

59. AGREE ON DELIVERY DOCUMENTATION & REQUIREMENTS

60. DETERMINE IF THE SCHEDULE IS REALISTIC

Acquisition strategy, is the schedule realistic?

61. DETERMINE THE SOURCES OF LOGISTIC SUPPORT

Determine where your center(s) will be located. Determine the sources. Many sources of repair. Many sources of supply.

62. DEVELOP MAKE-OR-BUY PLAN

63. FACTOR IN CHANGES RESULTING FROM USE OF PROTOTYPE

64. PREPARE/DESIGN FOR TECHNOLOGY TRANSFER/INSERTION

Insertion = don't make your design so rigid. Is that the same thing as open systems? Yes.

65. DETERMINE THE REQUIREMENT FOR FOLLOW-ON PROTOTYPES (EMD AND PRODUCTION)

66. OBTAIN FUNDING NECESSARY TO EXECUTE DIRECTED PROGRAM

67. REORGANIZE/REESTABLISH PMO AND MATRIX TO FUNCTION (LEGAL FINANCIAL TEST MANAGER)

Matrix to function = relationship, whether it really is a matrix or not. T&E = test planners and managers.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

68. DELETED [SOURCE SELECTION]

Incorporated into #169

69. DEVELOP RATES OF PRODUCTION STRATEGY

Both full rate and low rate.

70. REVIEW AND UPDATE CONFIGURATION MANAGEMENT PLAN

71. GENERATE AND VALIDATE SERVICE AND MAINTENANCE MANUALS

Does that include training manuals? No. Is validation inherent in the generation? #238 Came from this.

72. INTRODUCE PRODUCT INTO FIELD

73. PLAN FOR CHANGING PROGRAM CONTINGENCIES

Pure organizational terms. Strategic planning. How to prepare yourself for changing program contingencies.

74. ORDER RAW MATERIAL AND CONTRACT WITH SUBCONTRACTORS

75. REVALIDATE JOINTNESS AND INTEROPERABILITY REQUIREMENTS [ORIGINAL ITEM: DEMAND JOINTNESS AND INTEROPERABILITY]

76. ENSURE APPROPRIATE ACCESS TO, USABILITY AND PORTABILITY OF ESSENTIAL DATA

Portability = do I have to get it on microfiche...how to transfer and manipulate the data.

77. DELETED [DEVELOP "MANPRINT" PLAN]

Included in item #36.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

78. DELETED [DEVELOP THE MANUFACTURING TECHNOLOGY PLAN [ORIGINAL ITEM: DEVELOP THE "MANTECH" PLAN]]

    Incorporated into #12. [Original Clarification: Manufacturing Technology. What you're going to do to upgrade the line.]

79. REVIEW TOTAL DESIGN TO DISPOSAL ENVIRONMENTAL IMPACTS [ORIGINAL ITEM: REVIEW TOTAL ENVIRONMENTAL IMPACTS; MANUFACTURING TO DISPOSAL]

80. DETERMINE THE MEDIA FOR TECHNICAL & MAINTENANCE DATA (PAPER OR DIGITAL)

81. COMPLETE PRODUCTION SECURITY & SYSTEMS SECURITY PLANS

    In systems security, does it include operational security? I see it including everything.

82. REVIEW OPERATIONAL TEST AND EVALUATION RESULTS AND INTEGRATE INTO CURRENT DESIGN

83. PERFORM PROVISIONING FOR FIELDING SUPPORT

    Includes actual equipment and the support system to run it. Similar to #110. #239 came from this.

84. DEVELOP GOVERNMENT FURNISHED PROPERTIES STRATEGY/PLAN

    How and when. Not just who. #14 is limited.

85. DEVELOP PLAN FOR AUDITS

86. MAINTAIN "AS BUILT" CONFIGURATION

87. TRAIN THE TRAINERS

88. DESIGN A PHASING-OUT PROCESS

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

89. MONITOR AND MEASURE MANUFACTURING PROCESS FOR QUALITY

90. STREAMLINE AND TAILOR MIL-STANDARDS, ETC.

91. ESTABLISH DAMAGE ASSESSMENT, DAMAGE TOLERANCE ANALYSIS AND SYSTEM INTEGRITY PROGRAMS

92. ESTABLISH INSTALLATION AND TRANSITION PLAN

What are you installing? This is the product. The system. A site activation type plan. In the field - for the user.

93. REVIEW/REFINE INTELLECTUAL DATA REQUIREMENTS/RIGHTS

It's got to be a conscious decision the PM makes.

94. REVIEW/DEVELOP A VALUE ENGINEERING PROGRAM

Is this a post-deployment? No. This is a continued product improvement process.

95. COMPLETE THE ACQUISITION PROGRAM BASELINE

96. UPDATE BUILD-TO PACKAGE, TOOLING DESIGN AND PRODUCTION ENGINEERING DATA

97. PERFORM THE PRODUCTION QUALIFICATION TEST [ORIGINAL ITEM: TEST AND EVALUATE PRODUCTION HARDWARE ITEMS]

Test the end product. The end item can be a component. Qualify the production process. Only happens once.

98. APPROVE SUBCONTRACTOR COMPETITION PLAN

Similar to #37.

99. ESTABLISH PRODUCTION PROGRAM MASTER SCHEDULE

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

100. DESIGN AND PROCURE/PRODUCE SUPPORT EQUIPMENT

101. ESTABLISH ESSENTIAL ELEMENTS OF PROGRAM INFORMATION

Status tracking system.

102. PUT INTO PLACE PROCUREMENT-INVENTORY CONTROL SYSTEM

103. ESTABLISH SUPPORT ORGANIZATIONS TO AID THE MANUFACTURING PROCESS

Includes any organization.

104. INCORPORATE STANDARDS WHERE APPROPRIATE

105. BUILD A SUSTAINING ENGINEERING PLAN WITH THE PRIME CONTRACTOR

106. DEVELOP THE PRODUCTION MANAGEMENT ORGANIZATION

To include systems engineering technical assistants support.

107. MANAGE SOLUTION INTEGRITY

One person to manage one solution. It's more than configuration management. This is the person trying to fill the holes on paper. Someone has to be responsible for managing over the life cycle. Can be tied to requirements tracking if original by users.

108. DETERMINE U.S. INDUSTRIAL BASE IMPLICATIONS

Going from prototype to fielded system - what is our industrial base. Can the industrial base support this. [Both ways.]

109. DEVELOP A COMBAT DAMAGE ASSESSMENT AND REPAIR PROGRAM

110. DETERMINE INITIAL SPARES AND SUPPORT EQUIPMENT REQUIREMENTS

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

111. UTILIZE WILOUGHBY TEMPLATES/BEST PRACTICES IN TRANSITION FROM DEVELOPMENT TO PRODUCTION

112. DEVELOP MAINTENANCE PROGRAM

Put maintenance part into the field.

113. ESTABLISH PRODUCTION ACCEPTANCE TESTING CRITERIA

114. VERIFY THAT THE PROPOSED DESIGN MEETS THE PERFORMANCE OPERABILITY, SUPPORTABILITY & PRODUCIBILITY REQUIREMENTS

115. DELETED [PERFORM PRODUCTION READINESS REVIEW]

116. DEVELOP PRODUCTION BUDGET

Budget does not include scheduled already considered.

117. CREATE AN INTEGRATED DOCUMENTATION/COMMUNICATION NETWORK

118. TRAIN SERVICE PERSONNEL TO OPERATE AND MAINTAIN PRODUCT

Service personnel is user.

119. VERIFY THAT ALL ACQUISITION DOCUMENTATION IS APPROVED AND CURRENT

120. DEVELOP AND IMPLEMENT DEPOT ACTIVATION PLANS (INCLUDING REVIEW OF SERDS)

Including review of supporting equipment documents section.

121. DEVELOP MANAGEMENT RESERVE REQUIREMENTS

122. REVIEW LESSONS LEARNED TO IMPROVE/SIMPLIFY PROCESSES

123. UPDATE/REFINE SALES/LIAISON COMMUNICATIONS STRATEGY (CONGRESS, DoD, AND PUBLIC)

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

124. DEVELOP/REVIEW ELECTROMAGNETIC PULSE HARDENING

125. OBTAIN APPROVAL TO AWARD PRODUCTION CONTRACT

126. DRAFT RFP PROPOSAL PAGE LIMITATION; SET UP BIDDERS CONFERENCE

127. PREPARE CBD ANNOUNCEMENT

128. DELETED [COMPLETE ROBOTICS INVESTMENT STRATEGY]

Included in "mantech" #78.

129. REVIEW AND UPDATE ELECTROMAGNETIC COMPATIBILITY AND RADIO FREQUENCY MANAGEMENT PLAN

130. MAKE SOFT VS. HARD TOOLS DECISION

131. PERFORM FIRST ARTICLE TESTS

Tests, instructions

132. RESOLVE PROBLEMS DURING MANUFACTURING PROCESS

133. DETERMINE PROCUREMENT START FOR PROCUREMENT LAW

134. PROGRAM FOR FACTORY TRAINING TO DEPOT AND FIELD PERSONNEL [ORIGINAL ITEM: PROGRAM FOR AND PROVIDE FACTORY TRAINING TO DEPOT AND FIELD PERSONNEL]

#240 Came from this.

135. EXECUTE PLANS TO BUILD, FIELD, AND SUPPORT SYSTEMS/ PRODUCT

136. PLAN FOR REAL USERS TO TEST AND VALIDATE THE SYSTEM

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

137. OBTAIN REQUIRED WAIVERS (E.G., LIVE FIRE TESTING, WARRANTIES, WORK MEASUREMENT)

138. ESTABLISH WARRANTY CRITERIA AND ADMINISTRATION PLAN

139. MAKE FIELDING RELEASE DECISION

140. UNDERSTAND AND PLAN FOR SMALL BUSINESS SET-ASIDE

141. REVIEW AND UPDATE SYSTEM SAFETY PLAN

142. USE DESIGN-TO-COST TECHNIQUE

143. ESTABLISH MAKE/BUY DECISION PROCESS

There's a crossover to #62

144. INTEGRATE PRODUCT INTO INVENTORY/FORCE STRUCTURE

145. DEVELOP AND MAINTAIN A REQUIREMENTS/SPEC AUDIT TRAIL

146. DEVELOP AND IMPLEMENT SITE ACTIVATION PLANS

147. REVIEW TYPE OF CLASSIFICATION REQUIREMENTS (STANDARD VS. LIMITED PRODUCTION) TO DEVELOP TEST AND SUPPORT STRATEGY

Different from production rate. Reviewing type of production authorized to determine the test requirements.

148. MONITOR STATUS AND MANAGE DEPENDENCIES WITH ASSOCIATED ACQUISITIONS (E.G., INTERFACING SYSTEMS, FACILITIES, TRAINERS, ETC.)

Associated = formal relationship with program offices.

149. DETERMINE IV&V REQUIREMENTS

150. REVIEW AND UPDATE THE SURVIVABILITY PLAN AND REQUIREMENTS

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

151. DETERMINE INTERIM CONTRACTOR SUPPORT (ICS) REQUIREMENTS

152. PERFORM INDEPENDENT COST ANALYSIS

153. MONITOR AND REACT TO FIELDED ITEMS FAILURES

Includes problems, issues and failures.

154. ESTABLISH IOC DEFINITION AND DATE

155. REVIEW AND UPDATE QUALITY ASSURANCE PLAN

Includes #54.

156. PERFORM VERIFICATION/CERTIFICATION OF PRODUCT

157. CONDUCT MISSION TRAINING/WAR GAMES

158. COORDINATE DARPA INVOLVEMENT

159. PROVISION FOR AND CATALOG SPARES, INCLUDING CREATION OF THE MASTER ITEM SUPPORT LIST (MISL)

#83 and #110 are similar.

160. REVIEW STATE OF THE ART

161. DEFINE CONTRACTOR DATA REQUIREMENTS LIST

162. REVIEW AND REESTABLISH ACQUISITION STRATEGY

163. COMPLETE DUAL SOURCE AND COMPETITION ANALYSIS

It's really a subset of acquisition strategy.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

164. REVIEW CRITICAL PARTS AVAILABILITY

Is 'parts' part of the product or part of tooling? Parts of the product, but it should be expanded to tooling. Parts for both product and tooling. Identify parts. We don't have any available yet unless it's off the shelf. Maybe it means continuously review. Normally, when you look at parts you look at the whole life of the product. It stays the way it is.

165. ESTABLISH PROGRAM MANAGEMENT TEAM

166. ESTABLISH AND MAINTAIN PRODUCT AT OPERATIONAL BASIS

167. ESTABLISH A COST SURVEILLANCE SYSTEM [ORIGINAL ITEM: IF APPROPRIATE, ESTABLISH A COST SURVEILLANCE SYSTEM]

How about, "establish an effective and continuing system for surveillance of critical program progress." I don't think we should loose the essence of cost surveillance. Maybe we should add another element.

168. DELETED [REQUIRE AND VALIDATE SOFTWARE ARCHITECTURE INDEX AND MODIFICATION ROAD MAP]

Split into two separate functions - #236 and #237. [Original Clarification: It allows you to identify all the places in the software code. It's a tracking system.]

169. CONDUCT SOURCE SELECTION AND AWARD PRODUCTION CONTRACT [ORIGINAL ITEM: SELECT SOURCE AND AWARD PRODUCTION CONTRACT]

#68 incorporated into this one.

170. ESTABLISH SOURCE SELECTION CRITERIA, WEIGHTING AND ORGANIZE SOURCE SELECTION AUTHORITY

171. DETERMINE RELEASABILITY OF FMS TECHNOLOGY

172. ESTABLISH A TECHNICAL PERFORMANCE MEASUREMENT/ MONITORING SYSTEM

173. ESTABLISH FIELD INTRODUCTION TEAM

174. GENERATE BLOCK UPDATE PLAN/PROGRAM

Think ahead for changes and plan for blocks. Block updates. It keeps you from being in a continuous change. Permits you to get something out on the original schedule.

175. APPLY TQM

176. REQUIRE BUILT IN DIAGNOSTIC FEATURES AND PERFORMANCE [ORIGINAL ITEM: VALIDATE BUILT IN DIAGNOSTIC FEATURES AND PERFORMANCE]

Just don't presume it works without testing it.

177. UPDATE COMPUTER RESOURCES LIFE-CYCLE MANAGEMENT PLAN AND DESIGNATE SOFTWARE SUPPORT ACTIVITIES

The plan is done early on. Is the designate software done at the same time in the plan, or are they separate? It goes both ways.

178. ESTABLISH CONFIGURATION CONTROL BOARD

179. DEVELOP PRODUCTION CONTRACT NEGOTIATION STRATEGY

180. OBTAIN MULTI-YEAR PROCUREMENT AUTHORITY

181. DEVELOP SECURITY CLASSIFICATION GUIDELINES IF REQUIRED

182. MAINTAIN STATUS OF ESSENTIAL ELEMENTS OF PROGRAM INFORMATION

183. PROVIDE THE CONTRACTOR WITH APPROXIMATE FUNDING LIMITATIONS

Before contract. Need it throughout the life of the contract. Prevents buying-in.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

184. ESTABLISH A FAILURE DATA COLLECTION AND ANALYSIS SYSTEM

Serves as a springboard for projects. Collecting reliability, maintainability data? Yes.

185. IMPLEMENT MEASUREMENT SYSTEM TO DEMONSTRATE MEETING QUALITY ASSURANCE PLAN [ORIGINAL ITEM: ESTABLISH MEASUREMENT SYSTEM TO DEMONSTRATE MEETING QUALITY ASSURANCE PLAN]

You're not just talking software? No. I'm talking QA across the project.

186. CONDUCT ILS PLANNING

187. REEXAMINE LINKAGE OF REQUIREMENT TO NATIONAL SECURITY STRATEGY

One of the requirements we're trying to meet should link back to national security strategy. This is a function that needs to be done after the prototype.

188. APPROVE PRIME'S OFF SHORE MANUFACTURING SOURCING

Prime manufacture means I manufacture.

189. DELETED [REVIEW AND UPDATE SYSTEM SECURITY PLAN]

Part of #81.

190. PERFORM OPERATIONAL T&E

191. CONDUCT PHYSICAL CONFIGURATION AUDIT

192. PUT MISSION CRITICAL COMPUTING RESOURCES INTO PLACE

'Into' hands of user. We consider mission data loaders. The integrated support facility and those in support of the weapons mission.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

193. ESTABLISH IMIP PLAN

The IMIP plan is basically sitting down with the contractor and identify those processes we agree on.

194. ESTABLISH AUTOMATED (JIT) INVENTORY CONTROL SYSTEM

195. DETERMINE CONTRACT VEHICLE

196. DEVELOP AND IMPLEMENT A POST DEPLOYMENT SOFTWARE SUPPORT PLAN [ORIGINAL ITEM: DEVELOP AND IMPLEMENT A POST DEPLOYMENT STRUCTURE SOFTWARE SUPPORT PLAN]

197. ESTABLISH/UPDATE CAD/CAM PLAN

Computer aided design. Computer aided management. Would not this be the area to implement CALS?

198. FINALIZE MULTI-NATIONAL CO-PRODUCTION AGREEMENTS, IF APPLICABLE

199. DETERMINE USABILITY OF PROTOTYPE DATA PACKAGE

How are you going to try to do that? I don't know. The key to determine how much work to do in this phase is to determine how much work has been completed before us.

200. UPGRADE OF PROTOTYPES TO PRODUCTION CONFIGURATION IF APPROPRIATE [ORIGINAL ITEM: DETERMINE UPGRADE OF PROTOTYPES TO PRODUCTION]

Is this modifying the prototype to production configuration? Yes. I don't think this is a contractual issue.

201. IMPLEMENT CONTRACTOR PERFORMANCE ASSESSMENT AND REPORTING SYSTEM

A report card on the full range of contractor performance. Goes into a data base and shared among Program Managers.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

202. AUGMENT CAD/CAM PLAN WITH INTEGRATED COMPUTER AIDED SOFTWARE ENGINEERING TOOLS ETC., TO PROVIDE INTEGRATED DATA FOR PROGRAM PARTICIPANTS

To provide integrated data to program participants (e.g., CITIS)

203. ESTABLISH COST SCHEDULE CONTROLLED SYSTEM

204. DETERMINE SYSTEM SERVICE LIFE AND ESTABLISH FINAL DISPOSITION PLAN

205. ESTABLISH THE INITIAL TRAINING PROGRAM

Conceptually we have the initial training and someone else provides the on-going training.

206. DETERMINE ACCEPTABILITY/RELIABILITY OF FOREIGN SUPPLY SOURCES [ORIGINAL ITEM: DETERMINE ACCEPTABILITY/RELIABILITY OF FOREIGN SUPPLY SOURCES (COMPLY WITH "BUY AMERICAN")]

See #242.

207. ESTABLISH FUNDING SCHEDULE RELATIVE TO POLITICAL ENVIRONMENT

You should lay out your funding in agreement with the administration.

208. INTEGRATE THE CONCURRENT DEVELOPMENT OF WEAPONS, ASSOCIATED SUPPORT SYSTEMS, ETC

Similar to #148.

209. DEFINE PARTS/SUPPORTABLE MODULE LIST

Lay down which are parts to be replace and which are modules to be replaced.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

210. OBTAIN AND VALIDATE WORK BREAKDOWN STRUCTURE

This is from the Program Manager side.

211. ESTABLISH CONGRESSIONAL AND MEDIA LIAISON

212. ESTIMATE MINIMUM SUSTAINING PRODUCTION RATE

213. PROJECT ESTIMATED WEAPONS SYSTEM MANAGEMENT, MAINTENANCE AND SUPPORT COSTS TO USERS

Program management office responsibility. Is this a one time thing? No, every year. Related to Defense Base Operations Fund (DBOF).

214. CONTINUOUSLY PERFORM RISK ANALYSIS

215. STAFF AND FACILITIZE PROGRAM OFFICE FOR PRODUCTION PHASE

216. ESTABLISH VERIFICATION/CERTIFICATION REQUIREMENTS

What is being verified and certified? The product is being certified. We're establishing the requirements which we think should be verified and certified. Specific skills are certified. There's a range of stuff to be certified. All we're doing is establishing the requirements where the emphasis has been placed.

217. DETERMINE PROGRAMMED DEPOT MAINTENANCE INTERVALS AND DEVELOP DEPOT WORK PACKAGES INCLUDING SYSTEM/ITEM INTEGRITY INSPECTION POINTS [ORIGINAL ITEM: DETERMINE PROGRAM DEPOT MAINTENANCE INTERVALS AND DEVELOP DEPOT WORK PACKAGES INCLUDING AIRCRAFT STRUCTURAL INTEGRITY INSPECTION POINTS]

E.g., including system/item integrity inspection points.

218. DEFINE OPERATIONAL TEST AND EVALUATION REQUIREMENT

219. PROJECT ESTIMATED REQUIREMENTS TO REVOLVING STOCK FUNDS [ORIGINAL ITEM: PROJECT REQUIREMENTS TO STOCK FUNDS]

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

220. ESTABLISH END-ITEM SALES PRICES FOR USERS

Again, coming out of the DBOF. This is both logistics and maintenance support.

221. DEACTIVATE PRODUCT/ITEM [ORIGINAL ITEM: DECOMMISSION AIRCRAFT]

I meant how you strike it from the inventory--take it out of it's active operational status.

222. ESTABLISH EXIT CRITERIA

Exit criteria that must be satisfactorily completed before moving to a new program phase.

223. DEVELOP PRODUCTION CONTRACT

224. PRESERVE ESSENTIAL PROGRAM KNOWLEDGE* [ORIGINAL ITEM: PRESERVE PMO CORPORATE MEMORY]

* In case there is a gap.

225. GENERATE AND VALIDATE USER OPERATIONAL MANUALS

226. DETERMINE GLOBAL INDUSTRIAL BASE IMPLICATIONS

227. DEFINE AND ESTABLISH RELATIONSHIPS BETWEEN THE PMO, DEFENSE CONTRACT MANAGEMENT SERVICE, AND CONTRACTORS

Contract administration.

228. DEFINE AND ESTABLISH RELATIONSHIPS WITH SUPPORTING INVENTORY CONTROL POINTS

I'm talking inventory control points. This can be COMS, DLA, sister services.

229. PERFORM IV&V

230. DEVELOP OR VALIDATE RISK MANAGEMENT PLAN

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

231. OBTAIN PRODUCTION PACKAGE

By Level III drawings, data rights, etc.

232. SATISFACTORILY COMPLETE CRITICAL DESIGN REVIEW

233. ORGANIZE TO AND SUSTAIN THE SYSTEM/PRODUCT/COMMODITY/ITEM

We've talked about organizing the program office to support production phase. We actually have to sustain this system for the life of the program.

234. PERIODICALLY VERIFY PROGRAM VIABILITY

235. PROVIDE FOR THE SKILLS OPERATORS NEED

Skills operators need in system design, training and aids, response to changing skills, and system improvements.

236. REQUIRE SOFTWARE ARCHITECTURE INDEX AND MODIFICATION ROAD MAP

Came from #168.

237. VALIDATE SOFTWARE ARCHITECTURE INDEX AND MODIFICATION ROAD MAP

Came from #168.

238. PLAN FOR GENERATION AND VALIDATION OF SERVICE AND MAINTENANCE MANUALS

Came from #71.

239. PLAN PROVISIONING FOR FIELDING SUPPORT

Came from #83.

240. PROVIDE FACTORY TRAINING TO DEPOT AND FIELD PERSONNEL

Came from #134.

241. DETERMINE STRATEGIC RAW MATERIAL AND RESOURCES REQUIREMENTS

242. COMPLY WITH "BUY AMERICAN"

Came from #206.

