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Extension to:

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Preface to First Edition, 2003

This document is the first edition (2003) of a *U.S. Department of Defense (DoD) Extension* to the Project Management Institute's (PMI®) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)* 2000 Edition.

The primary purpose of this document is to identify and describe *defense applications* of the core project management knowledge areas contained in the *PMBOK® Guide*, as well as those defense-intensive knowledge areas not contained in the *Guide*. It is important to understand that this is an extension to the *PMBOK® Guide*, and is not intended to be a stand-alone document. The *PMBOK® Guide* is a valuable document in its own right and its principles need to be understood and practiced by DoD Program Managers (PM).

This Extension generally follows United States Department of Defense (hereinafter referred to as DoD) acquisition system policies and procedures (principally found in the DoD 5000 series directives – DoDD 5000.1, DoDI 5000.2, and *Interim Defense Acquisition Guidebook (IDAG)*). However, many of the concepts are generic to defense acquisition worldwide. For more information about the acquisition systems of important U.S. Allies, see the following two documents published by the Defense Acquisition University Press:

- *A Comparison of the Defense Acquisition Systems of Australia, Japan, South Korea, Singapore, and the United States.*

- *A Comparison of the Defense Acquisition Systems of France, Great Britain, Germany, and the United States.*

These documents are available at http://www.dau.mil/pubs/pubs-main.asp.

Department of Defense (DoD) acquisition directives, instructions and guidance (in the 5000 series) are published and updated periodically and provide mandatory and discretionary information to effectively manage defense system acquisition. Consistent with these documents the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD (AT&L)), has published a listing of AT&L Management Initiatives which are organized into five goals. The five goals and their objectives (which are subject to regular revision and status reporting), are noted below:

- Goal # 1. Objective: **Achieve credibility in acquisition and logistics support process Reduce Cycle Time** – A key part of this goal is the use of realistic cost estimates and fully funding those estimates; plus the use of evolutionary acquisition and spiral development as ways to deliver systems more quickly and at lower cost.
- Goal # 2. Objective: **Revitalize quality and morale of the DoD acquisition, technology and logistics workforce** – Progress can be made on this goal by giving acquisition managers more control in recruiting and job classification , and improving the training and education of the AT&L workforce.

- Goal # 3. Objective: **Improve health of defense industrial base** – Work on achieving this goal involves increasing progress and performance-based payments for completed defense work, and working to incentivize defense corporations to eliminate unused industrial infrastructure.
- Goal # 4. Objective: **Rationalize the weapon systems and infrastructure with defense strategy** – Involves transformation of the U.S. military and defense establishment over time into a capabilities-based approach and force structure.
- Goal # 5. Objective: **Initiate high leverage technologies** – This goal focuses on leveraging technologies to create warfighting capabilities, systems, and strategies of the future.

Each of the goals are further broken down into specific initiatives and actions needed to accomplish the goals. This *U.S. DoD Extension* is a direct product of Goal #1.

Special thanks are due to Mr. Norman Bull for extensive research, editing, and support in preparing the initial draft (in 2002) of the *U.S. DoD Extension* under contract DADW35-01-P-0079. Thanks are also due to those members of the Defense Acquisition University faculty, private consultants, and members of the U.S. defense industry, (all noted in Appendix B), who originated, edited, and reviewed the text. This list of contributors includes Mr. Fred Ayer, who was the driving force and main proponent of the Extension; without his leadership and knowledge of PMI processes, this project would never have gotten off the ground. Thanks are also due to Ms. Pat Bartlett, Bartlett Communications, and to Ms. Debbie Gonzalez for their detailed proofreading, editing and formatting of this document.

The Defense Acquisition University is the controlling agency for this *U.S. DoD Extension.* Comments and recommendations relating to the text are solicited. You are encouraged to fax such comments to the DAU Press, 703-805-2917.

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SECTION I

THE PROJECT MANAGEMENT FRAMEWORK

1. Introduction
2. The Project Management Context
3. Project Management Processes

Chapter 1

Introduction

The nine knowledge areas identified in the *PMBOK® Guide* are applicable to the DoD in the development, production