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Continued)

243. APPROPRIATE LIAISON/COORDINATION WITH MATRIX FUNCTIONS (E.G., LEGAL, FINANCIAL...)

Created for the "Continuous" category while discussing the "Program Management" category.

244. ANALYZE THE VALUE OF FOLLOW-ON PROTOTYPES

245. DEVELOP TRADE-OFF ANALYSIS IN COST SCHEDULE AND PERFORMANCE

246. CONSIDER INCORPORATION OF PROGRAMMATIC INITIATIVES

E.g., Software Engineering Institute Capability Maturity Model; Commercially available off the shelf; Non Development item.

247. ACCEPT PRODUCT

E.g., DD 250.

248. ACCEPT MATERIAL

Vendor/Subcontractor provided.

249. QUALIFY SUPPLIERS/VENDORS

250. CONTINUOUS SOFTWARE MANAGEMENT

251. INITIATE PROVISIONING FOR FIELDING SUPPORT

252. TRANSPORT PRODUCT INTO FIELD

253. INSTALL THE FIELD CHANGES

254. DEVELOP THE PROCUREMENT AND DEPLOYMENT PLAN

255. ACCOMMODATE MULTI-NATIONAL CO-PRODUCTION AGREEMENTS

256. DEPLOY TRAINING SOFTWARE (FIRMWARE) AND EQUIPMENT

257. VALIDATE COMPONENT REWORK/REPAIR PROCEDURES

258. PRODUCE MISSION CRITICAL COMPUTING RESOURCES

259. PRODUCE IT

260. REACT TO FIELDED ITEMS FAILURES

FUNCTIONS TO BE ACCOMMODATED TO MOVE FROM INITIAL PROTOTYPE SYSTEMS TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-1 (Concluded)

Table B-2 reports the voting on the first 53 functions/tasks. Once again, votes for "most important functions/tasks" are shown by noting a "1" beside the task number. Similarly, second most important is noted as "2", 3rd most important by "3", and so on. Table B-2 reveals considerable spread in the voting. Table B-3 summarizes the voting for the most important tasks in the first group of 53 functions/tasks.

1. 1, 2, 2, 1, 2, 2	15. 2, 5	28. 3	41.
2. 4, 1, 1	16.	29. 1	42.
3. 4, 3, 2, 4	17. 3	30.	43.
4.	18.	31. 4, 2, 4	44. 5, 3
5. 3, 1, 2	19. 2	32. 5, 4	45. 1
6.	20. 2, 3	33.	46. 3
7.	21. 1, 4	34.	47.
8. 2, 1	22. 5	35.	48.
9. 3, 4, 5	23. 5, 4	36. 1	49. 5
10. 3, 4	24. 5, 4	37. 2	50.
11. 1	25. 3	38.	51.
12. 3	26. 5, 5	39.	52. 5
13. 5, 4	27.	40. 1	53.
14. 3			

VOTING FOR THE MOST IMPORTANT FUNCTIONS THAT SHOULD BE ACCOMMODATED TO MOVE FROM PROTOTYPES TO PRODUCIBLE, SUPPORTABLE SYSTEMS

Table B-2

STATEMENT NUMBERS	*# VOTES*	*# INCLUDED*
17	5	1
7	4	1
2, 5, 9, 31	3	4
8, 10, 13, 15, 20, 21, 23, 24, 26, 32, 44	2	11
11, 12, 14, 17, 19, 22, 25, 28, 29, 36, 37, 40, 45, 46, 49, 52	1	16
4, 6, 7, 16, 18, 27, 30, 33, 34, 35, 38, 39, 41, 42, 43, 47, 48, 50, 51, 53	0	20

SUMMARY OF VOTING DISTRIBUTION FOR FIRST 53 FUNCTIONS/TASKS

Table B-3

Because of the "Spreadthink" indicated by the voting distribution in Table B-3, it was decided to form functional groupings and then work with them to determine sub-ordinate groups of individual functions and structural relationships within the functional groupings. Participants were asked:

"In the context of moving from weapon system prototypes to fully deployed, supported weapon system, does function

"A"

belong in the same aggregate functional grouping as function

"B"?

Participants grouped functional statements they considered to be related within a set of aggregate groups. Most groupings were driven by the time period during which they were performed. Other affinities considered had to do with skills required to perform functions/tasks.

Participants placed all functions within four major aggregate groupings: (1) 199 Functions were placed within a group entitled "Pre-Production Functions"; (2) 56 functions were considered to be "Production Functions"; (3) 33 functions were thought of as "Deploying Functions"; and (4) 26 functions were "Sustaining Functions". Each major aggregate group contained some smaller functional aggregate groups. Within the functional aggregate sub-groups, individual functions/tasks (1) were related to each other temporally; (2) related in terms of functional activity; or (3) were grouped because they needed they fit within the general category and had to be performed at the time the rest of the functions/tasks were performed.

Tables B-4 and B-6 through B-8 identify the individual functions/tasks within major aggregate functional groups and their sub-groups.

B.2.3 Pre-Production Functions

Table B-4 shows the affinity structure (functions/tasks and the sub-groups of which they are members) of all individual functions/tasks necessary to accomplish required Pre-Production activities. This major functional/task group contains 10 smaller sub-groups which include 35 smaller function/task aggregations.

Table B-5 is a summary of the grouping structure within the Pre-Production major aggregate area.

Figure B-1 shows the temporal relations within the Pre-Production structure.

PRE-PRODUCTION FUNCTIONS

REQUIREMENT DEFINITION (7 Functions)

1. Verify the operational requirement document
11. Determine if requirements are based on user requirements
75. Revalidate jointness and interoperability
150. Review and update the survivability plan and requirements
150. Establish Initial Operational Capability (IOC) definition and date
154. Reexamine linkage of requirement to national security strategy
204. Determine system service life and establish final disposition plan

DESIGN DEFINITION (37 Functions)

STANDARDS (2 Functions)

90. Streamline and tailor Mil-Standards, etc.
104. Incorporate standards where appropriate.

DESIGN DRIVERS (6 Functions)

17. Pursue reusable, re-applicable, modular approaches to support environment: e.g., do not give a new set of test equipment.
91. Establish damage assessment, damage tolerance analysis and system integrity programs.
111. Use "Willoughby Best Practices" to transition from development to production.
142. Use design-to-cost technique.
176. Require built-in diagnostic features and performance.
236. Require software architecture index and modification road map.

REFINE (6 Functions)

4. Determine the differences or shortfalls between the prototype and the item to be fielded.
35. Review/revalidate systems interfaces.
36. Review the human factors engineering.
50. Review safety considerations and factors.
63. Factor in changes resulting from use of prototype.
82. Review operational test and evaluation results and integrate into current design.

DEVELOP (7 Functions)

2. Synthesize, simplify, pursue integration in the design.
5. Review allocation of functions between hardware, software and operations.
29. Decide on modularity and assembly equipment.
58. Decide limits of system and solution adaptability.
64. Prepare/design for technology transfer/insertion.
209. Define parts/supportable module list.
244. Analyze the value of follow-on prototypes.

OTHER CONSIDERATIONS (3 Functions)

79. Review total design to disposal environmental impacts.
124. Develop/review electromagnetic pulse hardening.
129. Compatibility and radio frequency management plan.

COMMUNICATE/VERIFY (8 Functions)

7. Achieve design stability - verify that design meets performance/operational requirements.
22. Complete the required engineering drawing package.
25. Refine and finalize required system specifications.
96. Up-date build-to package, tooling design and production engineering data.
114. Verify that the proposed design meets the performance, operability, supportability and producibility requirements.
199. Determine usability of prototype data package.
231. Obtain production package.
232. Satisfactorily complete critical design review.

FUNCTIONS/TASKS INCLUDED WITHIN PRE-PRODUCTION ACTIVITIES

Table B-4

DEFINITION TEST SUPPORT (2 Functions)

27. Define factory test equipment.
100. Design and procure/produce support equipment.

WITH 169 (3 Functions)

188. Approve prime's off-shore manufacturing sourcing.
198. Finalize multi-national co-production agreements if applicable.
121. Develop management reserve requirements.

PROGRAM MANAGEMENT (60 Functions)

PLANNING (4 Functions)

Program Baseline

95. Complete the acquisition program baseline.
99. Establish production program master schedule.
254. Develop the procurement and deployment plan.

Execute

135. Execute plans to build, field, and support system/ product

DEVELOP PLANS (9 Functions)

37. Complete sub-contractor management plan.
85. Develop a plan for audits.
88. Design a phasing-out process.
136. Plan for real users to test and validate the system.
181. Develop security classification guidelines if required.
193. Establish IMIP plan.
197. Establish up-to-date CAD/CAM plan.
202. Establish CAD/CAM plan with integrated Computer Aided Software engineering tools, etc., to provide integrated data for program participants.
230. Develop or validate risk management plan.

PROGRAM MANAGEMENT OFFICE (9 Functions)

67. Reorganize/Reestablish the PM Office.
152. Perform independent cost analysis.
165. Establish program management team.
183. Provide the contractor with approximate funding limitations.
213. Project estimated weapon system management, maintenance and support costs to users.
220. Establish end-item sales prices for users.
224. Preserve essential program knowledge.
227. Define and establish relationships between the PMO, Defense Contract Management Service, and contractors.

WAIVERS (4 Functions)

31. Concur in go-no-go decision block.
80. Determine the media for technical and maintenance data; (paper or digital).
137. Obtain required waivers; e.g., live fire testing, warranties, work measurement.
222. Establish exit criteria.

MANAGEMENT CONTROL (11 Functions)

60. Determine if the schedule is realistic.
76. Ensure appropriate access to, usability and portability of essential data.
101. Establish essential elements of program information.
117. Create an integrated documentation/communication network.
148. Monitor status and manage dependencies with associated acquisitions; e.g., interfacing systems, facilities, trainers, etc.
167. Establish a cost surveillance system.
172. Establish a technical performance measurement/ monitoring system.
182. Maintain status of essential elements of program information.
201. Implement contractor performance assessment and reporting system.
203. Establish cost schedule controlled system.
245. Develop trade-off analysis in cost, schedule and performance.

PROGRAM FUNDING (4 Functions)

First

116. Develop production budget.

Then

33. Determine system affordability.
46. Determine if funding is available.
66. Obtain funding necessary to execute directed program.

FUNCTIONS/TASKS INCLUDED WITHIN PRE-PRODUCTION ACTIVITIES

Table B-4 (Continued)

EXTEND INTERFACE (2 Functions)

158. Coordinate ARPA involvement.
211. Establish Congressional and media liaison.

REVIEW/UPDATE PLANS (5 Functions)

20. Review and implement risk management plan.
44. Design modification procedure and evaluate modification scope.
70. Review and update configuration management plan.
94. Review/develop a value engineering program.
141. Review and update system safety plan.

CONTRACTING (3 Functions)

125. Obtain approval to award production contract.
127. Prepare CBD announcement.
133. Determine when procurement starts for procurement IA Law.

PM LEAD (6 Functions)

26. Perform production readiness reviews.
119. Verify that all acquisition documentation is approved and current.
161. Define contractor data requirements list.
169. Conduct source selection and award production contract.
208. Integrate the concurrent development of weapons, associated support systems, etc.
210. Obtain and validate work breakdown structure.
223. Develop production contract.

PRODUCTION PLAN (2 Functions)

59. Agree on delivery documentation and requirements.
65. Determine the requirement for follow-on prototypes (EMD and production)

ACQUISITION STRATEGY (31 Functions)

CONTRACT (3 Functions)

126. Draft RFP proposal page limitation and set up bidders conference.
170. Establish source selection criteria, weighting and organize source selection authority.
179. Develop production contract negotiation strategy.

OVERALL (3 Functions)

162. Review and re-establish acquisition strategy.
207. Establish funding schedule relative to political environment.
246. Consider incorporation of programmatic initiatives.

GLOBAL (5 Functions)

18. Determine if technology is releasable in foreign sales.
51. Develop a foreign military sales plan.
108. Determine U.S. industrial base implications.
206. Determine acceptability/reliability of foreign supply sources.
226. Determine global industrial base implications.

LEGAL (3 Functions)

93. Review/refine intellectual data requirements/ rights.
138. Establish warranty criteria and administration plan.
242. Comply with "Buy American".

PLANNING (7 Functions)

47. Incentivize to get organic support early when appropriate.
48. Develop P^3I program.
62. Develop make or buy plan.
84. Develop government furnished properties strategy/plan.
143. Determine interim contractor support (ICS) requirements.
151. Generate block update plan/program.

GAP (2 Functions)

38. Create and implement skill recruitment retention strategy.
53. Create and implement contractual basis for continuing prime and sub-contractor commitment (assuming gap between development and production).

FUNCTIONS/TASKS INCLUDED WITHIN PRE-PRODUCTION ACTIVITIES

Table B-4 (Continued)

ACQUISITION STRATEGY (Continued)

PRODUCTION (3 FUNCTIONS)

24. Define production quantities.
69. Develop rates of production strategy.
147. Review type of classification requirements (standard vs. limited production) to develop test and support strategy.

PROCUREMENT STRATEGY AND MECHANISMS (5 Functions)

13. Develop procurement strategy.
23. Review state of existing contractual agreements.
140. Understand and plan for small business set-aside.
163. Complete dual source and competition analysis.
195. Determine contract vehicle.

PRODUCTION PLANNING (13 Functions)

PLAN (6 Functions)

6. Analyze producibility.
8. Analyze skill, facility, subcontractor support and tooling availability.
12. Prepare manufacturing plan.
108. Determine U.S. industrial base implications.
212. Estimate minimum economical sustaining production rate.
241. Determine strategic raw material and resources requirements.

BRIDGE TO PRODUCTION (1 Function)

106. Develop the production management organization.

DETAILED PLANS (4 Functions)

39. Determine long lead item release.
40. Complete manufacturing environmental impact statement.
130. Make soft vs., hard tools decision.
194. Establish automated (Just in Time) inventory control system.

IMPLEMENTING PLANS (2 Functions)

114. Establish in-house production/sub-contractor mix.
81. Complete production security and system security plans.

LOGISTIC PLANNING CONSIDERATIONS (19 Functions)

LOGISTIC PLANNING (4 functions)

32. Define/refine approach to logistic support.
43. Establish maintenance philosophy.
61. Determine the sources of logistic support.
186. Conduct Integrated Logistic Support (ILS) planning.

MAINTENANCE (4 Functions)

112. Develop maintenance program.
120. Develop and implement depot activation plans (including review of SERDS).
217. Determine programmed depot maintenance intervals and develop depot work packages including system/item integrity inspection points.
238. Plan for generation and validation of service and maintenance manuals.

SPARES (2 Functions)

110. Determine initial spares and support equipment requirements.
239. Plan provisioning for fielding support.

TRAINING (4 Functions)

21. Review the training requirements.
28. Define the skills operators need.
134. Program for factory training to depot and field personnel.
138. Establish warranty criteria and administration plan.

FUNCTIONS/TASKS INCLUDED WITHIN PRE-PRODUCTION ACTIVITIES

Table B-4 (Continued)

LOGISTIC PLANNING CONSIDERATIONS (Continued)

ENGINEERING (5 Functions)

80. Determine the media for technical and maintenance data (paper or digital).
109. Develop a combat damage assessment and repair program.
177. Update computer resources life-cycle management plan and designate software support activities.
184. Establish a failure data collection and analysis system.
196. Develop and implement a post deployment software support plan.

VERIFY AND VALIDATE (7 Functions)

10. Finalize the Test and Evaluation Master Plan (TEMP).
34. Validate the software production plan.
41. Prepare system integration and test plan.
113. Establish production acceptance testing criteria.
149. Determine Independent Verification and Validation (IV&V) Requirements.
216. Establish verification/certification requirements.
218. Define operational test and evaluation requirements.

TECHNICAL DEVELOPMENT (2 Functions)

3. Determine that the technology is still current.
160. Review state of the art.

QUALITY (2 Functions)

155. Review and update quality assurance plan.
185. Implement measurement system to demonstrate meeting quality assurance plan.

CONTINUOUS (21 Functions)

16. Verify SECDEF/DEPSECDEF definition of Prototype.
19. Reassess operational suitability.
55. Review and update life cycle cost analysis.
60. Determine if the schedule is realistic.
73. Plan for changing program contingencies.
86. Maintain "as built" configuration.
107. Manage solution integrity.
121. Develop management reserve requirements.
122. Review lessons learned to improve/simplify processes.
123. Update/refine sales/liaison communications strategy (DoD, Congress, and public).
145. Develop and maintain a requirements/specification audit trail
169. Conduct source selection and award production contract.
175. Apply Total Quality Management (TQM).
182. Maintain status of essential elements of program information.
211. Establish Congressional and media liaison.
212. Estimate minimum economical sustaining production rate.
213. Project estimated weapon system management maintenance and support.
214. Continuously perform risk analysis costs to users.
222. Establish exit criteria.
234. Periodically verify program viability.
243. Appropriate liaison/coordination with matrix functions; e.g., legal, financial

FUNCTIONS/TASKS INCLUDED WITHIN PRE-PRODUCTION ACTIVITIES

Table B-4 (Concluded)

Figure B-1 (and the other figures which show temporal function/task structures of each of the 4 major functional aggregate groups) was derived using Interpretive Structural Modeling methodology. The question asked was:

"Do the functions/tasks in aggregate group "A" need to be performed prior to (or at the same time) as the functions in aggregate group "B"?

While the structure in Figure B-1 appears rather straightforward, it embeds

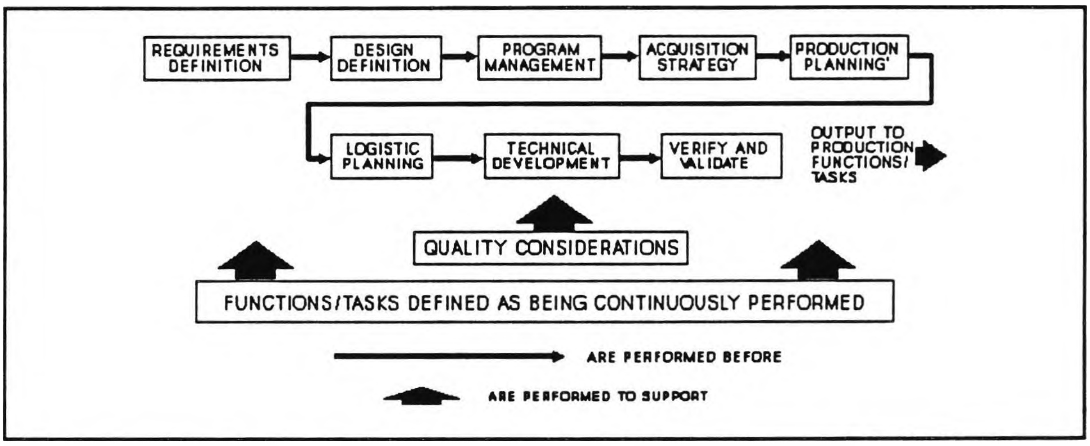
AGGREGATE GROUP	SUBORDINATE AGGREGATE GROUP
# 1 - Requirement Definition	None
# 2 - Design Definition	Standards; Design Drivers; Refine; Develop; Other Considerations; Communicate/Verify; Definition Test Support; With Statement 169
# 3 - Program Management	Planning; Develop Plans; Program Management Office; Waivers; Management Control; Program Funding; Extend Interface; Review/Update Plans; Contracting; PM Lean; Production Plan
# 4 - Acquisition Strategy	Contract; Overall; Global; Legal; Planning; Gap; Production; Procurement Strategy and Mechanisms
# 5 - Production Planning	Plan; Bridge to Production; Detailed Plans; Implementing Plans
# 6 - Logistic Planning	Logistic Planning; Maintenance; Spares; Training; Engineering
# 7 - Verify and Validate	None
# 8 - Technical Development	None
# 9 - Continuous	None
#10 - Quality	None

SUMMARY OF SUBORDINATE AGGREGATE FUNCTION/TASK STRUCTURE WITHIN THE PRE-PRODUCTION MAJOR GROUP AGGREGATE
Table B-5

within it the complex functional/task structure shown in Tables B-4 and B-5. Simply looking at Figure B-1 does not in itself indicate the complexity of the interfaces between the various aggregate sub-ordinate functional/task groupings.

The time line of Figure B-1 indicates a sequential temporal relationship between 8 of the 10 functional/task groups. Quality Considerations and other functions/tasks defined as "Continuously Performed Functions/Tasks" go on throughout the pre-production phase. Figure B-1 also indicates that the understanding derived from performance of the pre-producing functions/tasks is the basis for performing detailed production functions/tasks.

When decision makers look at the temporal relationships in Figure B-1, the details of relationships within each element and the relationships between the individual functions/tasks being performed across the interfaces between elements are lost. Managing the interfaces absent detailed continuous knowledge of task performance across those interfaces can easily lead to errors either of omission or commission.



PRE-PRODUCTION FUNCTIONAL/ TASK GROUP RELATIONSHIPS

Figure B-1

An even more interesting observation can be made from study of the detail contained within this Appendix: The assumption that little effort would be involved in making prototypical systems suitable for full scale production and field support is very likely in error. The number of individual tasks in performing "Pre-Production" activities is the largest of any step in the process of moving from ideas to fully supported, fielded systems! Given that, it might be asked whether dividing the process is a wise decision.

B.2.4 Production Functions

The production functional group contained the second largest number of functions. Five major aggregate groups were defined and the "Continuous" functional group defined in the Pre-Production phase carries through production as well. Several functional statements from "Pre-Production" influence directly what occurs when the production functions are performed. Table B-6 shows the affinity structure of all tasks that participants thought necessary to accomplish the "Production" activities.

PRODUCTION FUNCTIONS

GEAR UP (22 Functions)

PREPARE (12 Functions)

12. Prepare/update manufacturing plan.
54. Complete quality assurance plan.
81. Complete production security and systems security plans.
98. Approve sub-contractor competition plan.
104. Incorporate standards where appropriate.
105. Build a sustaining engineering plan with the prime contractor.
106. Develop the production management organization.
201. Implement contractor performance assessment and reporting system.
203. Establish cost schedule controlled system.
210. Obtain and validate work breakdown structure.
215. Staff and facilitize program office for production phase.
255. Accommodate multi-national co-production agreements

DO (8 Functions)

15. Hire/transfer/train/certify work force.
30. Order raw material and sub-contracted subsystems to support tooling.
57. Establish production facility.
74. Order raw material and contract with subcontractors.
102. Put into place procurement-inventory control system.
103. Establish support organizations to aid the manufacturing process.
194. Establish automated just-in-time (JIT) inventory control system.
249. Qualify suppliers/vendors.

REVIEW (2 Functions)

9. Re-examine critical materials, parts, human interfaces, IFS, manufacturing processes, automation, etc.
26. Perform production readiness reviews.

EXECUTION (19 Functions)

INITIAL (4 Functions)

89. Monitor and measure manufacturing process for quality.
132. Resolve problems during manufacturing process.
164. Review critical parts availability.
205. Establish initial training program.

INTERMEDIATE (5 Functions)

45. Document training and validate training plan, equipment and software.
92. Establish installation and transition plan
133. Determine when procurement starts for procurement IA law.
225. Generate and validate user operational manuals.
259. Produce it.

FINAL (6 Functions)

86. Maintain "as built" configuration.
113. Establish production acceptance testing criteria.
173. Establish field introduction team.
191. Conduct physical configuration audit.
200. Upgrade of prototypes to production configuration if appropriate.
258. Produce mission critical computing resources.

CONTINUOUS (4 Functions)

56. Maintain parts program.
89. Monitor and measure manufacturing process for quality.
135. Execute plans to build, field and support system/model.
248. Accept material.

FUNCTIONS/TASKS INCLUDED WITHIN PRODUCTION ACTIVITIES

Table B-6

TEST (6 Functions)

DEVELOPMENT TESTING (3 Functions)

42. Complete R&M Tests.
229. Perform Independent Verification and Validation.
237. Validate software architecture index and modification road map.

FIRST ARTICLE TESTING (2 Functions)

131. Perform first article tests.
190. Perform operational test and evaluation.

ON-GOING PRODUCTION TESTING (1 Function)

97. Perform the production qualification test.

DELIVER (2 Functions)

156. Perform verification/certification of product.
247. Accept product.

SUPPORT (5 Functions)

76. Ensure appropriate access to, usability and portability of essential data.
120. Develop and implement depot activation plans (including a review of SERDS).
219. Project estimated requirements to revolving stock funds.
228. Define and establish relationships with supporting inventory control points.
251. Initiate provisioning for fielding support.

(Feed back to the execution functions, and feed forward to sustaining functions)

ADDITIONAL PROGRAM MANAGEMENT FUNCTIONS (2 Functions)

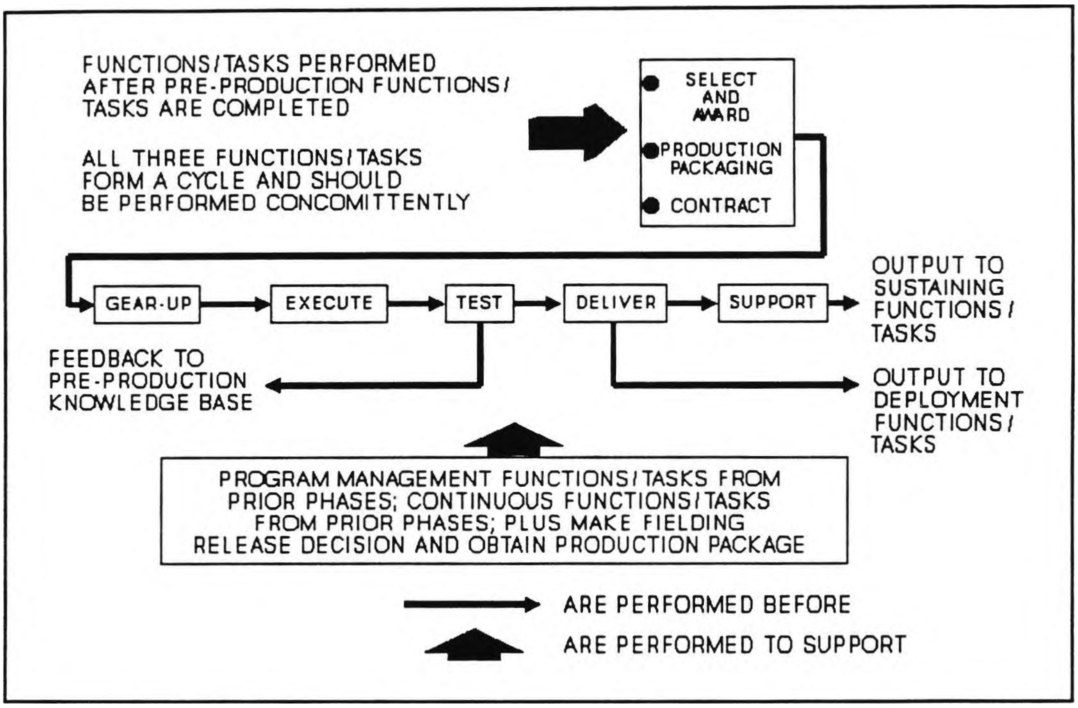
139. Make fielding release decision.
231. Obtain production package.

FUNCTIONS/TASKS INCLUDED WITHIN PRODUCTION ACTIVITIES

Table B-6 (Concluded)

Figure B-2 shows the performance sequence for Production functions. Functions at the extreme left of Figure B-2 are carried forward from Pre-Production functional activities. Figure B-2 also shows an augmented group of continuous functions are performed during production: those performed throughout Pre-Production continue to be key to performing production functions.

Figure B-2 indicates 3 major feedback mechanisms: functional sub-groups influence sub-groups to their right and provide input to continuously performed functions. They also have effect on continuously performed functions. In addition, Test functions affect both deployment functions and any pre-production activities which might still be in progress. Lastly, results of production functional performance provide output directly for sustaining functions.



PRODUCTION FUNCTION/ TASK GROUP RELATIONSHIPS

Figure B-2

B.2.5 <u>Deployment Functions</u>

The deployment functional/task group contained 33 discrete functions/tasks grouped within six aggregate functional/task groups; two of which (support and continuous management) had sub-ordinate aggregate functional/task groups. Table B-7 shows deployment aggregate functional/task groups, sub-ordinate aggregate functional/task groups, and individual tasks within those groups.

Figure B-3 represents the deploying functions as a group of continuing activities carried out in parallel. Although no integrative relationships are shown, it is clearly necessary to coordinate activities among the group involved in the deployment process. The continuous management activities are, therefore, shown as a broad box which is beneath all of the other functional sub-groups.

DEPLOYMENT FUNCTIONS

SYSTEM (4 Functions)

72. Introduce product into the field.
86. Maintain "As Built" configuration.
144. Integrate product into inventory/force structure.
252. Transport product into the field.

FINAL OPERATIONAL TEST AND EVALUATION (3 Functions)

19. Reassess operational suitability.
36. Review human factors engineering.
82. Review operational test and evaluation results and integrate into current design.

TRAINING (8 Functions)

21. Review the training requirements.
28. Define the skills operators need.
87. Train the trainers.
118. Train service personnel to operate and maintain product.
157. Consider mission training/war games.
235. Provide for the skills operators need.
240. Provide factory training to depot and field personnel.
256. Deploy training software (firmware) and equipment.

FACILITIES (2 Functions)

146. Develop and implement site activation plan.
166. Establish and maintain product at operational bases.

SUPPORT (6 Functions)

EQUIPMENT (2 Functions)

83. Perform provisioning for fielding support.
192. Put mission critical computing resources into place.

SPARE PARTS (4 Functions)

56. Maintain parts program
219. Project estimated requirements to revolving stock funds.
228. Define and establish relationships with supporting inventory control personnel.
251. Initiate provisioning for fielding support

CONTINUOUS MANAGEMENT (10 Functions)

INTERNAL MANAGEMENT

DOCUMENTATION (2 Functions)

76. Ensure appropriate access to, usability and portability of essential data.
80. Determine the media for technical and maintenance data (paper or digital).

DECISIONS (2 Functions)

92. Establish installation and transition plan.
139. Make field release decision.

FUNCTIONS/TASKS INCLUDED WITHIN DEPLOYMENT ACTIVITIES

Table B-7

CONTINUOUS MANAGEMENT (Continued)
INTERNAL MANAGEMENT

SOFTWARE (2 Functions)

196. Develop and implement a post deployment software support plan.
250. Continuous software management funds.

DATA COLLECTION (2 Functions)

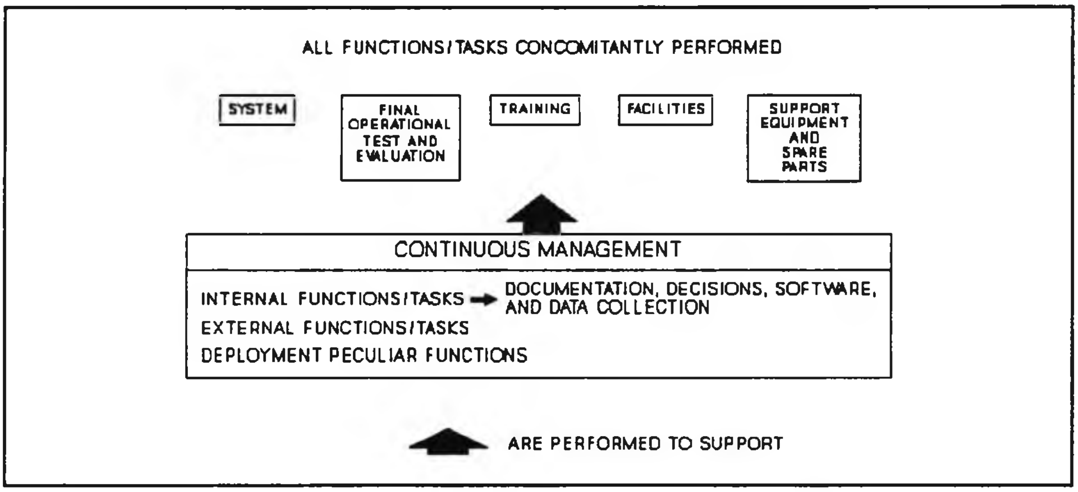
109. Develop a combat damage assessment and repair program.
184. Establish a failure data collection and analysis system.

EXTERNAL MANAGEMENTS (2 Functions)

23. Review state of existing contractual agreement.
233. Organize and sustain the system/product/commodity item.

FUNCTIONS/TASKS INCLUDED WITHIN DEPLOYMENT ACTIVITIES

Table B-7 (Concluded)



DEPLOYMENT FUNCTIONAL/ TASK GROUP RELATIONSHIPS

Figure B-3

B.2.6 Sustainment Functions

The sustainment functional/task group contained 26 discrete functions/tasks grouped within five aggregate functional/task groups. Table B-8 states the individual functions/tasks. Only one aggregate group has sub-ordinate functional/task groupings.

SUSTAINMENT FUNCTIONS

SUPPORT/REFURBISH (14 Functions)

BUY PARTS & SERVICES (4 Functions)

23. Review state of existing contractual agreement.
93. Review/revise intellectual data requirements/rights.
104. Incorporate standards where appropriate.
170. Establish source selection criteria, weighting and organize source selection authority.

OVERALL (1 Function)

32. Define/refine approach to logistic support.

GENERAL (9 Functions)

53. Maintain parts system.
151. Determine interim contractor support requirements.
159. Provision for and catalog spares including creation of the Master Item Support List.
219. Project estimated requirements to revolving stock fund.
235. Provide for the skills operators need.
237. Validate software architecture index and modification road map.
253. Install the field changes
257. Validate component rework/repair procedures.
260. React to fielded item failures.

MONITOR PERFORMANCE (7 Functions)

19. Reassess operational suitability.
21. Review the training requirements.
35. Review/validate systems interfaces.
36. Review the human factors engineering.
82. Review operational test and evaluation results and integrate into current design.
153. Monitor fielded items failures.
166. Review state of the art.

UPDATE (2 Functions)

70. Review and update configuration management plan.
174. Generate block update plan/program.

RETIRE (2 Functions)

183. Provide the contractor with approximate funding limitations.
221. De-activate production.

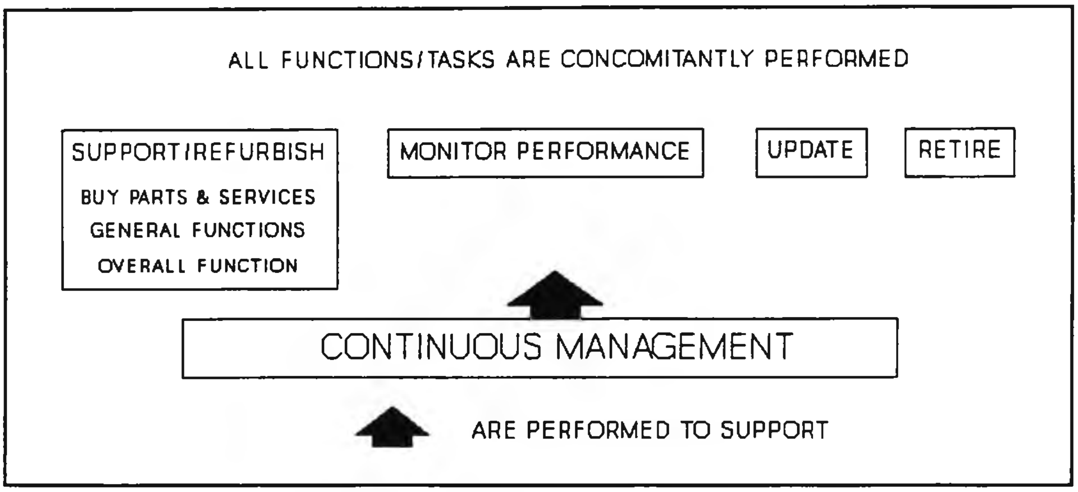
CONTINUOUS (1 Function)

152. Perform continuing independent cost analysis.

FUNCTIONS/TASKS INCLUDED WITHIN SUSTAINMENT ACTIVITIES

Table B-8

Figure B-4 presents the sustainment functions/tasks as groups of activities carried out in parallel.



SUSTAINMENT FUNCTIONAL/ TASK GROUP RELATIONSHIPS

Figure B-4

Once again, although no interactive relationships are shown, coordination among all of the functions being performed is necessary; therefore the management functions are shown in a broad box beneath all of the other functional/task groups.

B.2.7 <u>Management Functions</u>

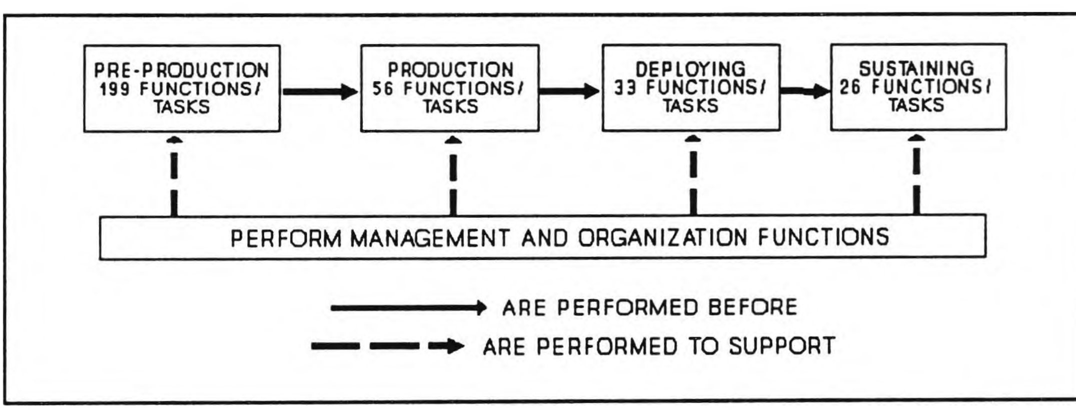
After the functional groupings described above hade been completed, participants recognized that sixty functions could be aggregated within a group called "Management Functions". Those 60 activities are normally performed within the Program Management Office. To help them understand exactly which of the 60 functions were performed by the program office during the four major phases of a program's progress from prototype to final supported system, participants analyzed each function and decided whether or not it was performed during each phase.

The management functions/tasks were apportioned between technical/engineering tasks and tasks made necessary by the oversight requirements of the acquisition process within which work was carried out. The analysis indicated two reasons which created functions/activities required in program management: (1) prototype systems generally required considerable modification before full scale production could begin; and (2) the time period between starting to ready prototypes for full production, deployment, and sustainment a program and concluding that work was spread over a considerable time period. The first reason generally contributes to the second.

B.2.8 <u>The Functional/Task Grouped Time Line</u>

With the detailed structure of functional/task groups determined, participants were asked to determine the sequence of performance of each of the major functional/task aggregate groups. Figure B-5 shows the time line of performance of the major aggregate functional groupings found necessary to convert prototypical weapon systems into fully fielded, sustainable weapons. Once again, the task sequence is logical: Pre-Production functions/tasks precede Production functions/tasks which must be performed before Deployment and Sustainment can be accomplished.

Again, the structure is intuitively logical. But again too, when decision makers consider the structure in Figure B-5, the interfaces appear to be simple, and the structure does not reveal the detail of the process. It is not surprising that the macro-level structure, which generally provides most of the information higher level decision makers have available when considering decision alternatives, clouds understanding of



FROM PROTOTYPES TO FULLY SUPPORTED SYSTEMS

Figure B-5

what consequences are likely associated with the choices. Participants thought it necessary to craft an acquisition process which would not require high level decision makers to absorb details of the work in order to exercise oversight and make critical management choices.

APPENDIX C
SKILL SET ATTRIBUTES REQUIRED TO PERFORM FUNCTIONS WITHIN A REDESIGNED ACQUISITION PROCESS

This appendix: (1) Presents the analysis of skills necessary to perform all of the functions necessary to move from ideas to fully supported, fielded weapon systems; (2) Discusses the implications of the skill set distribution on the organizational form of a redesigned acquisition process.

C.1 DEFINITION OF SKILL SETS USED IN FUNCTIONAL/TASK ANALYSIS

Participants analyzed all major functional groupings in the refined acquisition process using a set of seven personnel skill sets. The skill sets and the definition participants stated for each of them are presented in Table C-1.

SKILL SET	NARRATIVE DESCRIPTION
Management Skill Set	Primarily skilled in managing diverse disciplines; capable of understanding details of significant factors in those disciplines integral to the program.
Engineering Skill Set	Highly expert in engineering disciplines; understands principles of other disciplines integral to development, production, and sustaining activities.
Logistic Skill Set	Highly skilled and having in-depth knowledge of the principles and practices of sustainment activity at both tactical locations, and in production and program management sites.
Procurement Skill Set	Procurement professional with detailed understanding of contracting principles and practices; capable of using technical inputs from other program skill sets to achieve procurement objectives.
Finance Skill Set	Deep understanding and knowledge of financial activities and capacity to use technical inputs from other program skills to achieve timely financial support for program activities.
Manufacturing Skill Set	Expert in technology and practice of manufacture both of singular items and production quantities of complex technical sub-systems and systems Capable of defining requirements for production facilities and individual production components for both "in-use" and "new" production techniques
User Skill Set	Seasoned, skilled in theory and practice of military tactical operations. Capable of translating tactical understanding into useful input for program office team specialists to help define policies and actions which keep the program focused on its military objectives.

SKILLS REQUIRED FOR THE FUNCTIONAL ACQUISITION PROCESS

Table C-1

Participants felt that understanding the skill sets and their distribution throughout the process were essential to arrive at a proper organizational design. The information proved invaluable for that task.

C.2 SKILL SETS REQUIRED TO MOVE FROM IDEAS TO PROTOTYPE SYSTEMS

To make certain that each major aggregate functional/task group and each function/task within it was clearly understood by participants, each of the seven major aggregated functional/task groups and all 98 individual tasks within them was discussed in some detail.

Table C-2 shows the result of that work. In table C-2 as in the other tables which follow, abbreviated headings are used to label six of the skill sets. The headings are: (1) MGT for Management Skills; (2) ENG for Engineering Skills; (3) LOG for Logistic Skills; (4) PRO for Procurement Skills; (5) FIN for Finance Skills; (6) MFG for Manufacturing Skills. The abbreviation TOT is used to indicate the Total number of skill sets required.

Table C-2 indicates that User skill sets are extremely important in performing the functions/tasks which aggregate within the "Identify Need" and "Analyze Need and Define Program Objective" major functional/task groups. Two other skill sets are also of great importance in these aggregate functional areas: Engineering and Manufacturing skills were thought to be of secondary and tertiary importance.

Developing Acquisition Strategy and Implementing it requires about equal parts Management, Engineering, Manufacturing and Procurement skills, and while User skills are very important, they do not dominate the process.

Table C-3 summarizes the skill set analysis reported in detail in table C-2.

C.3 SKILL SETS REQUIRED TO MOVE FROM PROTOTYPICAL SYSTEMS TO FULLY SUPPORTED, DEPLOYED SYSTEMS

The procedure which determined the skill sets necessary to move from ideas to prototypical systems was used again to analyze skill sets required to perform functions essential to all aspects of the aggregate functional groupings.

Table C-4 analyzes the skill sets required to perform the Pre-Production functions/tasks; Table C-5 does the same for the Production functions/tasks. Similarly, table C-6 presents the skill set analysis for functions/tasks necessary to accomplish deployment,

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
CATEGORY A - IDENTIFY NEED								
1. Clearly defined need							X	1
16. Develop application scenarios							X	1
21. Define R&M requirements			X					1
24. Defining integrated system boundaries		X	X			X	X	4
44. Initial validation of need							X	1
50. Include training and simulation							X	1
82. Identify/define interfaces		X	X			X	X	4
93. Evaluate counter measures							X	1
104. Joint service/multi-national considerations	X						X	2
CATEGORY B - ANALYZE NEED AND DEFINE PROGRAM OBJECTIVE								
6. Define program objective				X			X	2
7. Analyze/evaluate need		X					X	2
9. Review existing and required technologies		X						1
17. Begin research on new technology		X						1
32. Second order effects (technology)		X						1
38. Identify most critical materials, parts, human interfaces, ILS, manufacturing processes, automation, etc.		X	X			X		3
39. Evaluate operational and educational requirements		X	X			X	X	4
55. Prepare acquisition budget	X	X	X	X	X	X	X	7
90. Consider rationalization, standardization, inter-operability (RSI) needs	X	X	X		X	X	X	6
91. Understand the operational environment	X					X	X	3
102. First cut definition of production quantities	X	X				X	X	4
107. Perform cost trade-off study	X	X	X	X		X	X	6
114. Verification of need							X	1
115. Verification of technical approach		X				X		2
116. Develop technical approach (response)		X				X		2
122. Determine if there is an appropriate industrial base available	X	X				X		3

SKILL SETS REQUIRED TO MOVE FROM IDEAS TO PROTOTYPES

Table C-2

FUNCTIONAL/TASK GROUPS		MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
CATEGORY C - DEVELOP ACQUISITION STRATEGY									
4.	Up-front risk evaluation		X	X	X	X	X	X	6
14.	Organize design team	X	X	X	X	X	X	X	7
20.	Evaluate opportunities for inserting new technology		X				X		2
26.	Select supplier sector		X		X		X		4
27.	Determine stage for technology freeze	X	X				X		2
37.	Sell proposal	X			X			X	3
41.	Select type of contract	X			X				2
48.	Decide whether to establish competition	X	X		X	X	X		5
52.	Life cycle costing		X	X			X		3
60.	Test proposal	X	X		X		X		4
68.	Option to form operational experimental unit	X	X	X			X	X	5
69.	Design of demonstration process	X	X				X	X	4
85.	Consider external federal, state and local legal constraints		X		X		X		3
86.	Consider socio-economic burdens on performance	X	X	X			X	X	4
96.	Organize program management team	X	X	X	X		X	X	6
97.	Finalize acquisition strategy	X	X	X	X	X	X	X	7
117.	Develop the essential elements of information	X			X			X	3
118.	Program manager approves acquisition strategy	X			X	X	X	X	5
CATEGORY D - IMPLEMENT STRATEGY									
2.	Contract definition	X			X	X			3
3.	Define the technical specs and concept of system integration		X	X			X	X	4
10.	Write statement of work		X				X		2
18.	Contractor propose price	X	X				X		3
31.	Tell industry what is needed, heavy on performance and light on military specs		X				X		2
53.	Consider multiple prime associate contractors	X	X		X		X		4
58.	Establish protest and dispute resolution process	X			X				2
61.	Maximize use of industry best practices		X				X		2
62.	Establish change procedure and authority	X	X		X		X		4

SKILL SETS REQUIRED TO MOVE FROM IDEAS TO PROTOTYPES

Table C-2 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
CATEGORY D - IMPLEMENT STRATEGY (Continued)								
67. Establish configuration control process and accountability	X	X	X	X		X		5
71. Define buyer involvement in performance (oversight, inspection, GFE, GFP, facilitization, whole system integration)	X			X				2
75. Define intellectual property rights				X				1
76. Demonstrate the idea		X	X			X	X	4
78. Define rights and obligations which survive delivery and acceptance	X			X				2
79. Ensure system sustainment and infrastructure needs		X	X	X			X	5
80. Determine payment process				X	X			2
83. Define applicable ground rules (FAR, DFAR)	X			X				2
88. Establish make or buy decision process		X	X	X		X		4
95. Consider business risk of contractor	X	X	X		X			4
99. Communicate need effectively to industry	X	X	X	X		X	X	6
105. Industrial base viability (keep company alive)	X			X	X			3
108. Incentive sanctions (carrot & stick)	X			X	X			3
109. Government analysis of contract price	X	X	X	X	X	X		6
110. Contract negotiation and award	X			X	X			3
111. Source selection	X	X	X	X		X	X	6
CATEGORY E - DESIGN, TEST, & EVALUATION (DOING)								
11. Create a (paper) design		X				X		2
12. Performance evaluation		X				X	X	3
15. Demonstrate technology		X	X			X		3
19. Build a mockup/model		X				X		2
23. Independently test and evaluate (technology) demonstrator	X	X	X			X	X	5
25. Test to the revalidated need		X				X	X	3
28. Evaluate producibility		X				X		2
30. Reassess concept	X	X	X			X	X	5
35. Fabricate the experimental prototypes		X				X		2
42. Test and evaluate the experimental prototypes		X				X		2
45. Use pre-prod model for final test evaluation	X	X	X			X	X	5

SKILL SETS REQUIRED TO MOVE FROM IDEAS TO PROTOTYPES

Table C-2 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
CATEGORY E - DESIGN, TEST, & EVALUATION (DOING)								
54. Build the operational prototypes		X				X		2
57. Design organizational and management support for operational system	X	X	X			X	X	5
59. Test and evaluate operational prototypes and system integration	X	X	X			X	X	5
64. Organize engineering team	X	X	X			X		4
66. Feasibility testing		X	X			X		4
73. Produce engineering unit		X				X	X	2
81. Continuous control: schedules, performance relative to goal, cost and budget, and risk assessment	X	X				X		3
98. Execute and refine the demonstration process	X	X	X			X	X	5
CATEGORY F - DEVELOP OUTPUT								
12. Performance evaluation	X	X					X	3
13. Complete "build to" packages		X	X					2
33. Complete design of tooling		X				X		2
40. Complete production engineering data		X				X		2
50. Define production quantities	X	X			X	X	X	5
72. Make go - no go production decision	X	X	X	X	X	X	X	7
81. Continuous control: schedules, performance relative to goal, cost and budget, and risk assessment	X	X		X	X	X		5
98. Execute and refine the demonstration process	X	X	X			X	X	5
CATEGORY G - CONTINUOUS MANAGEMENT FUNCTIONS								
43. Assign responsibility for congressional liaison	X						X	2
56. Use seamless program management including major decisions minimizing program delay	X	X		X	X	X		5
84. Assign public information responsibility	X							1
120. Provide essential elements of program information routinely to "decision makers"	X						X	2
121. Continuous review of program by program manager - still viable? (e.g., Need, technology, cost effectiveness)	X	X	X	X	X	X	X	7

SKILL SETS REQUIRED TO MOVE FROM IDEAS TO PROTOTYPES

Table C-2 (Concluded)

ACQUISITION PROCESS FUNCTIONAL/TASK GROUPS	MANAGEMENT	ENGINEERING	LOGISTICS	PROCUREMENT	FINANCE	MANUFACTURING	USER	CATEGORY TOTAL
CATEGORY A -IDENTIFY NEED	1	2	3	0	0	2	8	16
CATEGORY B - ANALYZE NEED AND DEFINE PROGRAM OBJECTIVE	6	13	4	3	2	10	9	48
CATEGORY C - DEVELOP ACQUISITION STRATEGY	13	14	7	12	5	15	10	76
CATEGORY D - IMPLEMENT STRATEGY	16	15	9	18	7	13	5	83
CATEGORY E - DESIGN, TEST, AND EVALUATION (DOING)	8	19	9	0	0	19	9	64
CATEGORY F - DEVELOP OUTPUT	5	8	3	2	3	6	4	31
CATEGORY G - CONTINUOUS MANAGEMENT FUNCTIONS	5	2	1	2	2	2	3	17
GRAND TOTAL	54	73	37	37	19	67	48	335

SKILL SETS REQUIRED TO MOVE FROM IDEAS TO PROTOTYPES

Table C-3

and finally, Table C-7 details of the skill sets necessary for system sustainment in the field. Participants noted their ideas about organizational attributes at the conclusion of Tables where they believed those ideas should appear.

Table C-8 summarizes the distribution of skill sets participants thought necessary to discharge the responsibilities involved in moving from Prototype systems to operational, supported weapon systems. Participants realized the possibility that their functional analyses might not have been inclusive of everything involved in moving from prototype

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
REQUIREMENTS DEFINITION								
1. Verify the operational requirements document							X	1
11. Determine if requirements are based on user requirements	X						X	2
75. Revalidate jointness and interoperability requirements	X						X	2
150. Review and update the survivability plan and requirements		X	X				X	3
154. Establish IOC definition and date	X						X	2
187. Re-examine linkage to national strategy	X						X	2
204. Determine system service life and final disposition plans			X				X	2
DESIGN DEFINITION								
2. Synthesize, simplify and pursue integration in the design		X						1
4. Determine the differences or shortfalls between the prototype and the item to be fielded	X	X						2
5. Review allocations of functions between hardware, software, and operations		X						1
7. Achieve design stability - verify that design meets performance/operational requirements	X	X	X				X	4
17. Pursue reusable, reapplicable modular approaches to support environment (i.e., do not give a new set of test equipment, etc)			X					1
22. Complete the required engineering drawing package		X						1
25. Refine and finalize required systems specifications	X							1
27. Define factory test equipment						X		1
29. Decide on modularity and assembly requirements			X			X		2
35. Review/revalidate systems interfaces		X						1
36. Review human factors engineering		X	X					2
50. Review safety considerations and factors		X						1
58. Decide limits on system and solution adaptability		X	X					2
63. Factor in changes resulting from use of prototype		X	X					2
64. Prepare/Design for technology transfer/insertion	X	X						2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS
PRE-PRODUCTION FUNCTIONS
Table C-4

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
DESIGN DEFINITION (Continued)								
79. Review total design to disposal environmental impacts	X	X	X			X		4
82. Review operational test and evaluation results and integrate into current design		X	X				X	3
90. Streamline and tailor Mil-Standards, etc	X	X	X					3
91. Tolerance analysis and system integrity programs		X	X					2
96. Update "Build-To" package, tooling design and production engineering data		X				X		2
100. Design and procure/produce support equipment		X	X					2
104. Incorporate standards where appropriate	X	X	X	X				4
111. Utilize Willoughby templates/best practices in transition from development to production	X	X		X				3
114. Verify that the proposed design meets the performance, operability, supportability, and producability requirements	X	X	X			X		4
121. Develop Management Reserve Requirements	X				X			2
124. Develop/review electromagnetic pulse hardening		X	X					2
129. Review and update electromagnetic compatibility and radio frequency management plan		X						1
142. Use design to cost techniques	X	X			X			3
176. Require built-in diagnostic features and performance		X	X					2
188. Approve prime's off-shore manufacturing sourcing	X		X			X		3
193. Finalize multi-national co-production agreement if applicable	X					X		2
199. Determine usability of prototype data package	X	X	X	X				4
209. Define parts/supportable module list			X					1
231. Obtain production package		X		X				2
232. Satisfactorily complete critical design	X	X	X					3
236. Require software architecture index and modification road map			X					1
244. Analyze the value of follow-on prototypes	X						X	2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS
PRE-PRODUCTION FUNCTIONS

Table C-4 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
ACQUISITION STRATEGY								
13. Develop procurement strategy	X			X				2
18. Determine if technology is releasable in foreign sales	X	X						2
24. Define production quantities	X							1
38. Create and implement skill recruitment/retention strategy	X							1
47. Incentive to get organic support early when appropriate	X		X					2
48. Develop P^3I program	X	X						2
51. Develop a foreign military sales plan	X							1
53. Create and implement contractual basis for continuing prime and subcontractor commitment (assuming a gap between development and production	X			X				2
62. Develop make or buy plan	X	X	X					3
69. Develop rate of production strategy	X					X		2
73. Plan for changing program contingencies				X				1
84. Develop Government Furnished Properties strategy/plan	X	X	X	X				4
93. Review/refine intellectual property rights	X			X				2
108. Determine industrial base implications	X							1
126. Draft RFP proposal page limitation and set up bidder's conference	X			X				2
138. Establish warranty criteria and administration plan	X			X				2
140. Understand and plan for small business set-aside	X			X				2
143. Establish make/buy decision process	X							1
147. Review type of classification requirements (standard vs limited production) to develop test and support strategy	X							1
151. Determine interim contractor support (ICS) requirements			X					1
162. Review and re-establish acquisition strategy	X			X				2
163. Complete dual source and competition analysis				X				1
170. Establish source selection criteria, weighting, and organize source selection authority	X			X				2
174. Generate block update plan/program	X	X						2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS PRE-PRODUCTION FUNCTIONS

Table C-4 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
ACQUISITION STRATEGY (Concluded)								
179. Develop production contract negotiation strategy	X			X				2
195. Determine contract vehicle	X			X				2
206. Determine acceptability/reliability of foreign supply sources	X	X		X		X	X	5
207. Establish funding schedule relative to political environment	X							1
226. Determine global industrial base implications	X	X		X				3
242. Comply with "Buy American" act	X			X				2
246. Consider incorporation of programmatic initiatives	X							1
PRODUCTION PLANNING								
6. Analyze producibility						X		1
8. Analyze skill, facility, sub-contractor support and tooling availability	X					X		2
12. Prepare up-to-date manufacturing plan						X		1
14. Establish in-house production/sub-contractor mix	X					X		2
39. Determine long lead item release						X		1
40. Complete manufacturing environmental impact statement	X					X		2
81. Complete production security and system security plans						X		1
106. Develop the production management organization	X					X		2
108. Determine U.S. industrial base implications	X					X		2
130. Make soft vs. hard tools decision						X		1
194. Establish automated (Just-In-Time) inventory control system						X		1
212. Estimate minimum economical sustaining production rate						X		1
241. Determine strategic raw material and resources						X		1
LOGISTIC PLANNING								
21. Review the training requirements			X					1
28. Define the skills operators need		X	X					2
32. Define/refine approach to logistic support	X		X					2
43. Establish maintenance philosophy	X		X					2
61. Determine sources of logistic support			X					1

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS
PRE-PRODUCTION FUNCTIONS
Table C-4 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
LOGISTIC PLANNING (Continued)								
80. Determine media for technical and maintenance data (paper or digital)			X					1
109. Develop a combat damage assessment and repair program		X	X				X	3
110. Determine initial spares and support equipment requirements			X					1
112. Develop maintenance program			X					1
120. Develop and implement depot activation plans including review of SERDS			X					1
134. Program for factory training to depot and field personnel			X					1
138. Establish warranty criteria and administration plan		X	X				X	3
177. Update computer life cycle management plan and designate software support activities	X		X	X			X	4
184. Establish a failure data collection and analysis system			X				X	2
186. Conduct ILS planning			X					1
196. Develop and implement a post deployment software support plan			X					1
217. Determine program depot maintenance intervals and develop depot works packages including system/item integrity inspection points			X				X	2
238. Plan for generation and validation of service and maintenance manuals			X				X	2
239. Plan provisioning for fielding support			X				X	2
TECHNICAL DEVELOPMENT								
3. Determine that the technology is still current		X						1
160. Review state of the art		X						1
VERIFY AND VALIDATE								
10. Finalize the TEMP	X	X						2
34. Validate the software production plan		X						1
41. Prepare system integration and test plan		X						1
113. Establish production acceptance testing criteria		X						1
149. Determine Independent Verification and Validation (IVV) Requirements		X						1
216. Establish IVV/Certification requirements		X						1
218. Define operational test and evaluation (OTE) requirement		X						1

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS PRE-PRODUCTION FUNCTIONS

Table C-4 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
CONTINUOUS								
19. Re-assess operational suitability	X		X				X	3
55. Review and up-date life cycle cost analysis	X		X		X			3
80. Determine if the schedule is realistic	X							1
73. Plan for changing program contingencies	X		X					2
86. Maintain "As Built" configuration	X	X						2
107. Manage solution integrity	X	X					X	3
121. Develop management reserve requirements	X				X			2
122. Review lessons learned to improve/simplify processes	X	X	X	X		X		5
123. Update/refine sales/liaison communications strategy (Congress, DoD)	X							1
145. Develop and maintain a requirements/specifications audit trail								
169. Conduct source selection and award production contract	X	X	X	X				4
175. Apply TQM		X			X			2
122. Maintain status of essential elements of program information	X	X	X	X	X	X	X	7
211. Establish Congressional and media liaison	X	X	X	X	X		X	6
212. Estimate minimum economical sustaining production rate	X							1
213. Project estimated weapon systems management, maintenance and support costs to users	X		X		X		X	4
214. Continuously perform risk analysis	X	X	X	X	X	X	X	7
222. Establish exit criteria	X							1
234. Periodically verify program viability	X		X				X	3
243. Appropriate liaison/coordination with matrix functions (e.g., legal)	X							1
QUALITY								
155. Review and update quality assurance plan	X					X		2
186. Implement measurement system to demonstrate meeting quality assurance plan	X					X		2
MANAGEMENT								
20. Review and implement risk management plan	X	X						2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS
PRE-PRODUCTION FUNCTIONS

Table C-4 (Continued)

FUNCTIONAL/TASK GROUPS		MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
MANAGEMENT (Continued)									
26.	Perform production readiness reviews	X	X				X		3
31.	Concur in Go-No-Go decision (Block 72)	X						X	2
33.	Determine system affordability	X	X	X				X	4
48.	Determine if funding is available	X				X			2
59.	Agree on documentation and requirements	X	X	X					3
60.	Develop if the schedule is realistic	X	X						2
65.	Determine the requirement for follow-on prototypes		X	X				X	3
66.	Obtain funding necessary to execute directed program	X						X	2
67.	Establish/re-organize Project Management Office (PMO)	X	X	X	X	X	X	X	7
70.	Review and update configuration management plan	X	X	X					3
85.	Develop a plan for audits	X				X			2
87.	Train the trainers	X		X			X		3
94.	Review/develop an engineering program	X	X						2
95.	Complete the acquisition program baseline	X				X			2
99.	Establish production program master schedule	X	X			X	X	X	5
101.	Establish essential elements of program information	X							1
116.	Develop production budget	X				X			2
117.	Create an integrated documentation/communication network	X							1
119.	Verify that all acquisition documentation is approved and current	X							1
121.	Develop management reserve requirements	X				X			2
125.	Obtain approval to award production contract	X			X				2
127.	Prepare Commerce Business Daily (CBD) announcement	X			X				2
133.	Determine when procurement starts for procurement IA law	X			X				2
136.	Plan for real users to test and validate the system	X					X	X	3
137.	Obtain required waivers	X							1
141.	Review and update system safety plan	X	X	X				X	4
148.	Monitor status and manage dependencies with associated acquisitions	X	X	X					3
152.	Perform independent cost analysis	X				X			2
158.	Coordinate Defense Advanced Project Agency (DARPA) involvement	X	X						2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS PRE-PRODUCTION FUNCTIONS

Table C-4 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
MANAGEMENT (Concluded)								
161. Define contractor data requirements list	X	X	X					3
165. Establish program management team	X	X	X	X	X	X	X	7
167. Establish a cost surveillance system	X				X			2
169. Conduct source selection and award production contract	X			X				2
172. Establish a technical performance measurement/monitoring system	X	X						2
178. Establish a configuration control board	X							1
180. Obtain multi-year procurement authority	X							1
181. Develop security classification guidelines if required	X							1
182. Maintain status of essential elements of program information	X	X	X	X	X	X	X	7
183. Provide the contractor with approximate funding limitations	X				X			2
195. Determine the contract vehicle	X		X			X		3
197. Establish/update CAD/CAM plan	X		X			X		3
201. Implement contractor performance assessment and reporting system	X			X		X		3
202. Augment CAD/CAM plan with integrated computer aided software engineering tools (etc.) to provide integrated data for program participants	X	X	X			X		4
203. Establish cost schedule controlled system	X				X			2
208. Determine acceptability/reliability of foreign supply sources	X	X	X			X		4
210. Obtain and validate work breakdown structure		X					X	2
211. Establish Congressional and media liaison	X							1
213. Project estimated user system management, maintenance and support costs	X	X	X		X	X	X	6
220. Establish end-item sales prices for users	X		X		X			3
222. Establish exit criteria	X							1
223. Develop Production contract	X			X				2
224. Preserve essential program knowledge	X							1
227. Define and establish relationships between contractors and PMO, DCMS	X			X				2
230. Develop or validate risk management plan	X	X	X					3
245. Develop trade-off analysis in cost, schedule and performance	X	X	X		X	X		5
254. Develop the procurement and deployment plan	X	X	X				X	4

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS
PRE-PRODUCTION FUNCTIONS
Table C-4 (Concluded)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
***GEAR UP** - PREPARE PHASE*								
12. Prepare/update manufacturing plan						X		1
54. Complete quality assurance plan	X		X			X		3
81. Complete production security & systems security plans	X							1
98. Approve subcontractor competition plan	X			X				2
104. Incorporate standards where appropriate		X				X		2
105. Build a sustaining engineering plan with the prime contractor	X	X						2
106. Develop the production management organization	X							1
201. Implement contractor performance assessment and reporting system	X			X		X		3
203. Establish cost schedule controlled system	X					X		2
210. Obtain and validate a work breakdown structure		X	X					2
215. Staff and facilitize program office for production phase	X	X		X		X		4
255. Accommodate multi-national co-production agreements	X					X		2
***GEAR UP** - DO PHASE*								
15. Hire/transfer/train/certify workforce						X		1
30. Subsystems to support tooling				X		X		2
57. Establish production facility	X					X		2
74. Order raw material and contract with subcontractors				X		X		2
102. Put into place procurement-inventory control system						X		1
103. Establish support organizations to aid the manufacturing process	X					X		2
194. Establish automated (JIT) inventory control system						X		1
249. Qualify suppliers/vendors				X		X		2
***GEAR UP** - REVIEW PHASE*								
9. Reexamine critical materials, parts, human interfaces, ifs, manufacturing processes, automation, etc.	X					X		2
26. Perform production readiness reviews	X					X		2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS PRODUCTION FUNCTIONS

Table C-5

FUNCTIONAL/TASK GROUPS		MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
EXECUTION - *INITIAL (Continued)*									
89.	Monitor and measure manufacturing process for quality						X		1
132.	Resolve problems during manufacturing process						X		1
164.	Review critical parts availability				X		X		2
205	Establish the initial training program			X					1
EXECUTION - *INTERMEDIATE*									
45.	Document training & validate training plan, equipment and software			X					1
92.	Establish installation and transition plan	X							1
133.	Determine when procurement starts for procurement IA law			X					1
225.	Generate and validate user operational manuals		X					X	2
259.	Produce it						X		1
EXECUTION - *FINAL*									
86.	Maintain "As Built" Configuration		X						1
113.	Establish production acceptance testing criteria	X	X						2
173.	Establish field introducton team			X					1
191.	Conduct physical configuration audit	X					X		2
200.	Upgrade of prototypes to production configuration if appropriate						X		1
258.	Produce mission critical computing resources			X				X	2
EXECUTION - *CONTINUOUS*									
56.	Maintain parts program			X					1
89.	Monitor and measure manufacturing process for quality						X		1
135.	Execute plans to build, field, and support systems/product	X							1
248.	Accept material				X		X		2
TEST - *DEVELOPMENT TESTING*									
42.	Order raw material and subcontracted complete R&M tests			X					1
229.	Review and update electromagnetic compatibility, RF management plan	X							1
237.	Validate software architecture index and modification road map		X	X					2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS PRODUCTION FUNCTIONS

Table C-5 (Continued)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
TEST *- FIRST ARTICLE TESTING*								
131. Perform first article tests						X		1
190. Perform operational T&E							X	1
TEST *- ON-GOING PRODUCTION TESTING*								
97. Perform the production qualification test						X		1
(Feed forward to training and deployment)								
DELIVER								
156. Perform verification/certification of product						X		1
247. Accept product	X		X			X		3
(Feed back to the Execution Functions)								
(Feed forward to the Sustaining Functions)								
SUPPORT								
76. Ensure appropriate access to, usability and portability of essential data	X		X					2
120. Develop and implement depot activation plans (incl. SERDS review)			X					1
219. Project estimated requirements to revolving stock funds			X					1
228. Define and establish relationships with supporting inventory control points			X					1
251. Initiate provisioning for fielding support			X					1
PROGRAM MANAGEMENT FUNCTIONS								
20. Review and implement risk management plan	X					X		2
46. Determine if funding is available	X				X			2
59. Agree on delivery documentation & requirements	X		X			X		3
66. Obtain funding necessary to execute directed program	X				X			2
67. Reorganize/reestablish PMO	X	X	X	X		X		5
70. Review and update configuration management plan	X	X	X			X		4
76. Ensure appropriate access to, usability and portability of essential data	X	X				X		3
94. Review/develop a value engineering program	X	X				X		3

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS
PRODUCTION FUNCTIONS

Table C-5 (Continued)

FUNCTIONAL/TASK GROUPS		MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
PROGRAM MANAGEMENT FUNCTIONS (Concluded)									
119.	Verify that all acquisition documentation is approved and current	X							1
121.	Develop management reserve requirements	X	X				X		3
135.	Execute plans to build, field, and support systems/product	X		X			X		3
139.	Make fielding release decision	X						X	2
141.	Review and update system safety plan	X	X						2
148.	Monitor status and manage dependencies with associated acquisitions	X							1
152.	Perform independent cost analysis	X				X	X		3
161.	Define contractor data requirements list	X	X	X					3
169.	Conduct source selection and award production contract	X			X				2
182.	Maintain status of essential elements of program information	X	X	X			X		4
183.	Provide the contractor with approximate funding limitations	X			X	X			3
201.	Implement contractor performance assessment and reporting system	X					X		2
202.	Augment cad/cam plan with integrated computer aided software engineering tools etc., To provide integrated data for program participants	X	X				X		3
210.	Obtain and validate work breakdown structure		X	X			X		3
213.	Project estimated weapons system management, maintenance and support costs to users	X		X		X			3
222.	Establish exit criteria	X					X		2
224.	Preserve essential program knowledge	X					X		2
230.	Develop or validate risk management plan	X	X	X			X		4
231.	Obtain production package	X					X		2
245.	Develop trade-off analysis in cost, schedule and performance	X	X	X		X	X		5

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS PRODUCTION FUNCTIONS

Table C-5 (Concluded)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
SYSTEM								
72. Introduce product into field	X							1
86. Maintain "As Built" configuration		X						1
144. Integrate product into inventory/force structure				X				1
152. Transport product into field			X					1
FINAL OPERATIONAL TEST AND EVALUATION								
19. Reassess operational suitability	X	X					X	3
36. Review the human factors engineering		X					X	2
82. Review operational test and evaluation results and integrate into current design		X						1
TRAINING								
21. Review the training requirements			X				X	2
28. Define the skills operators need			X				X	2
87. Train the trainers		X	X					2
118. Train service personnel to operate and maintain product			X					1
157. Conduct mission training/war games			X				X	2
235. Provide for the skills operators need			X				X	2
240. Provide factory training to depot and field personnel			X			X		2
258. Deploy training software (firmware) and equipment			X					1
FACILITIES								
146. Develop and implement site activation plans			X				X	2
166. Establish and maintain product at operational bases			X				X	2
SUPPORT - EQUIPMENT								
83. Perform provisioning for fielding support			X					1
192. Put mission critical computing resources into place			X					1

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS DEPLOYMENT FUNCTIONS

Table C-6

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
SUPPORT - *SPARE PARTS*								
56. Maintain parts program			X					1
219. Project estimated requirements to revolving stock funds			X					1
228. Define and establish relationships with supporting inventory control points			X					1
251. Initiate provisioning for fielding support			X					1
INTERNAL CONTINUOUS MANAGEMENT - *DOCUMENTATION*								
76. Ensure appropriate access to, usability and portability of essential data	X		X				X	3
80. Determine the media for technical and maintenance data, paper or digital	X	X	X	X		X	X	6
INTERNAL CONTINUOUS MANAGEMENT - *SOFTWARE*								
196. Develop and implement a post deployment software support plan		X	X					2
250. Continuous software management		X	X				X	3
INTERNAL CONTINUOUS MANAGEMENT - *DATA COLLECTION*								
109. Develop a combat damage assessment and repair program		X	X				X	4
184. Establish a failure data collection and analysis system	X	X	X				X	3
INTERNAL CONTINUOUS MANAGEMENT - *DECISIONS*								
92. Establish installation and transition plan	X							1
139. Make fielding release decision	X						X	2
EXTERNAL AND OTHER CONTINUOUS MANAGEMENT FUNCTIONS								
20. Review and implement risk management plan	X						X	1
23. Review state of existing contractual agreements								
44. Design modification procedure and evaluate modification scope	X	X	X				X	4
46. Determine if funding is available	X				X			2
60. Determine if the schedule is realistic	X		X				X	3
66. Obtain funding necessary to execute directed program	X						X	2
67. Reorganize/reestablish PMO	X	X	X	X	X	X		6
70. Review and update configuration management plan	X	X						2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS DEPLOYMENT FUNCTIONS

Table C-6 (Continued)

FUNCTIONAL/TASK GROUPS		MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
EXTERNAL AND OTHER CONTINUOUS MANAGEMENT FUNCTIONS									
76.	Ensure appropriate access to, usability and portability of essential data	X		X				X	3
119.	Verify that all acquisition documentation is approved and current	X		X					2
121.	Develop management reserve requirements	X	X				X		3
135.	Execute plans to build, field, and support systems/product	X		X				X	3
141.	Review and update system safety plan	X	X						2
148.	Monitor status and manage dependencies with associated acquisitions	X	X	X					3
152.	Perform independent cost analysis	X	X	X	X	X	X	X	7
161.	Define contractor data requirements list	X	X	X				X	4
182.	Maintain status of essential elements of program information	X							1
183.	Provide the contractor with approximate funding limitations	X				X			2
213.	Project estimated weapons system management, maintenance and support costs to users	X		X				X	3
222.	Establish exit criteria	X						X	2
224.	Preserve essential program knowledge	X	X	X	X		X	X	6
230.	Develop or validate risk management plan	X	X	X				X	4
233.	Organize to and sustain the system/product/commodity/item	X		X				X	3
245.	Develop trade-off analysis in cost, schedule and performance	X	X	X		X	X	X	6

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS DEPLOYMENT FUNCTIONS

Table C-6 (Concluded)

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
SUPPORT/REFURBISH *- BUY PARTS AND SERVICES*								
23. Review state of existing contractual agreements	X			X				2
93. Review/refine intellectual data requirements/rights		X	X	X				3
104. Incorporate standards where appropriate	X			X				2
170. Establish source selection criteria, weighting and organize source selection authority	X			X		X		3
SUPPORT/REFURBISH *- OVERALL*								
32. Define/refine approach to logistic support			X					1
SUPPORT/REFURBISH *- GENERAL*								
56. Maintain parts program			X					1
151. Determine interim contractor support (ICS) requirements				X				1
159. Provision for and catalog spares, including creation of the master item support list (MISL)			X					1
219. Project estimated requirements to revolving stock funds			X					1
237. Validate software architecture index and modification road map		X	X					2
253. Install the field changes			X				X	2
260. React to fielded items failures	X	X	X					3
MONITOR PERFORMANCE								
19. Reassess operational suitability	X		X				X	3
21. Review the training requirements			X					1
35. Review/revalidate systems interfaces		X	X					2
36. Review the human factors engineering		X					X	2
82. Review operational test and evaluation results and integrate into current design	X	X	X					3
153. Monitor fielded items failures	X	X	X				X	4
160. Review state of the art	X	X						2

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS SUSTAINMENT FUNCTIONS

Table C-7

FUNCTIONAL/TASK GROUPS	MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
UPDATE								
70. Review and update configuration management plan	X	X						2
174. Generate block update plan/program	X	X	X					3
RETIRE								
183. Provide the contractor with approximate funding limitations	X							1
221. Deactivate product/item		X		X				2
CONTINUOUS								
152. Perform independent cost analysis	X				X			2
235. Provide for the skills operators need			X				X	2
257. Validate component rework/repair procedures			X			X		2
MANAGEMENT								
20. Review and implement risk management plan	X	X	X					3
44. Design modification procedure and evaluate modification scope	X	X	X				X	4
46. Determine if funding is available	X				X		X	3
60. Determine if the schedule is realistic	X		X				X	3
66. Obtain funding necessary to execute directed program	X						X	2
67. Reorganize/reestablish PMO	X			X	X			3
70. Review and update configuration management plan	X	X	X					3
76. Ensure appropriate access to, usability and portability of essential data	X	X	X				X	4
88. Design a phasing-out process	X		X				X	3
94. Review/develop a value engineering program	X	X						2
119. Verify that all acquisition documentation is approved and current	X		X					2
121. Develop management reserve requirements	X		X					2
135. Execute plans to build, field, and support systems/product			X					1
141. Review and update system safety plan	X	X	X				X	4
148, Monitor status and manage dependencies with associated acquisitions	X	X	X				X	4
152. Perform independent cost analysis	X		X		X		X	4

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS SUSTAINMENT FUNCTIONS

Table C-7 (Continued)

FUNCTIONAL/TASK GROUPS		MGT	ENG	LOG	PRO	FIN	MFG	USER	TOT
MANAGEMENT (Concluded)									
161.	Define contractor data requirements list	X	X	X					3
182	Maintain status of essential elements of program information	X		X					2
183.	Provide the contractor with approximate funding limitations	X							1
201.	Implement contractor performance assessment and reporting system	X			X		X		3
213.	Project estimated weapons system management, maintenance and support costs to users	X		X		X			3
222.	Establish exit criteria	X							1
220.	Establish end-item sales prices for users	X		X		X			3
224.	Preserve essential program knowledge	X	X	X		X	X	X	6
230.	Develop or validate risk management plan	X	X	X				X	4
245.	Develop trade-off analysis in cost, schedule and performance	X	X	X		X		X	5

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPES TO SUPPORTED SYSTEMS SUSTAINMENT FUNCTIONS

Table C-7 (Concluded)

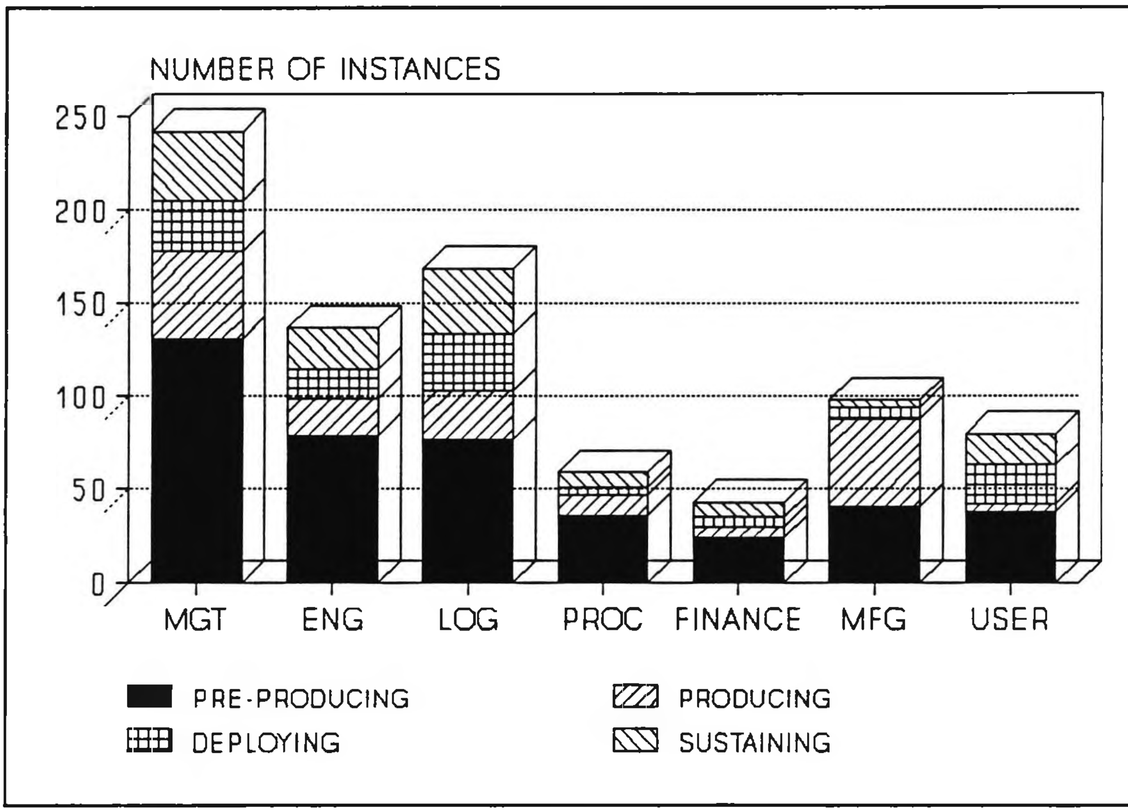
ACQUISITION PROCESS FUNCTIONAL/TASK GROUPS	MANAGEMENT	ENGINEERING	LOGISTICS	PROCUREMENT	FINANCE	MANUFACTURING	USER	CATEGORY TOTAL
PRE-PRODUCTION FUNCTIONS								
Requirement Definition	4	1	2	0	0	0	7	14
Design Definition	15	27	22	4	1	7	3	79
Acquisition Strategy	28	7	4	16	0	2	1	58
Production Planning	5	0	0	0	0	13	0	18
Logistic Planning	3	3	19	1	0	0	7	33
Technical Development	0	2	0	0	0	0	0	2
Verify/Validate	1	7	0	0	0	0	0	8
Quality	2	0	0	0	0	2	0	4
Continuous	18	8	10	5	7	3	7	58
Management	55	24	20	10	16	14	13	152
PRODUCTION FUNCTIONS								
Gear-up	13	4	2	6	0	17	0	42
Execute	4	3	6	2	0	8	2	25
Testing	1	1	2	0	0	2	1	7
Deliver	1	0	1	0	0	2	0	4
Support	1	0	5	0	0	0	0	6
Management	27	12	10	3	6	28	1	77
DEPLOYMENT FUNCTIONS								
System	1	1	1	1	0	0	0	4
Final Operational Testing	1	3	0	0	0	0	2	6
Training	0	1	8	0	0	1	4	14
Facility	0	0	2	0	0	0	0	2
Support	0	0	6	0	0	0	0	6
Internal Management	2	0	0	0	0	0	1	3
Management	23	11	14	3	5	5	14	75
SUSTAINMENT FUNCTIONS								
Support	4	3	8	5	0	1	1	22
Monitor	4	5	5	0	0	0	3	17
Update	2	2	1	0	0	0	0	5
Retire	1	1	0	1	0	0	0	3
Continuous	1	0	2	0	1	1	1	6
Management	25	11	19	2	7	2	12	78
GRAND TOTAL	243	137	169	59	43	98	80	828

SKILL SETS REQUIRED TO MOVE FROM PROTOTYPE TO FIELDED, SUPPORTED SYSTEM

Table C-8

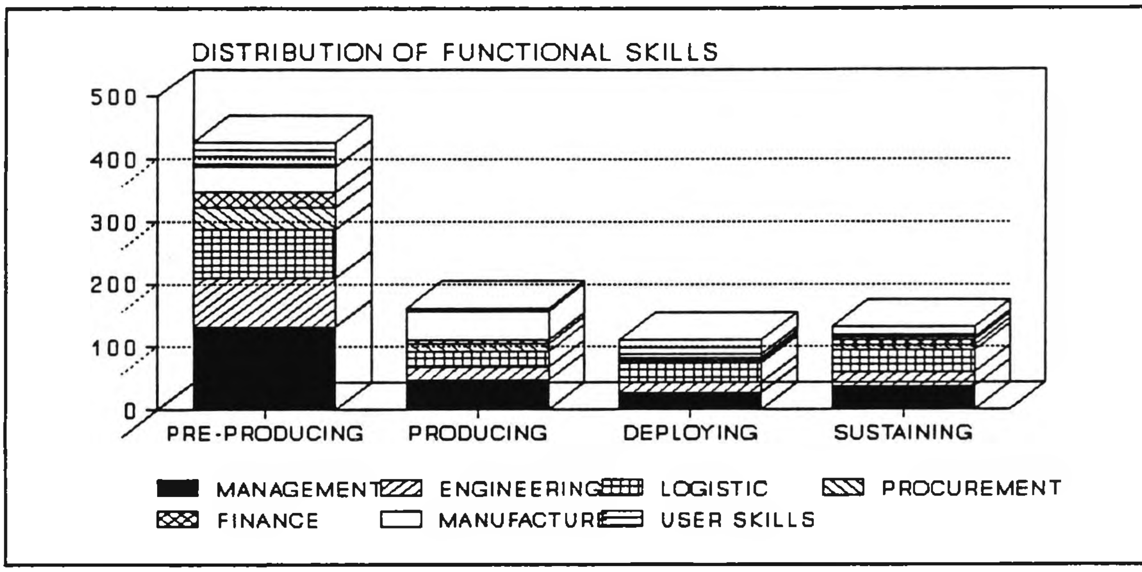
to fully supported deployed weapons, and that the level of activity within one functional statement might be inclusive of some others. That notwithstanding, there was agreement that the analytical results were thought provoking.

Participants decided to use the functional data in graphical analysis. Three graphics were created: (1) A plot of the number of each type of skill set required to perform all functions in each of the four major functional aggregate groups; (2) A plot of the way that number of skill sets was distributed within each major functional aggregate group; and (3) A plot showing the percentage of each kind of skill set necessary to perform all functions within each major functional aggregate group. These plots are shown in Figures C-1, C-2, and C-3.



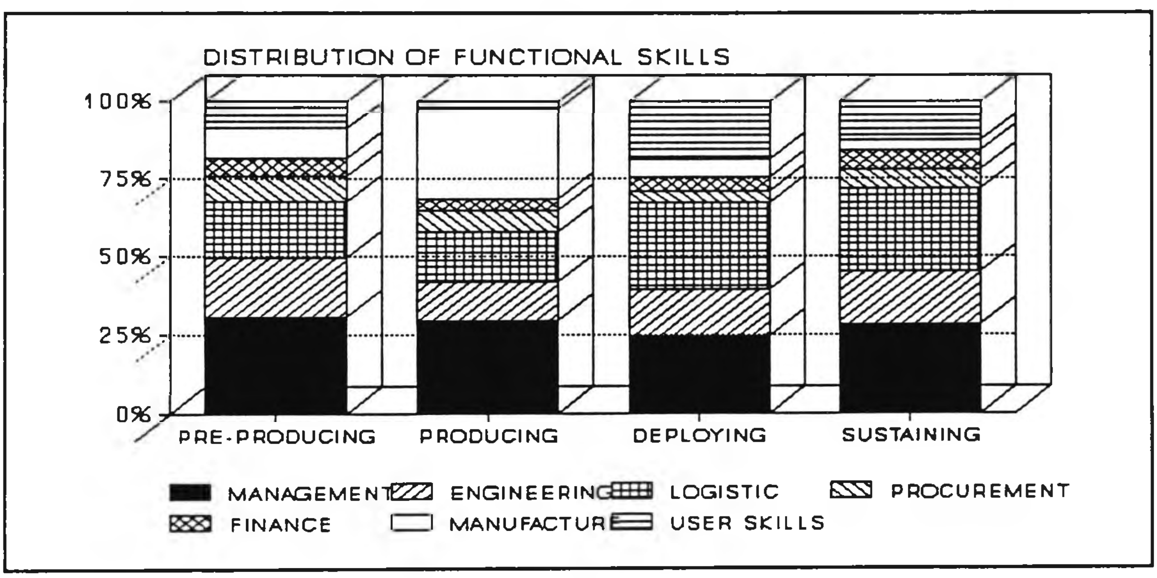
WHERE SKILL SETS ARE USED DURING THE PROCESS OF MOVING FROM PROTOTYPES TO SUPPORTED WEAPON SYSTEMS

Figure C-1



DISTRIBUTION OF SKILL SETS WITHIN MAJOR AGGREGATE FUNCTIONS GOING FROM PROTOTYPES TO SUPPORTED SYSTEMS

Figure C-2



SKILL SET DISTRIBUTION WITHIN MAJOR FUNCTIONAL AGGREGATE GROUPS - FROM PROTOTYPE TO SUPPORTED SYSTEMS

Figure C-3

C.4 IMPLICATIONS OF THE SKILL SET ANALYSIS

The skill-set analysis led participants to conclude that there would be need to configure the acquisition organization differently from its historic construct. As an example, since the skill mix required changed even while performing a single functional aggregate, they recognized the need to change leadership and organizational tenets over time. The need for rapid change caused them to recommend major configuration changes in both the acquisition process and the organization charged with performing that process. They believed that a singularly configured organization would not be a satisfactory solution for future acquisitions.

APPENDIX D
PREDICTING THE EFFICACY OF THE REDESIGNED ACQUISITION PROCESS TO SOLVE ACQUISITION PROBLEMS

This appendix: (1) Presents the conditions under which it was assumed the redesigned acquisition process would be used; (2) Presents the results of the inquiry into whether the redesigned process, when institutionalized, would solve each of the problems defined in previous workshops.

D.1 CONDITIONS UNDER WHICH THE REDESIGNED PROCESS WOULD BE EMPLOYED

The workshop met during the period 15-19 June 1992. It was the culmination of the process begun in 1988 to redesign the Defense Acquisition System. Previous workshops had: Defined and consolidated problems experienced by over 300 DoD and Contractor program managers; and (2) Defined an acquisition process specific to accommodation of those functions/tasks required to produce deployed, supported weapon systems. This was the last stage in the redesign process: and its purpose was to determine whether that functionally defined process would create an acquisition environment within which the previously defined problems would be precluded.

To help in this effort, participants were advised of the assumptions under which the redesigned acquisition process was developed:

1. Each phase will be fully funded without the need for annual re-justification.
2. It is assumed all programs will ultimately be managed using this process.
3. All funds allocated to the program are made available to program manager without categorization or time limitations.
4. The program manager reports directly to the acquisition decision authority.
5. DELETED. [Original statement was: "PM negotiates reporting requirements at the beginning of each phase"].
6. PM's charter will clearly state their responsibility to recommend without peril whether a prototype should go into production.
7. As used here, the word "Prototype" does not imply a production ready item but rather a proof of principle model.
8. Inspectors and auditors can only get involved at the three major decision points.
9. No reporting required external to the decision authority other than those required by law.
10. PM executes, <u>does not sell</u> the program.
11. PM has direct control of all program players except operational test [original item was: "PM has solid line relationship with all program players except operation test"].
12. There are only three decision points.

13. DELETED. [Original statement was: "The PM has unrestrained authority within DoD"].
14. No annual negotiations with comptroller. (Subsumed in assumption #1.)
15. PM has an authorized management reserve funding.
16. Decision points are event based.
17. DELETED. [Original statement was: "Apparent cost not driven total cost may be reduced but it would be serendipitous.]
18. Model does not address OSD staff organizations.
19. Deal with statutory regulations as a "yes, if..." (i.e., Assume that the regulations are applicable under certain conditions but can be abrogated if those conditions do not apply.)
20. Use of performance system specifications is presumed.

D.2 METHODOLOGY USED TO EVALUATE PROBABLE OUTCOME OF INSTITUTIONALIZING THE REDESIGNED ACQUISITION PROCESS

When participants felt they understood prior workshop details sufficiently, they began the process of determining ***serie item*** whether or not the new "System of Stewardship" would improve the lot of the people and organizations involved in the functional process of development. For this purpose, functional development is taken to include all of the steps indicated by prior workshops as being performed by Acquisition Managers in Program Offices, and by supporting personnel either within Government or Industry. Participants were asked to answer the following question:

> ***If a new acquisition system were installed which enabled efficient performance of functions defined by the TMAW workshops as necessary to move from ideas through prototypes to deployed, fully supported weapon systems, will that system likely eliminate situations such as those described by prior USD(A) and other workshops?***

Participants then reviewed all problem statements within the 20 problem areas defined by the previous workshops. Following that review, participants were asked *serie-item* what effect the functionally based acquisition process would have on each problem.

As participants began to consider the issues, the point was raised that the problems defined by prior workshops might already be solved or ameliorated as the result of the spurred by the Defense Management Review which culminated in the 23 February 1992 issue of revised acquisition documents DoD Directive 5000.1 and DoD Instruction 5000.2. After some discussion it was agreed that responses to the question would comment on participants' understanding of the DMR effects as well as on effects likely attributable to adopting the functionally based acquisition process.

In the course of participants providing their evaluations of potential effects of DMR and the functional acquisition system, they also found that a small set of possible answers to the question could be established and used to simplify the evaluative process: There were;

Three reasons for concluding that a problem should be deleted,

- Outside the scope of the problems addressed at this level of this acquisition process;
- Overtaken by events - the problem no longer exists; and
- The DMR or implementation of the new 5000.1 and 5000.2 et seq. had eliminated the problem.

Four reasons for concluding that the problem would be solved,

- DMR mitigated the problem; the new system would eliminate it;
- If the new process is implemented in accordance with the assumptions stated, the problem will not exist;
- The new system will encourage an environment which, over time should eliminate the problem; and
- Yes, if.....

Two reasons for believing the problem would be ameliorated but not necessarily solved,

- DMR has put a process in place which encourages solution of the problem. The new system would enhance that environment.
- If the new process were implemented in accordance with the assumptions stated, the problem will be mitigated: that is, difficulties may become less severe, or might be reduced in part; but the problem would not necessarily be eliminated or "solved".

Four reasons for believing that there would be little effect on the problem.

- No, because...(the reason is then given).
- Neither DMR actions nor the new system will help solve the problem. (in participants judgement)
- DMR has mitigated the problem, however the system proposed would not eliminate it either. (in participants judgement).
- DMR has mitigated the problem. (no further help is expected).

The responses to the question posed were noted for each of the problem statements within all 10 major problem areas. Specific answers were preserved for the record even when the generic answers were used. This assured capture of answers which did not fit one of the standard responses.

However, to assist in rapid overview of the workshop results, answers to the question were generally grouped within one of four categories;

1 - PROBLEM DELETED; 2 - YES; 3 - MAYBE; 4 - NO.

Participants responses are detailed in Paragraphs D.3.1 through D.3.20. Each table shows responses to each question in terms of the four answer categories described above or the actual response which describes the effect of the DMR and the functionally derived acquisition process. In the context of Paragraphs D.3.1 through D.3.20 the answer categories have the following meanings:

1. - DELETED - The problem was deleted from these discussions
2. - YES - The problem is solved either by the functional system or by the combined effects of DMR actions and the functional system.
3. - MAYBE - Over time, the problem is likely to be solved either by the functional system or by the combined effects of DMR actions and the functional system.
4. - NO - Neither the functional system, nor the effects of DMR actions will solve the difficulty.

D.3 PARTICIPANT RESPONSES TO THE QUESTION: "WILL THE FUNCTIONALLY DERIVED ACQUISITION PROCESS CREATE AN ENVIRONMENT IN WHICH THE FOLLOWING PROBLEMS WILL BE PRECLUDED?"

D.3.1 <u>Responses to Problems in Test and Evaluation</u>

1. *Redundancy of test agencies and test during development.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

2. *lack of "agreed to" way to test.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

3. *Program managers decisions subject to excessive test results.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR solution.

4. *Unrealistic and inadequate targets and test ranges.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

D.3.2 **Responses to Problems in Statutory and Regulatory Influences**

1. *Constraining procurement laws and acquisition regulations.*

   NO: Neither the DMR nor the proposed system will solve this problem.

2. *Excessive procurement laws and regulations.*

   NO: Neither the DMR nor the proposed system will solve this problem.

3. *Mandate for competition of small business that may be unqualified to participate.*

   NO: Neither the DMR nor the proposed system will solve this problem.

4. *Lack of regulation and historical approach cleansing.*

   NO: Neither the DMR nor the proposed system will solve this problem.

5. *Insistence of DoD and Congress to perform multi-tier audits of the services and industry.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

6. *Illogical competition.*

   NO: Neither the DMR nor the proposed system will solve this problem.

7. *Excessive government oversight.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR solution.

8. *Changes in policy and specifications.*

   NO: DMR was a change in policy and the new system is too.

9. *Limitations on the dod's ability to incentivize contractor investment (i.e., True multi-year contract.*

   DELETED: It was considered that this problem had been overtaken by events.

D.3.3 Responses to Problems with Funding Instability

1. *Lack of multi-year commitment.*

   YES: DMR has put a process in place that encourages the solution to that problem. The new system enhances this.

2. *Year-to-year instabilities to budget and procurements quantities.*

   NO: No solution.

3. *Lack of program funding stability.*

   YES: DMR partially eliminated the problem

4. *Lack of consistent budget for planning purposes.*

   YES: Same as #3 above

5. *Annual funding of production.*

   YES: The new system will in fact cure the problem.

6. *Annual funding of development.*

   YES: The new system will in fact cure the problem.

7. *Lack of fiscal planning.*

   NO: Neither DMR nor the new system will solve this problem.

8. *Annual production budget fluctuations leading to bathtubs and gaps.*

   YES: The new system will in fact cure the problem.

9. *Lack of budget stability*

   YES: DMR provides internal elements. The new system would fix the external elements.

10. Changing fiscal environment.

    YES: DMR provides internal elements. The new system would fix the external elements.

11. *Resource decisions are made hastily, usually at end of year, without adequate consideration for the acquisition impacts.*

    YES: DMR provides internal elements. The new system would fix the external elements.

12. *The comptroller function (PDB, DMRD execution).*

    YES: MR provides internal elements. The new system would fix the external elements.

13. *Funding changes or problems.*

    YES: DMR provides internal elements. The new system would fix the external elements.

14. *OSD/Service failure to provide agreed resources.*

    DELETED: DMR has taken care of it.

15. *Arbitrary dollar takes; no prioritization; no consideration for exceptional direction.*

    YES: DMR provides internal elements. The new system would fix the external elements.

16. *One year appropriations affect long-term stability and planning.*

    YES: If implemented as planned, will solve the problem.

17. *Inherent disconnect between the dod acquisition process and the congressional budget process results in a production gap.*

    YES: If implemented as envisioned.

18. *Limitations on the dod's ability to incentivize contractor investment (i.e., True multi-year contract).*

    YES: If implemented as envisioned.

D.3.4 <u>Responses to Problems with Executive Decision and Policy Makers</u>

1. *Lack of program management training, experience, and skill at top dod and services management level*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

2. *Changing players, priorities, guidance.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

3. *Overseers often do not have skills and/or experience and/or time to understand what they are overseeing.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

4. *Executive leadership turnover causes policy objectives to change frequently.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

5. *Key personnel turnover.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

6. *Pervasive lack of understanding of the acquisition process.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

7. *Leadership high turnover rate*

   NO: Neither the DMR nor the proposed system will solve this problem.

D.3.5 Responses to Problems with the DAB/DRB Process

1. *Neither the acquisition process nor resource allocation process consider resource constraints beyond budget year or at best 5 year program.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will no longer exist.

2. *Conflict between the DAB and DPRD.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will no longer exist.

3. *Acquisition process participants including requirement generators do not prioritize.*

   YES: DMR partially eliminated the problem, the new system does so.

4. *Role of DAE, SAE in resource allocation.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will no longer exist.

5. *Inadequate information to the resource allocators.*

   YES: DMR mitigated the problem; however, the system proposed would eliminate the problem.

6. *Staff roles and missions of stakeholders in requirements, resource allocation and acquisition process are not clearly defined (limited).*

   YES: DMR significantly helped alleviate the problem. The new system as envisioned would eliminate it.

7. *Acquisition decisions are not viewed as a requirements/acquisition/ resource allocation community product.*

   YES: DMR addressed the problem but did not address the organizational problems to implement it. The new system would as long as the funding is there.

8. *Hard, timely decisions need to be made about which programs will be kept and those not.*

   YES: DMR allowed vertical cuts. The environment did it. This system will institutionalize it for new programs.

D.3.6 <u>Responses to Problems with Long Range Planning Process</u>

1. *Acquisition process is poorly structured to address affordability in terms of milestone 1 and 2 with milestone 1 being too early and milestone 2 too late.*

   DELETED: DMR has taken care of it.

2. *No forum or mechanism for considering acquisition programs in context of long-term investment plan especially one that is resource constrained.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

3. *Requirement can be developed without regard to resource constraints.*

   YES: DMR mitigated the problem. The new system would eliminate it.

4. *DoD is unrealistic about long-range resource projections and we don't hedge our investments against this weakness.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

5. *Resource allocations are determined on a different basis than those of requirement prioritization.*

   YES: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

6. *Lack of clarity about when a program has "started" and what that means. The milestone zero or 1 problem.*

   DELETED: DMR has taken care of it.

7. *Acquisition process considers program/requirements on only an individual basis without considering larger investment context and trade-off.*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

8. *Lack of effective long-range planning to include new starts.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

9. *Changes to acquisition strategy and plan without adequate resource adjustments.*

   YES: DMR mitigated the problem. The new system would eliminate it.

10. *Lack of or undisciplined strategic planning.*

    NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

11. *Lack of clear military strategy and quantitative military requirements.*

    NO: Neither the DMR nor the proposed system will solve this problem.

12. *Short-term planning dominates decision making process.*

    NO: DMR and the new system mitigate but will not solve the problem.

D.3.7 <u>Responses to Problems with User Support</u>

1. *Lack of priority by acquisition organization for weapon systems.*

   NO: DMR mitigated the problem; however the system proposed would not eliminate the problem either.

2. *Lack of consensus between the OSD and the Services and within the Services of what kind of smart munitions they want.*

   YES: DMR mitigated the problem. The new system would eliminate it.

3. *Inadequate user understanding of the implementation and utilization of smart munitions.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

4. *Lack of strong, consistent, and long-term user support for smart munitions programs.*

   NO: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

D.3.8 <u>Responses to Immutable Problems</u>

1. *Instability of DoD and Congressional support for programs.*

   NO: Neither DMR nor the proposed system will solve the problem.

2. *Abrogation of commitment at all levels.*

   NO: Neither DMR nor the proposed system will solve the problem.

3. *Its never over.*

   NO: Neither DMR nor the proposed system will solve the problem.

4. *There is no agreement between the executive branch and the congress on the long-term budget projection.*

   NO: Neither DMR nor the proposed system will solve the problem.

5. *Congressional authorization and appropriation process.*

   NO: Neither DMR nor the proposed system will solve the problem.

6. *Congressional mistrust and meddling and language.*

   NO: Neither DMR nor the proposed system will solve the problem.

D.3.9 Responses to Problems With International Factors

1. *Inadequate foreign sales planning.*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

2. *U.S. security and customs regulation not consistent with international co-development.*

   NO: Neither DMR nor the proposed system will solve the problem.

D.3.10 Responses to Problems Concerning Program Manager Authority

1. *Dilution of the program managers' authority.*

   YES: DMR mitigated the problem. The new system will eliminate it.

2. *Political motives in the decision process.*

   NO: The process proposed would not eliminate it.

3. *Management philosophy.*

   YES: Definition is not clear. Under DMR and the new system, PM's have authority to implement whatever ideas they want to.

4. *Too many management layers and staff at DoD.*

   YES: DMR mitigated by eliminating some service reviews; However it did not alleviate this problem. As a result of the DMR actions, service management levels were reduced but there has been no reduction in OSD staff. The new system requires reporting only at the three decision points, thereby proscribing the amount of reporting required.

5. *Too many inhibitors outside the control of the PM.*

   YES: DMR mitigated it by encouraging reduced layered service staffs, PM still has no control of the budget. The new system would, except for statutory requirements (such as independent test and evaluation activities) eliminate the problem.

6. *Government program managers cannot control programs.*

   DELETED: It was considered that this problem had been overtaken by events.

7. *No one can say "go" but everyone can say "stop".*

   NO: DMR mitigated/addressed the problem first by declaring staff advice to be "advisory" and second by redefining "stop" to mean "delay". The new system minimizes the opportunities for "stop" or "delay" by limiting opportunities for doing either to the decisions points.

8. *Interference from congressional oversight.*

   NO: The new system would not eliminate constitutional Congressional Oversight from being required.

9. *Continual erosion of project office management authority.*

   YES: Similar argument to that given in #1 above.

10. *Conflict between true objectives and self-protection objectives.*

    YES: Similar argument to that given in #4 above. DMR mitigated it but did not eliminate the problem; however, there are fewer opportunities in the new organization to insert self-protection considerations.

11. *Need to accommodate every "neat" idea that comes along i.e., Competition, value engineering, etc.*

    YES: DMR mitigated the problem. The new system would eliminate it.

12. *Failure to identify program participant charters up-front.*

    YES: DMR mitigated the problem through the mechanism described in #5 above. Under the new system, the PM has authority to define charters within the directive received to authorize the program.

13. *Existence of parallel channels e.g., For requirements, acquisition authorization and acquisition plans approval.*

    DELETED: It was considered that this problem had been overtaken by events.

14. *Existence of extensive special interest bureaucracy within the acquisition infrastructure.*

    YES: Similar argument to that given in #11 above.

15. *Proliferation and lack of accountability of ankle biters.*

    NO: Similar argument to that given in #7 above.

16. *Political influences beyond the program managers' control.*

    NO: Similar argument to that given in #2 above.

17. *Lack of a non-punitive program update mechanism.*

    YES: Solved based on assumptions of new system.

18. *Lack of fiscal accountability or outside organizations which have influence into the program.*

    YES: DMR mitigated the problem. The new system would eliminate it.

19: *Responsibilities of PEO's and PM's exceed their authorities.*

    YES: Similar argument to that given in #3 above.

20. *Lack of accountability for decisions that adversely affect programs.*

    YES: Similar argument to that given in #14 above.

21. *Too many nay-sayers ... In the review chain.*

    NO: Similar argument to that given in #7 above.

22. *Tendency not to surface problems.*

    NO: Similar argument to that given in #17 above. DMR mitigated it through the 5000 environment and the subsequent direction which addressed the issue and through that activity improved the situation. If the charter authorizing the work is not carefully worded, the new system may reverse the DMR achievement.

23. *Too many participants can stop or slow process without responsibility for delivering the product.*

    NO: This problem was considered to be the same as #11

24. *Too many rice bowls exist in program oversight without accountability and responsibility for the program outcome.*

    YES: Similar argument to that given in #11 above.

25. *Lack of direct PM control over resources.*

    YES: Similar argument to that given in #1 and #2 above.

26. *OSD decisions outside the program's approval chain.*

    YES: Similar argument to that given in #4 above.

27. *People outside the approval chain have the authority to delay the program without being held accountable for the delay and without any responsibility.*

    YES: Similar argument to that given in #11 above.

D.3.11 <u>Responses to Problems Concerning Inadequacy of Program Team</u>

1. *Lack of adequate program management staff and motivating factors to maintain.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

2. *Constant turnover of government managers.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

3. *Loss of program focus due to program personnel rotations.*

   NO: Neither DMR nor the proposed system will solve the problem.

4. *Lack of contractor's ability to provide people resources as required.*

   NO: Neither DMR nor the proposed system will solve the problem.

5. *Lack of acquisition training and experience of superiors.*

   NO: Neither DMR nor the proposed system will solve the problem.

6. *Increasing demand for oversight information (small programs and/or multiple functions) conflicts with demand for reduced acquisition personnel resources.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

7. *Inadequate resources (doing more with less).*

   Yes: For personnel inside the Program Office; BUT
   NO: For personnel outside the Program Office.

8. *Barriers erected between defense and non-defense divisions of companies and sectors.*

   NO: Neither DMR nor the proposed system will solve the problem.

9. *Intensive unfocused effort demotivates personnel.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

10. *Inadequacy of program team.*

    YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

D.3.12 Responses to Problems Concerning Technical Requirement Management

1. *Changing requirements.*

   DELETED: It was considered that this problem had been overtaken by events.

2. *Desire for perfect solution and not just the adequate solution.*

   DELETED: It was considered that this problem had been overtaken by events.

3. *Lack of prioritization of system requirements.*

   DELETED: It was considered that this problem had been overtaken by events. A system is already in place by DMR which takes care of the problem.

4. *Uncertainty of the requirements.*

   YES: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

5. *Objectives set without full appreciation of program content.*

   YES: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

6. *Lack of priority in RDT&E to evolutionary rather than revolutionary designs.*

   YES: DMR and 5000 addressed it as will the new system. One of many ways.

7. *Inability to lock in the requirements.*

   YES: DMR helps this. This system would treat this because of the performance specification.

8. *Lack of consensus on requirement results and their evolution.*

   YES: DMR helps this. This system would treat this because of the performance specification.

9. *Evolution of both technology and the threat drives proliferation of new smart munitions.*

   DELETED: It was considered that this problem had been overtaken by events.

10. *Lack of a non-punitive program update mechanism.*

    YES: Solved based on assumptions of new system.

11. *Inability to synthesize a design the first time.*

    NO: No acquisition process will solve the problem.

12. *Changes in policy and specifications.*

    NO: DMR was a change in policy and this was too.

13. *Poorly defined and changing technical performance requirements.*

    YES: DMR helped and this system will help some more.

14. *Changing interpretation of criteria for successful demonstration of requirements.*

    YES: DMR reduced the problem, the new system will eliminate it.

15. *Failure to specifically define requirements in terms of quantity and capability early and finally.*

    YES: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

16. *Lack of early agreement of program expectations by all parties.*

    DELETED: Overtaken by events.

17. *Inadequate cost performance trade-off.*

    DELETED: Overtaken by events.

18. *Unclear and changing requirements.*

    DELETED: Overtaken by events.

D.3.13 **Responses to Problems Concerning Risk Management**

1. *Failure to know how to respond to risks even when known (risk/penalty/profit).*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

2. *Failure to take a total systems approach to acquisition management.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

3. *Imprecise risk management methodologies.*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

4. *Management of the dod acquisition process is not disciplined enough.*

   NO: Neither DMR nor the proposed system will solve the problem.

5. *Conflict between short-term focus of government and industry with continuous process improvement.*

   DELETED: It was considered that this problem had been overtaken by events.

6. *Lack of early management focus.*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

D.3.14 **Responses to Problems Concerning Credibility**

1. *Lack of total quality philosophy in implementation of oversight.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

2. *Lack of trust: up, down, and across.*

   MAYBE: Trust is dependent on personalities. The new system may foster a more trusting environment.

D.3.15 **Responses to Problems Concerning Oversight**

1. *Oversight is often reactive not proactive, punitive not coaching.*

   MAYBE: DMR mitigated the problem. The new system enhances the DMR action.

2. *Multiple functional chains and large staff still exist and result in slow and inadequate decision making process.*

   MAYBE: DMR mitigated the problem. The new system enhances the DMR action.

3. *Disparate multiple oversight activities are not deconflicted, integrated or sequenced properly.*

   MAYBE: DMR mitigated the problem. The new system enhances the DMR action.

4. *Lines of responsibility/authority between lateral and vertical elements of staff are undefined or unenforced.*

   MAYBE: DMR mitigated the problem. The new system enhances the DMR action.

5. *Objectives, processes and roles of program oversight are not clearly defined or understood by many participants (both overseers and overseen).*

   MAYBE: DMR mitigated the problem. The new system enhances the DMR action.

D.3.16 <u>Responses to Problems With the Industrial Base</u>

1. *Loss of industrial base (inadequate R&D).*

   NO: Neither the DMR nor the proposed system addresses this problem.

2. *OSD is a small customer of the general industrial base.*

   NO: Neither the DMR nor the proposed system addresses this problem.

3. *Outward migration of investment capital and skilled people.*

   NO: Neither DMR nor the proposed system will solve this problem.

4. *DoD is unwilling to fund industrial base improvement program.*

   NO: Neither DMR nor the proposed system will solve this problem.

5. *intervention is not an administration policy.*

   NO: Neither DMR nor the proposed system will solve this problem.

6. *Their present acquisition policies contain conflicting goals making it virtually impossible to strengthen the base.*

   NO: Neither DMR nor the proposed system will solve this problem.

7. *Lack of a clear understanding of the consequences of some of the perceived industrial base problems.*

   NO: Although the problem is appreciated, however, neither DMR nor the proposed system will solve it.

8. *Lack of agreement on the crucial or core elements of the industrial base that must be sustained.*

   NO: Neither DMR nor the proposed system will solve this problem.

9. *Failure to consider the industrial base early in the acquisition process.*

   NO: Although both DMR and the proposed system address the problem at a program level, neither will solve the industrial base issue. There is the possibility that programmatic action may exacerbate the problem.

10. *DoD fiscal management structure does not support and strengthen the industrial base (unit cost policy).*

    NO: The new system will encourage a new environment which, over time, should eliminate the unit cost structure.

11. *Need to formalize or institutionalize consideration of industrial base.*

    NO: Neither DMR nor the proposed system will solve this problem.

D.3.17 <u>Responses to Problems With Contract Requirements Development</u>

1. *Specifying requirements and "how to".*

   NO: DMR mitigated it. The model could create an environment conducive to significantly reducing the problem over time.

2. *Excessive complexity in solicitation.*

   YES: If the excessive complexity is due to unstable requirements, then the new system will fix the problem.

3. *Conformance to military standards.*

   YES: DMR mitigated it by focusing on communication between government and contractor prior to solicitation. DMR encourages NDI approach. The new system will encourage a new environment which, over time, should eliminate the problem.

4. *Adverse impact of well meaning but ineffective attempts.*

   NO: This is a further attempt to enforce further change.

5. *Data requirements.*

   NO: DMR mitigated the problem; However the system proposed would not eliminate the problem either.

6. *Failure to adequately describe performance verification and validation process by which success is measured.*

   NO: Phase 1 of the model does not address the level of detail required.

7. *Failure to reward good contractor performance.*

   DELETED: It was considered that this problem had been overtaken by events.

8. *Poor contractor performance.*

   DELETED: It was considered that this problem had been overtaken by events.

9. *Absence of specification tailoring.*

   DELETED: It was considered that this problem had been overtaken by events.

10. *Inappropriate contract type.*

    DELETED: It was considered that this problem had been overtaken by events.

D.3.18 <u>Responses to Problems With Cost and Schedule Estimates</u>

1. *Unrealistic program plans/schedules and associated funding profiles.*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

2. *Pressure for unrealistic schedule, cost, and performance.*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

3. *Ineffective cost estimating up-front.*

   NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

4. *Lack of good plans and schedules at the start of the programs.*

   YES: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

5. *Underestimating the project.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

6. *Competitive pressures lead to unrealistic expectations.*

   NO: Neither the DMR nor the proposed system will solve this problem.

7. *Lack of credible cost goals and assessments during program initiation.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

8. *Underestimating logistics and life cycle costs.*

   MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

9. *Funding profiles do not match needs.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

10. *Attempting to achieve too high performance.*

    YES: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

11. *Optimistic program cost and schedules driven by program initiation pressures.*

    YES: If the model is implemented in accordance with the assumptions made, then the problem will no longer exist.

12. *Mis-estimation of technical difficulties.*

    MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

13. *Mis-estimation of costs and schedule (31, 33, & 20).*

    MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

14. *General insistence upon unrealistically compressed schedules from program initiation.*

    MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

15. *Assessment of program cost risk by DoD is inadequate.*

    NO: DMR has mitigated the problem. The new system would not eliminate it.

16. *Failure of contractors to propose realistic costing to rfp's (buying in)*

    NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

17. *The government forces contractor to buy in thereby increasing the risk.*

    NO: DMR mitigated the problem; however, the system proposed would not eliminate the problem either.

18. *Overly "can-do" attitude.*

    YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

19. *Lack of government understanding of the cost of procuring many smart munitions programs.*

    NO: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

D.3.19 **Responses to Problems With Program Execution**

1. *Assigning resources to accomplish the task.*

   MAYBE: DMR mitigated the problem. The new system would eliminate it.

2. *Lack of cost/schedule sensitivity by monitoring laboratories.*

   MAYBE: The new system will encourage a new environment which, over time, should eliminate the problem.

3. *Government furnished equipment.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

4. *Inability to distinguish real quality issues from perceptions.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

5. *Engineering change process requires excessive time/cost.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

6. *Second source brought on too early.*

   DELETED: It was considered that this problem had been overtaken by events.

7. *Failure to contract for total system program responsibility.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

8. *No OSD/Service policy on concurrent engineering.*

   NO: Neither the DMR nor the proposed system will address this.

9. *Failure to make timely decisions by above pm level decision makers.*

   YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

10. *Government PM's are forced to be success oriented thereby reducing their ability to objectively manage results.*

    YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

11. *Failure to address underlying issues and work on the margin.*

    YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

12. *When significant new information arises about a system in acquisition we do not make satisfactory changes in resources or the acquisition plan.*

    MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

13. *Program changes are not reflected in related programs/objectives in a timely manner.*

    MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

14. *Inability to award timely contracts due to external controls.*

    NO: Neither the DMR nor the proposed system will solve this problem.

15. *Lack of timely decisions.*

    YES: If the model is implemented in accordance with the assumptions, then the problem will be mitigated.

16. *The government decision process screens information up to the decision maker.*

    MAYBE: DMR has put a process in place that encourages the solution to that problem. The new system enhances the DMR action.

D.3.20 Responses to Problems With Transition Management

1. *Lack of production transition phase.*

   YES: DMR mitigated the problem. The new system would eliminate it.

2. *Lack of adequate engineering discipline during all phases of the acquisition process.*

   DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

3. *Lack of disciplined engineering.*

DELETED: It was considered that this problem was outside the scope of the problems addressed at this level of the acquisition process.

D.4 RESULTS OF THE EVALUATION OF PROBABLE OUTCOMES

At the conclusion of this analysis it was found that: (1) 34 problems had been deleted from the discussion because they were either outside the purview of the acquisition process or they were overtaken by events; (2) 74 problems had been solved by either the redesigned system or the actions taken as the result of the DMR; (3) 24 problems would, over time, be solved either by the redesigned system of by the combined effect of DMR actions and the new system as institutionalized; and (4) 66 problems were not affected either by the DMR or by the redesigned system.

Participants felt that careful study of the problems unaffected would shed light on potential actions which could result in improved acquisition climate.

Table D-1 lists problems which were deleted from consideration. No problems were deleted in 8 of the 20 problem areas: DAB/DRB Process, Cost and schedule estimates, International Factors, Inadequacy of program team, Immutable, Industrial base, Credibility, and Oversight.

Table D-2 lists problems which participants felt would be precluded by institutionalizing the redesigned acquisition process in combination with the actions to be taken under the DMR. No problems were precluded in six of the 20 problem areas: International Factors, Immutable, Executive Decision and Policy Makers, Risk Management, Industrial Base, and Oversight.

Table D-3 lists problems which participants felt would be ameliorated by institutionalizing the redesigned acquisition process or in combination with actions to be taken under the DMR. No problems ameliorated in 11 of the 20 problem areas: Program Manager Authority, Contract Requirements Development, DAB-DRB Process, Technical Requirements Management. Funding Instability, International Factors, User Support, Transition Management, Immutable, Executive Policy Makers, and Industrial Base.

The problems will remain unsolved are shown in Table D-4

PROGRAM MANAGER AUTHORITY

- Government program managers cannot control programs
- Existence of parallel channels e.g., For requirements, acquisition authorization and acquisition plans approval

CONTRACT REQUIREMENTS DEVELOPMENT

- Failure to reward good contractor performance
- Poor contractor performance
- Absence of specification tailoring
- Inappropriate contract type

TECHNICAL REQUIREMENTS MANAGEMENT

- Changing requirements
- Desire for perfect solution and not just the adequate solution
- Lack of prioritization of system requirements
- Evolution of both technology and the threat drives proliferation of new smart munitions
- Lack of early agreement of program expectations by all parties
- Inadequate cost performance trade-off
- Unclear and changing requirements

FUNDING INSTABILITY

- OSD/Service failure to provide agreed resources

STATUTORY/REGULATORY REQUIREMENTS

- Limitations on the DoD's ability to incentivize contractor investment (i.e., True multi-year contract

LONG RANGE PLANNING

- Acquisition process is poorly structured to address affordability in terms of milestone 1 and 2 with milestone 1 being too early and milestone 2 too late
- Lack of clarity about when a program has "started" and what that means. The milestone zero or 1 problem

USER SUPPORT

- Inadequate user understanding of the implementation and utilization of smart munitions

TRANSITION MANAGEMENT

- Lack of adequate engineering discipline during all phases of the acquisition process
- Lack of disciplined engineering

TEST AND EVALUATION

- Lack of "agreed to" way to test
- Unrealistic and inadequate targets and test ranges

PROGRAM EXECUTION

- Government furnished equipment
- Inability to distinguish real quality issues from perceptions
- Engineering change process requires excessive time/cost
- Second source brought on too early
- Failure to contract for total system program responsibility

EXECUTIVE DECISIONS AND POLICY MAKERS

- Lack of program management training, experience, and skill at top DoD AND Services management level
- Changing players, priorities, guidance
- Overseers often do not have skills and/or experience and/or time to understand what they are overseeing
- Executive leadership turnover causes policy objectives to change frequently
- Key personnel turnover
- Pervasive lack of understanding of the acquisition process

RISK MANAGEMENT

- Conflict between short-term focus of government and industry with continuous process improvement

PROBLEMS DELETED FROM CONSIDERATION

Table D-1

PROGRAM MANAGER AUTHORITY

- Dilution of the program managers' authority
- Management philosophy
- Too many management layers and staff at DoD
- Too many inhibitors outside the control of the PM
- Continual erosion of project office management authority
- Conflict between true objectives and self-protection objectives
- Need to accommodate every "neat" idea that comes along i.e., Competition, value engineering, etc.
- Failure to identify program participant charters up-front
- Existence of extensive special interest bureaucracy within the acquisition infrastructure
- Lack of a non-punitive program update mechanism
- Lack of fiscal accountability of outside organizations which have influence into the program
- Responsibilities of PEO's and PM's exceed their authorities
- Lack of accountability for decisions that adversely affect programs
- Too many rice bowls exist in program oversight without accountability and responsibility for the program outcome
- Lack of direct PM control over resource
- OSD decisions outside the problem's approval chain
- People outside the approval chain have the authority to delay the problem without being held accountable for the delay and without any responsibility

CONTRACT REQUIREMENTS DEVELOPMENT

- Specifying requirements and "how to"
- Excessive complexity in solicitation
- Conformance to military standards

DAB-DRB PROCESS

- Neither the acquisition process nor resource allocation process consider resource constraints beyond budget year or at best 5 year program
- Conflict between the DAB and DRB
- Acquisition process participants including requirement generators do not prioritize
- Role of DAE, SAE in resource allocation
- Inadequate information to the resource allocators
- Staff roles and missions of stake holders in requirements, resource allocations and acquisition process are not clearly defined (limits)

DRB-DAB PROCESS

- Acquisition decisions are not viewed as requirements/acquisition/resource/resource allocation community product
- Hard, timely decisions need to be made about which programs will be kept and those not

TECHNICAL REQUIREMENTS MANAGEMENT

- Uncertainty of the requirements
- Objectives set without full appreciation of program content
- Lack of priority in RDT&E to evolution rather than revolutionary designs
- Inability to lock in the requirements
- Lack of consensus on requirement results and their evolution
- Lack of a non-punitive program update mechanism
- Poorly defined and changing technical performance requirements
- Changing interpretation of criteria for successful demonstration of requirements
- Failure to specifically define requirements in terms of quantity and capability early and finally

FUNDING INSTABILITY

- Lack of multi-year commitment
- Lack of program funding stability
- Lack of consistent budget for planning purposes
- Annual funding of production
- Annual funding of development
- Annual production budget fluctuations leading to bathtubs and gaps
- Lack of budget stability
- Changing fiscal environment
- Resource decisions are made hastily, usually at end of year, without adequate consideration for the acquisition impacts
- The comptroller function (PBD, DMRD execution)
- Funding changes or problems
- Arbitrary dollar takes; no prioritization; no consideration for exceptional direction
- One year appropriations affect long-term stability and planning
- Inherent disconnect between the DoD acquisition process and the Congressional budget process results in a production gap
- Limitations on the DoD's ability to incentivize contractor investment (i.e., True multi-year contract)

PROBLEMS PRECLUDED BY DMR AND THE NEW FUNCTIONAL DESIGN

Table D-2

STATUTORY/REGULATORY INFLUENCES

- Insistence of dod and congress to perform multi-tier audits of the services and industry

COST AND SCHEDULE ESTIMATES

- Lack of good plans and schedules at the start of the programs
- Funding profiles do not match needs
- Attempting to achieve too high performance
- Optimistic program cost and schedules driven by program initiation pressures
- Overly "can-do" attitude

LONG RANGE PLANNING

- Requirement can be developed without regard to resource constraints
- DoD is unrealistic about long-range resource projections and we don't hedge our investments against this weakness
- Resource allocations are determined on a different basis than those of requirement prioritization
- Changes to acquisition strategy and plan without adequate resource adjustments

USER SUPPORT

- Lack of consensus between the OSD and the Services and within the services of what kind of smart munitions they want

INADEQUACY OF PROGRAM TEAM

- Increasing demand for oversight information (small programs and/or multiple functions) conflicts with demand for reduced acquisition personnel resources
- Inadequate resources for personnel inside the program office (doing more with less)
- Intensive unfocused effort demotivates personnel
- Inadequacy of program team

TRANSITION MANAGEMENT

- Lack of production transition phase

TEST AND EVALUATION

- Redundancy of test agencies and test during development

PROGRAM EXECUTION

- Failure to make timely decisions by above PM level decision makers
- Government PM's are forced to be success oriented thereby reducing their ability to objectively manage results
- Failure to address underlying issues and work on the margin
- Lack of timely decisions

CREDIBILITY

- Lack of total quality philosophy in implementation of oversight

PROBLEMS PRECLUDED BY DMR AND THE NEW FUNCTIONAL DESIGN

Table D-2 (Concluded)

STATUTORY/REGULATORY INFLUENCES

- Excessive government oversight

COST AND SCHEDULE ESTIMATES

- Underestimating the project
- Lack of credible cost goals and assessments during program initiation
- Underestimating logistics and life cycle costs
- Mis-estimation of technical difficulties
- Mis-estimation of costs and schedule
- General insistence upon unrealistically compressed schedules from program initiation

LONG RANGE PLANNING

- No forum or mechanism for considering acquisition programs in context of long-term investment plan especially one that is resource constrained
- Lack of effective long-range planning to include new starts

USER SUPPORT

- Inadequate user understanding of the implementation and utilization of smart munitions

INADEQUACY OF PROGRAM TEAM

- Lack of adequate program management staff and motivating factors to maintain
- Constant turnover of government managers

TEST AND EVALUATION

- Program managers decisions subject to excessive test results

PROGRAM EXECUTION

- Assigning resources to accomplish the task
- Lack of cost/schedule sensitivity by monitoring laboratories
- When significant new information arises about a system in acquisition we do not make satisfactory changes in resources or the acquisition plan
- Program changes are not reflected in related programs/objectives in a timely manner
- The government decision process screens information up to the decision maker

RISK MANAGEMENT

- Failure to take a total systems approach to acquisition management

CREDIBILITY

- Lack of trust: up, down, and across

OVERSIGHT

- Oversight is often reactive not proactive, punitive not coaching
- Multiple functional chains and large staff still exist and result in slow and inadequate decision making process
- Disparate multiple oversight activities are not deconflicted, integrated or sequenced properly
- Lines of responsibility/authority between lateral and vertical elements of staff are undefined or unenforced
- Objectives, processes and roles of program oversight are not clearly defined or understood by many participants (both overseers and overseen)

PROBLEMS THOUGHT TO BE AMELIORATED BY THE NEW FUNCTIONAL DESIGN

Table D-3

STATUTORY-REGULATORY INFLUENCES

- Constraining procurement laws and acquisition regulations
- Excessive procurement laws and regulations
- Mandate for competition of small business that may be unqualified to participate
- Lack of regulation and historical approach cleansing
- Illogical competition
- Changes in policy and specifications

FUNDING INSTABILITY

- Year-to-year instabilities in budget and procurement quantities
- Lack of fiscal planning

EXECUTIVE AND POLICY MAKERS

- Leadership high turnover rate

LONG RANGE PLANNING

- Acquisition process considers program/requirements on only an individual basis without considering larger investment context and trade-off
- Lack of or undisciplined strategic planning
- Lack of clear military strategy and quantitative military requirements
- Short-term planning dominates decision making process

USER SUPPORT

- Lack of priority by acquisition organization for weapon systems
- Lack of strong, consistent, and long-term user support for smart munitions programs

IMMUTABLE

- Instability of DOD and Congressional support for programs
- Abrogation of commitment at all levels
- It's never over
- There is no agreement between the executive branch and the congress on the long-term budget projection
- Congressional authorization and appropriation process
- Congressional mistrust and meddling and language

INTERNATIONAL FACTORS

- Inadequate foreign sales planning
- U.S. security and Customs regulation not consistent with international co-development

PROGRAM MANAGER AUTHORITY

- Political motives in the decision process
- No one can say "Go" but everyone can say "Stop"
- Interference from congressional oversight
- Proliferation and lack of accountability of ankle biters
- Political influences beyond the program managers' control
- Too many nay-sayers ... In the review chain
- Tendency not to surface problems
- Too many participants can stop or slow process without responsibility for delivering the product

INADEQUACY OF PROGRAM TEAM

- Loss of program focus due to program personnel rotations
- Lack of contractor's ability to provide people resources as required
- Lack of acquisition training and experience of superiors
- Inadequate resources outside the program office (doing more with less)
- Barriers erected between defense and non-defense divisions of companies and sectors

TECHNICAL REQUIREMENTS MANAGEMENT

- Inability to synthesize a design the first time
- Changes in policy and specifications

RISK MANAGEMENT

- Failure to know how to respond to risks even when known (risk/penalty/profit)
- Imprecise risk management methodologies
- Management of the dod acquisition process is not disciplined enough
- Lack of early management focus

PROBLEMS THOUGHT TO BE UNSOLVED BY THE NEW FUNCTIONAL DESIGN

Table D-4

INDUSTRIAL BASE

- Loss of industrial base (inadequate R&D)
- OSD is a small customer of the general industrial base
- Outward migration of investment capital and skilled people
- DoD is unwilling to fund industrial base improvement program
- Intervention is not an administration policy
- Their present acquisition policies contain conflicting goals making it virtually impossible to strengthen the base
- Lack of a clear understanding of the consequences of some of the perceived industrial base problems
- Lack of agreement on the crucial or core elements of the industrial base that must be sustained
- Failure to consider the industrial base early in the acquisition process
- DoD fiscal management structure does not support and strengthen the industrial base (unit cost policy)
- Need to formalize or institutionalize consideration of industrial base

CONTRACT REQUIREMENTS DEVELOPMENT

- Adverse impact of well meaning but ineffective attempts improve the process
- Data requirements

CONTRACT REQUIREMENTS DEVELOPMENT (Continued)

- Failure to adequately describe performance verification and validation process by which success is measured

COST AND SCHEDULE ESTIMATES

- Unrealistic program plans/schedules and associated funding profiles
- Pressure for unrealistic schedule, cost, and performance
- Ineffective cost estimating up-front
- Competitive pressures lead to unrealistic expectations
- Assessment of program cost risk by dod is inadequate
- Failure of contractors to propose realistic costing to RFP's (buying in)
- The government forces contractor to buy in thereby increasing the risk
- Lack of government understanding of the cost of procuring many smart munitions programs

PROGRAM EXECUTION

- No OSD/Service policy on concurrent engineering
- Inability to award timely contracts due to external controls

PROBLEMS THOUGHT TO BE UNSOLVED BY THE NEW FUNCTIONAL DESIGN

Table D-4 (Concluded)

Although participants believed that a careful analysis ought to be undertaken to draw conclusions about why problems in Table D-4 remain would prove enlightening, they had no time to do so. They strongly recommended that the Workshop Director do such an analysis to see what additional steps might be helpful and to review their judgments about the effect of the redesigned system.

GLOSSARY

SYMBOL	MEANING OF THE ACRONYM
ASD(PA&E)	Assistant Secretary of Defense for Program Analysis and Evaluation
COTS	Commercial, Off the Shelf equipment
CRS	Congressional Research Service
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DAS	Defense Acquisition System
DAWIA	Defense Acquisition Workforce Improvement Act
DDR&E	Director, Defense Research and Engineering
DEPSECDEF	Deputy Secretary of Defense
DFAS	Defense Finance and Accounting Service
DIB	Defense Industrial Base
DLFT	Director, Live Fire Testing
DMR	Defense Management Review
DoD	Department of Defense, United States Of America
DoDD	Department of Defense Directive
DoDI	Department od Defense Instruction
DoDIG	Department of Defense, Inspector General
DOTE	Director, Operational Test and Evaluation
DRB	Defense Resources Board
DSMC	Defense Systems Management College
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FCRC	Federal Contract Research Center
FFF	Form, Fit, and Function
GAO	General Accounting Office, United States Congress
HAC	U. S. House of Representatives Appropriations Committee
HASC	U. S. House of Representatives Armed Services Committee
IDEF	Integrated Computer-Aided Manufacturing Definition
IM	Interactive Management
IPPD	Integrated Product and Process Development
IPT	Integrated Project Team
JCS	Joint Chiefs of Staff of the United States
JROC	Joint Requirements Oversight Council
LCC	Life Cycle Cost
MIL-STD	Military Standard
ODUSD	Office of the Deputy Undersecretary of Defense
OSD	Office of the Secretary of Defense
OTA	Office of Technology Assessment, United States Congress
PAT	Process Action Team
PM	Program Manager
PPBS	Programming Planning and Budgeting System
SAC	U. S. Senate Appropriations Committee
SAE	Service Acquisition Executive
SASC	U. S. Senate Armed Services Committee
SECDEF	Secretary of Defense
SGAC	U. S. Senate Government Affairs Committee
TDP	Technical Development Package
TMAW	Technical Managers Advanced Workshop
TQM	Total Quality Management
U.S.	United States of America
U.S.S.R	Union of Soviet Socialist Republics
USD(A)	UnderSecretary of Defense (Acquisition)
USD(AR)	UnderSecretary of Defense (Acquisition Reform)
WBS	Work Breakdown Structure

REFERENCES

[1] PL103-355. Federal Acquisition Streamlining Act of 1994; August 21, 1994; House of Representatives Report 103-712

[2] Warfield, J. N. Societal Systems; John Wiley Interscience Publications, New York; 1976; ISBN0914105-45-5

[3] Warfield, J. N. A Science of Generic Design; 2nd Edition, University of Iowa Press; Ames, Iowa 1994;

[4] Warfield, J. N., and Cárdenas A. R. A Handbook of Interactive Management; George Mason University IASIS, Fairfax, Virginia; 1993

[5] Department of Defense Manual 5000.2M; Defense Acquisition Program Procedures; Pages 15-1 through 15-3-1 inclusive; October 1987

[6] Department of Defense Instruction 7045.14; The Defense Planning, Programming, and Budgeting System; May 22, 1984

[7] Department of Defense Directive 7045.7: Implementation of the Defense Planning, Programming and Budgeting System; May 23, 1984

[8] Department of Defense Directive 5000.1; Major and Non-Major Defense Acquisition Programs; September 1, 1987

[9] Department of Defense Instruction 5000.2; Defense Acquisition Program Procedures; September 1, 1987

[10] Department of Defense Directive 5000.1; Defense Acquisition; February 23, 1991

[11] Department of Defense Instruction 5000.2; Defense Acquisition Management Policies and Procedures; February 23, 1991

[12] Catalog of War Games and Model Simulations; Joint Chiefs of Staff, Force Structure Resources and Assessment Directorate (J-8), Technical Operations Division; 1993; AD-M-000108

[13] Hearings before the Committee on the Armed Services, 100th Congress, 2nd Session, July 11,12,27, August 4, 1988; Defense Acquisition Process; U.S.Senate Committee On The Armed Services *[Rpt# Y 4.AR 5/3:S.hrg 100-963]*; 1989

REFERENCES

[14] Hearings before the Committee on the Armed Services. 102nd Congress. 2nd Session. 26.27.28 February 1992; Defense Build-Down and Inventory Management in the Department of Defense; U.S.Senate Committee On The Armed Services; S-102-848 *[Rpt# Y 4.AR 5/3:S.hrg 102-848]*; 1992

[15] Oversight of DoD's Management Of Inside Information; Hearing before the Sub-Committee on Oversight of Government Management of the Committee on Governmental Affairs, 101st Congress, 1st Session, 24 February 1989; *[Rpt# Y 4.G 74/9:S.hrg 101-20]*; 1989

[16] Oversight of DoD's Inadequate Use of Off-The-Shelf Items; Hearings before the Sub-Committee on Oversight of Government Management of the Committee on Governmental Affairs, 101st Congress, 1st Session, 30 May and 1 June 1989; *[Rpt# Y 4.G 74/9:S.hrg 101-249]*; 1989

[17] Subcontract Management In The Department of Defense; Hearings before the Committee on Governmental Affairs, 102nd Congress, 1st Session, 22 May 1992; *[Rpt# Y 4.G 74/9:S.hrg 102-329]*; 1992

[18] Integrity of Department of Defense Acquisition System and Its Impact on National Security; 1988; Hearings Held Before The Full Committee and the Acquisition Policy Panel, 100th Congress, 2nd Session, 29 June, 6,8,26 July, 10 August, 16,28,29 September, and 13 October 1988, HASC 100-89; *[Rpt# Y 4.AR 5/2 A:907-88]*; 1988

[19] Registration of Consultants; Hearing Held Before The Acquisition Policy Panel, 100th Congress, 2nd Session, 23 September 1988; *[Rpt# Y 4.AR 5/2 A:987-88/102]*; 1988

[20] The Quality And Professionalism of the Acquisition Workforce; Report of the Investigations Sub-Committee of the Committee on Armed Services, 101st Congress, 2nd Session; *[Rpt# Y 4.AR 5/2:AC7]*; 1989

[21] Life is Too Short; Report of the Investigations Sub-Committee of the Committee on Armed Services: A review of the Brief Periods Managers of Major Defense Acquisition Programs Stay On The Job, 101st Congress, 2nd Session *[Rpt# Y 4.AR 5/2:L62]*; 1990

[22] Acquisition Issues; Hearings Before The Investigations Sub-Committee of the Committee on Armed Services; 101st Congress, 2nd Session, Hearings held 15 and 29 March 1990 *[Rpt# Y 4.AR 5/2:A989-90/72]*; 1990

REFERENCES

[23] Small Business Concerns with Panel 800 Recommendations on Department of Defense Acquisition Reform; Hearing Before The Sub-Committee on Procurement, Taxation, and Tourism, 103rd Congress, 1st Session, 22 January 1993 *[Rpt# Y 4.SM 1:103-26];* 1993

[24] Streamlining Defense Acquisition Laws, Summary Report of the Acquisition Law Advisory Panel to the United States Congress; January 1993

[25] Legislative Barriers to Communication in the Defense Acquisition Process; Hicks, Donald A.; A Report to the Senate Armed Services Committee by a Former Under Secretary of Defense (Acquisition) *[BACKLOG 3]*; 1990

[26] Assessment of Admiral Rickover's Recommendations to Improve the Department of Defense (DoD) Procurement; in three parts:
1 - Utilization of Resources; 2 - The Contracting of Procurement;
3 - Resolution of Contractual Conflicts; General Accounting Office (GAO/PLRD); Report #88-37; 1983

[27] Status of Selected Programs; General Accounting Office (GAO/NSIAD); Report #90-159; 1990

[28] Cases Sent To The Department of Justice's Defense Procurement Fraud Unit; General Accounting Office (GAO/GGD); Report #86-1423FS; 1986

[29] Justice's Overall Management Can Be Enhanced; General Accounting Office (GAO/GGD); Report #88-96; 1988

[30] Information on Plea Agreements and Settlements; General Accounting Office (GAO/GGD); Report #92-135FS; 1992

[31] Defense Acquisition Board Should Address NORAD's Computer Deficiencies; General Accounting Office (GAO/IMTEC); Report #89-74; 1989

[32] Air Force Prematurely Recommends ADP Acquisitions; General Accounting Office (GAO/IMTEC); Report #90-07; 1990

[33] DoD's Defense Acquisition Program (Carlucci's 33 Initiatives); General Accounting Office (GAO/NSIAD); Report #88-148; 1986

[34] Status of the Defense Acquisition Improvement Program's 33 initiatives; General Accounting Office (GAO/NSIAD); Report #86-178BR; 1986

[35] Perspectives on Key Elements for Efficient Management; General Accounting Office (GAO/NSIAD); Report #90-90; 1990

REFERENCES

[36] Fleet Ballistic Missile Program Offers Lessons For A Successful Program; General Accounting Office (GAO/NSIAD); Report #90-160; 1990

[37] U.S.- German Examinations of the MLRS Terminal Guidance Warhead Program; General Accounting Office (GAO/NSIAD); Report #92-07; 1992

[38] More Information Needed of Individuals Convicted of Procurement Related Crime; General Accounting Office (GAO/NSIAD); Report #92-35; 1992

[39] The Special Operations Forces Aircrew Training System at One Year; General Accounting Office (GAO/NSIAD); Report #92-52; 1992

[40] Work Measurement Programs at Selected Contractor Locations; General Accounting Office (GAO/NSIAD); Report #88-43BR; 1988

[41] Solicitation for Contract Support Services Under Limited Competition; General Accounting Office (GAO/NSIAD); Report #90-150; 1990

[42] Not Providing Technical Data May Limit Defense Logistic Agency Competition; General Accounting Office (GAO/NSIAD); Report #91-53; 1991

[43] Qualification and Quality Requirements Purchases of Critical Spare Parts; General Accounting Office (GAO/NSIAD); Report #91-95; 1991

[44] DoD Purchase of Foreign-Made Machine Tools; General Accounting Office (GAO/NSIAD); Report #91-170; 1991

[45] Acquiring Technical Data for Spare Parts Re-Procurement; 1991; General Accounting Office (GAO/NSIAD); Report #91-313; 1991

[46] DoD Should Assess Cost Impact of Contracting Teaming Arrangements; General Accounting Office (GAO/NSIAD); Report #92-15; 1992

[47] Improvement Needed in Technical Data Management; General Accounting Office (GAO/NSIAD); Report #92-23; 1992

[48] Need to Improve Internal Controls On Deferred Contractor Debts; General Accounting Office (GAO/NSIAD); Report #92-198; 1992

[49] DoD Concerns Regarding Acceptance of Spare Parts Approvals; 1992; General Accounting Office (GAO/NSIAD); Report #92-209; 1992

[50] Implementation of the Defense Acquisition Workforce Improvement Act; General Accounting Office (GAO/NSIAD); Report #92-97; 1992

REFERENCES

[51] Implementation of the Defense Acquisition Workforce Improvement Act; General Accounting Office (GAO/NSIAD); Report #93-129; 1993

[52] Arming Our Allies: Cooperation and Competition in Defense Technology; OTA-ISC-449; May 1990

[53] Lessons in Restructuring Defense Industry: The French Experience; OTA-BP-ISC-96; June 1992

[54] Department of Defense Authorization Act, 1985: An Act to Authorize Appropriation for Military Functions of the Department of Defense and to Prescribe Military Personnel Levels for the Department of Defense for Fiscal Year 1985, Revise and Improve Defense Procurement, Compensation, and Management Programs ...; Department of Defense, Office of the Secretary (reprinted from Congressional Acta); Document 2.110: 98-525; 1985

[55] National Defense Appropriation Act for Fiscal Year 1987: An Act to Authorize Appropriations for Fiscal Year 1987 for Military Activities of the Department of Defense, for Military Construction, and for Defense Activities of the Department of Energy, to Prescribe Personnel Strengths for Such Fiscal Year for the Armed Forces, to Improve the Defense Acquisition Process, and for other purposes; Department of Defense, Office of the Secretary (reprinted from Congressional Acta); Document AE 2.110: 99-661; 1986

[56] Federal Acquisition Regulation as of 1 June 1988; U. S. Department of Defense; KF844. F33X; 1988

[57] Federal Acquisition Regulation Supplement; U. S. Department of Defense; KF844. F34X; 1988

[58] Federal Acquisition Regulation Supplement; U. S. Department of Defense; KF844. U55; 1988

[59] Federal Acquisition Regulation Supplement; U. S. Department of Defense; KF844. D44; 1991

[60] Streamlining Defense Acquisition Laws: Report of the Acquisition Law Advisory Panel to the United States Congress (Chapters 1 through 8); Department of Defense; KF852.A3 U53; 1993

[61] Effectiveness of DoD Use of Non Developmental Items In Major Defense Acquisition Programs; Department of Defense Inspector General Audit Report DoD IG 92-107; 1992

REFERENCES

[62] F/A-18 Program As A Part Of The Audit Of The Effectiveness Of The Defense Acquisition Board Review Process - FY 1992; Department of Defense Inspector General Audit Report DoD IG 92-097; 1992

[63] Special Defense Acquisition Fund Financial Statements for Fiscal Year 1992; Department of Defense Inspector General Audit Report DoD IG 93-121; 1993

[64] Low Rate Initial Production In Major Defense Acquisition Programs ; Department of Defense Inspector General Audit Report DoD IG 94-014; 1993

[65] Environmental Consequence Analysis Of Major Defense Acquisition Programs; Department of Defense Inspector General Audit Report DoD IG 94-020; 1993

[66] Review Of The All Source Analysis System As A Part Of The Analysis of The Effectiveness Of The Defense Acquisition Board Review Process Fiscal Year 1993; Department of Defense Inspector General Audit Report DoD IG 93-087; 1994

[67] Integrated Logistics Support For Non Major Defense Acquisition Programs; Department of Defense Inspector General Audit Report DoD IG 93-089; 1993

[68] Report Of The Defense Science Board Task Force On Defense Acquisition Reform; U. S. Defense Science Board Task Force on Defense Acquisition Reform; *[U264.3 .U55x 1993]*; 1993

[69] Goodman, Stuart N., Management Information Systems and the Computer in the Defense Acquisition Program Office; Department of Defense, Defense Systems Management College; *[ADA 052375]*; 1977

[70] Defense Systems Management Review, Volume 2, No 4: Defense Acquisition, The Process And The Problems; Department of Defense, Defense Systems Management College; *[ADA 092922]*; 1979

[71] Defense Systems Management Review, Volume 3, No 1: Defense Acquisition, Issues and Answers; Department of Defense, Defense Systems Management College; *[ADA 092921]*; 1980

[72] Columbia Research Company, Defense Acquisition Improvement Program: DoDAIP; Department of Defense, Defense Systems Management College; *[DSMC 1983-1]*; 1983

[73] Acker, D. D., Evaluation Of The Effectiveness of the Defense Systems Acquisition Review Council (DSARC); Department of Defense, Defense Systems Management College; *[ADA 129797]*; 1983

REFERENCES

[74] ANADAC Inc. Kratz, L.A. and Hiller, J. R., Establishing Competitive Production Sources, A Handbook for Program Managers; Department of Defense, Defense Systems Management College; *[DSMC 1984-3]*; 1984

[75] The Program Manager's Notebook: Glossary of Acquisition Management Acronyms and Terms; Fact Sheets; Defense Systems Management College; *[DSMC 1985-]*; 1985

[76] Behavioral Sciences Associates, Inc., Introduction to DOD Program Management; Defense Systems Management College; *[DSMC 1986-9]*; 1986

[77] Jones, W. D., Introduction To Defense Acquisition Management; 1989; Defense Systems Management College; *[DSMC 1989-7]*; 1989

[78] Jones, Wilbur D., Glossary of Defense Acquisition Acronyms and Terms; Defense Systems Management College; *[DSMC 1989-13]*; 1989

[79] Center for Acquisition Policy Management, Outcomes, Principles, and Criteria: A Framework for Assessing Changes to The Defense Acquisition System; Defense Systems Management College; *[DSMC 1989-1]*; 1989

[80] Defense Procurement Industrial Base Study; Defense Systems Management College; *[DSMC 1990-8]*; 1990

[81] Sweeny, B.D., Perkins, C.A., and Spencer, A.C., Using Commercial Practices in DoD Acquisition; A Page From Industry's Play Book; Defense Systems Management College; *[DSMC 1989-9]*; 1990

[82] Cole, W.E., Hochberg, R.C. and Therrien, A.E., Europe 1992: Catalyst for Change in Defense Acquisition; Report of the DSMC Research Fellows; Defense Systems Management College; *[DSMC 1990-7]*; 1990

[83] Cochrane, C. B., Glossary: Defense Acquisition Acronyms and Terms; Defense Systems Management College; *[DSMC 1991-2]*; 1991

[84] Jones, Wilbur D., Congressional Involvement and Relations: A Guide for DoD Acquisition Managers; Defense Systems Management College; *[DSMC 1992-1]*; 1992

[85] Rhodes, Dean I., Commercial Practices for Defense Acquisition Guidebook; Defense Systems Management College; *[DSMC 1992-3]*; 1992

[86] Puritano, V. and Berenson, P. J., Improving The Defense Acquisition System And Reducing System Costs; Office of the Secretary of Defense; ADA112680; 1981

REFERENCES

[87] Laurence, M.T., Defense Financial and Investment Review, Appendix 4, Part 1: Survey Of Defense Procurement Personnel Results and Findings; Office of the Deputy Under Secretary of Defense, Research and Engineering; ADA 158247; 1984

[88] Defense Financial and Investment Review, Appendix 4, Part 2: Survey Of Defense Procurement Personnel Narrative Comments; Office of the Deputy Under Secretary of Defense, Research and Engineering; ADA 158248; 1984

[89] Bolstering Defense Industrial Competitiveness: Preserving heritage: The Industrial Base: Securing Our Future; Office of the Under Secretary of Defense (Acquisition); UA18.U5 U55X; 1988

[90] Report To Congress on The Defense Industrial Base (ASD P&L); Office of the Under Secretary of Defense (Acquisition); UC263.U538 1990; 1990

[91] Report To Congress on The Defense Industrial Base (ASD P&L); Office of the Under Secretary of Defense (Acquisition); Y 1.1/8: 101-923; 1991

[92] Review of the Spare Parts Procurement Practices Of The Department of Defense; Office of Federal Procurement Policy, Policy Report From the Office of Management And Budget; 1984

[93] Tirone, J. M., The Schizophrenic Conscience Of Defense Acquisition; Army War College, Carlisle Barracks, Pa; *[ADA 194847]*; 1988

[94] Rannenberg, J. E., Warranties In Defense Acquisition: The Concept, The Context, And The Congress; U. S. Naval PostGraduate School, Monterey, California; *[ADA 155165]*; 1984

[95] Konetski, M. L., The Role Of Specifications And Standards In The Department Of Defense Acquisition Process; U. S. Naval PostGraduate School, Monterey, California; *[ADA 172442]*; 1986

[96] Brown, W. A., A Study Of The Barriers To Institutionalization Of Total Quality Management (TQM) In The Department Of Defense Acquisition Process; U. S. Naval PostGraduate School, Monterey, California; *[ADA 245368]*; 1990

[97] Lumb, M. D., An Examination Of The Skills, Experience, Training and Education Requirements Needed As A Functional Area by 97 Officers in the Army Acquisition Corps; U. S. Naval Post Graduate School, Monterey, California; *[ADA 246591]*; 1991

REFERENCES

[98] Suarez, G., Strategy For Educating The Department Of Defense Acquisition Work Force In Total Quality Management; Navy Personnel Research & Development Center, San Diego, California; NPRDS-TN-89-19 *[ADA 208222]*; 1989

[99] Walsh, B., Improving International Defense Acquisition: A Study Of Problems In Initiating Overseas Contracts; Air University, Air Power Research Institute, Maxwell Air Force Base, Alabama; AU-ARI-86-11 *[ADA 110161L]*; 1976

[100] McChesney, J. L., The Evolution Of The Foreign Military Sales Program And Its Impact On Defense Policies And Procedures; Air Force Institute Of Technology, Wright Patterson Air Force Base, Ohio; AFIT-CI-76-86 *[ADA 031822]*; 1976

[101] Burgess, G. M., A Management Analysis And Systems Model Of Department Of Defense Acquisition Structure And Policy; Air Force Institute Of Technology, Wright Patterson Air Force Base, Ohio; AFIT/CI/NR-88-151 *[ADA 197092]*; 1988

[102] Burgess, G. M. and Clark, T. D., Management Analysis & Structural Model of The Defense Acquisition System; Air Force Institute Of Technology, Wright Patterson Air Force Base, Ohio; AFIT/CI/CIA-88-209 *[ADA 208407]*; 1988

[103] Spanier, L. J., Theoretical Framework for Defense Acquisition Analysis; Air Force Institute Of Technology, Wright Patterson Air Force Base, Ohio; AFIT/GSM/LSQ/89S-40 *[ADA 215549]*; 1989

[104] Briefings on Defense Procurement Policy And Weapon System Acquisition; Logistics Management Institute, Bethesda, Maryland; LMI -70-4; *ADA 025278*; 1969

[105] Platt, A. W. and Conrad, D. M., Joining The Defense Directives and Defense Acquisition Regulatory Systems; Logistics Management Institute, Bethesda, Maryland; LMI-RE902; *ADA 107142*

[106] Young, R. S. and O'Hearn, T. H. Jr., Small Business Guide to The Defense Acquisition Regulation; Logistics Management Institute, Bethesda, Maryland; *ADA 095371*; 1980

[107] Information Resource Management Planning In The Office Of The Under Secretary of Defense (Acquisition); Logistics Management Institute, Bethesda, Maryland; *LMIAQ801R1*; 1989

REFERENCES

[108] DoD Implementation Guidelines for Electronic Data Interchange; Logistics Management Institute, Bethesda, Maryland; *U168L642H35*; 1991

[109] Graham, D. R., Bicksler, B. A., Hilton, R. P., Hoyler, M., and Kanter, H., Observations Two Years After The Packard Commission; Institute for Defense Analysis, Arlington, Virginia; IDA-R-347-VOL-1; *ADA 205728*; 1988

[110] Kanter, H., Wainstein, L., Kaganoff, R., and Pavel, B., The CINCS (Commanders-In-Chief) And The Acquisition Process; Institute for Defense Analysis, Arlington, Virginia; IDA-P-2113; *ADA 206858;* 1989

[111] Bicksler, B. A., Fox, J. R., Gilligan, M., Hilton, R. P., and Transue, J. R., Observations Two Years After The Packard Commission: Volume II, Background Papers; Institute for Defense Analysis, Arlington, Virginia; IDA-R-347-VOL-2; *ADA 236753*; 1989

[112] Webb, S., NATO And 1992: Defense Acquisition and Free Markets; The RAND Corporation, Santa Monica, California; RAND R 758 FF; Y3758FF; 1989

[113] Trapp, D. L., Cost Realism Handbook For Assuring More Realistic Contractor Cost Proposals: A Handbook For Program Management And Source Selection Personnel: For The U.S.Naval Material Command; Science Applications International Corporation, Los Angeles, California; 1985

[114] Shelkey, R. G., Defense Acquisition Strategy For The 1990's; Industrial College of the Armed Forces, Washington, D. C.; NDU-ICAF-91-RS6/8G; *ADB165843L*; 1991

[115] Commercial Off-The-Shelf/Non-Developmental Items Study (COTS/NDI); National Security Industrial Association National Headquarters, Washington, D.C.; UB212.C655; 1991

[116] A Study Of The Applicability Of FAR Clauses To Subcontracts Under Prime Defense Contracts: Including Defense FAR Supplement; National Security Industrial Association Headquarters, Washington, D.C.; KF844.S79; 1993

[117] Personal Communication, Ray Moll, Vice President, General Electric Heavy Electrical Generation Equipment Department, Schenectady, New York, April 24, 1992

[118] Personal Communication, John Wesford, General Manager, Motorola Arizona Center, Tucson Arizona, May 12, 1992

REFERENCES

[119] Personal Communication, Texas Instruments, Dallas Texas, Robert McLendon (April 29, 1993) and Dale Zimmerman (August 11 1993),

[120] Personal Communication, McDonnell Douglas Staff, St. Louis, Missouri May 11, 1993

[121] Personal Communication, Lockheed Aeronautical System Company Staff, Marietta, Georgia, May 12, 1993

[122] Personal Communication, Boeing Airplane Company Staff, Seattle and Everett, Washington, May 18, 1993

[123] Personal Communication, Lockheed Advanced Development Corporation Staff, Palmdale, California, May 19, 1993

[124] Personal Communication, Scaled Composites Corporation, Burt Rutan, CEO, Mojave, California, May 20, 1993

[125] Personal Communication, Chrysler Corporation, Roy Sjoberg Project Director for Viper, July 22, 1993

[126] Morgan, G., Beyond Method; SAGE Publications Inc, Newbury Park California; ISBN 0-8039-1973-5; 1983

[127] Heisenberg, W., Physics and Philosophy; Harper Brothers, N.Y. N.Y.; 1958

[128] Kant, I., Critique of Pure Reason; Prometheus Books, Buffalo, New York; Translated by J. M. D. Meiklejohn; ISBN 0-87975-596-2; 1990

[129] Dalton, J., New Systems of Chemical Phosophy, Part 1 1808; referenced in The Intelligent Man's Guide to Science by Isaac Azomiv; Basic Books Inc.; Library of Congress Catalogue Number 60-13145 (Pages 169 *et seq*); 1960

[130] Einstein, Albert as referenced in International Encyclopedia of Unified Science, Volume 1 Part 2; University of Chicago Press; Chicago, Ill.; 1955

[131] Munitz, M. K., Editor, Theories Of The Universe From Babylonian Myth To Modern Science; The Free Press, Glencoe, Illinois, Library of Congress Catalog Card No. 57-6746; 1957

[132] Ackoff, R. L., and Sasieni, M. W., The Art of Problem Solving; John Wiley, New York; 1979; ISBN 0471-00333-6

[133] Military Standard 881 (MIL-STD 881), Work Breakdown Structure (WBS):

REFERENCES

[134] Military Standard 499B (MIL-STD 499B), Systems Engineering

[135] Forrester, J. W., Industrial Dynamics; MIT Press, Cambridge, Massachusetts; 1961; ISBN 0-915299-88-7

[136] Taylor, F. W., The Principles of Scientific Management; Norton, New York, The Norton Library; 1967

[137] Juran, J., Quality Control Handbook; 4th Edition; McGraw-Hill, New York; 1992; ISBN 0-07-03376-6

[138] Deming, W. E., Out Of The Crises; Massachusetts Institute of Technology Center for Advanced Engineering Study, Cambridge, Massachusetts; 1982; ISBN 04-71-003336

[139] Churchman, C. W., Ackoff, R. L., and Arnoff, E. L., Introduction to Operations Research; John Wiley and Sons, New York; 1957; Library of Congress Catalog Number 57-5907

[140] A Plan for Corporate Information Management for the Department of Defense; Office of the Director of Defense Information; ADA252087; September 1990

[141] Kelman, S., Procurement and Public Management; The American Enterprise Institute Press, Washington, D.C.; 1990

[142] The Department of Defense Enterprise Model. Volume I: Strategic Activity and Data Models and Volume II: Using the DoD Enterprise Model; Department of Defense, Office of the Secretary of Defense, ASD (C^3I); January 1994

[143] Kaffenberger, S. A. and Martin, D. P., A Dynamic Policy Model of the Department of Defense Systems Acquisition Process; U. S. Air Force Institute of Technology, School of Systems and Logistics, LSSR 1-79A; June 1979

[144] Warfield, J. N., Annotated Bibliography: Generic Systems Design and Interactive Management; Institute for Advanced Studies in the Interactive Sciences, George Mason University, Fairfax, Virginia, (90/007); 1990

[145] Warfield, J. N., Annotated Bibliography: Interpretive Structural Modeling and Related Work; Institute for Advanced Studies in the Interactive Sciences, George Mason University, Fairfax, Virginia, (90/002); 1990

REFERENCES

[146] Warfield, J. N., Self-Study Program Development Guides for Warifield Literature; A Report Submitted to the Defense Systems Management College by the Institute for Advanced Studies in the Interactive Sciences, George Mason University, Fairfax, Virginia.; 1993

[147] Boehm, B., Software Engineering Economics; Prentice-Hall Inc., Englewood Cliffs, N.J. 07632; 1981; ISBN 0-13-822122-7

[148] U. S. Naval Aviation Systems Team, Noreen Bryan Director; Aircraft Cost Estimating; Special document prepared Defense Advanced Research Projects Agency (DARPA) Affordable Aircraft Acquisition Study; (Restricted Handling); 1993

[149] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 88-2; September 1988.

[150] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 89-1; December 1988.

[151] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 89-2; July 1989.

[152] Office of the UnderSecretary of Defense (Acquisition), Washington, D.C., The Smart Munitions Workshops Final Report; February 1990

[153] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 90-1S; January 1990.

[154] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 90-1; December 1989

[155] Bradley Fighting Vehicles Fails its Field Test; New York Times, July 1989.

[156] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 90-2; January 1990.

[157] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 90-3; April 1990.

[158] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-1; January 1991

REFERENCES

[159] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-2; January 1991

[160] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-3; January 1991

[161] The Shrinking Industrial Base; Segment of CBS Reports; February 1994

[162] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 90-4; May 1990

[163] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-4; January 1991

[164] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-10; September 1991

[165] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 89-1S; March 1989

[166] Office of the Secretary of Defense (OSD), Washington, D.C. Concurrent Engineering Workshops; February 1991

[167] Office of the Secretary of Defense (OSD), Washington, D.C.; Concurrent Engineering Implementation Plan; April 1991

[168] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 90-3S; July 1990

[169] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-5; February 1991

[170] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-11; September 1991

[171] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-6; May 1991

[172] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-7; July 1991

REFERENCES

[173] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-8; August 1991

[174] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 91-9; October 1991

[175] Gorbachev, M. S., Perestroika; Harper and Row Publishers, 10 East 53rd Street, New York, N.Y.; 1987; ISBN 0-06-039085-9

[176] Weaver, C. N. and Upton, M. T., CAPT USAF, Implementing Total Quality Management (TQM) I: The Command Imperative; Air Force Materiel Command, Armstrong Laboratories Special Report; ADA259885; December 1992

[177] U. S. Department of Defense, Office of the Secretary of Defense, Total Quality Management (TQM) Process Action Team Course; ADA225197; May 1990

[178] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 92-1; January 1992

[179] Defense Systems Management College (DSMC), Fort Belvoir, Virginia, Technical Manager's Advanced Workshop (TMAW) Report 92-2; April 1992

[180] Rock, M. L. Editor, Handbook of Wage and Salary Administration; McGraw-Hill Inc. New York, New York; 1972; ISBN 0-07-053348-2

[181] Bellak, A. O. The Hay Guide Chart-Profile Method of Job Evaluation; The Hay Company (for inclusion in the Second Edition of the Handbook of Wage and Salary Administration; 1982

[182] Alberts, H. C., A Quantitative Methodology for Organizational Design and Performance Measurement; Copyright MRJ Inc. 10400 Eaton Place, Suite 300, Fairfax, Virginia 22030; April 1983

[183] Department of Defense. Report of the Acquisition Law Advisory Panel to the United States Congress. Introduction; January 1993

[184] Secretary of Defense Dick Cheney; Defense Management Report To The President; Office of the Secretary of Defense; July 1989

[185] Department of Defense; Implementation of the Secretary of Defense's Defense Management Report To The President. Progress Report Detail; May 1992

[186] Ulrich, W., Some Difficulties of Ecological Thinking from a Critical Systems Perspective: A Plea for Critical Holism; in "A Challenge For Systems Thinking", ed. by. Ionna Tsivacou; University of The Agean Press, Athens, Greece; 1993; ISBN 960-7475-00-3

[187] Webster's New World Dictionary, Third College Edition; Websters New Work Dictionaries, Division of Simon and Schuster, New York, N.Y.; 1988 ISBN 0-13-947169-3 [Page 336]

[188] Naisbitt, John and Aburdene, Patricia; Megatrends 2000); Morrow, New York, N.Y.; 1990; ISBN 0-688-05244-0

[189] General Dynamics Accused of Fraud on Army DIVAD Gun - NASA Chief, Three Others Indicted; Washington Post, 6 December 1985

[190] General Dynamics DIVAD Fraud Case Abandoned - Beggs, Three Others Cleared; Washington Post, 3 July 1987

[191] China Warns Against 'Star Wars" Shield for U. S. Forces in Asia; New York Times; 18 February 1994

[192] Defense Production Act of 1954; U, S, Congress; 1954 amended and re-enacted bi-annually.

[193] Budget of The United States of America, Fiscal Year 1993; Executive Office of the President, Office of Management and Budget; August 1992

[194] McLuhan, M., The Medium Is The Message; International Publishers, New York; Library of Congress Call Number P90.M2583F5; 1st edition 1968

[195] Bartlett, J., Familiar Quotations; Little, Brown and Company, Boston Massachusetts; Library of Congress Catalog Card 55-10767; Thirteenth Edition, November 1955

[196] Joint Logistics Commanders Guidance for use of Evolutionary Acquisition Strategy to Acquire Weapon Systems; Defense Systems Management College, Fort Belvoir, Virginia; March 1995

[197] Re-Engineering the Acquisition Oversight and Review Process; Acquisition Reform Process Action Team; 9 December 1994

[198] Private Communication, Royal Military College of Science, Cranfield University, Richard A. Miller, at Defense Systems Management College, 14 July 1995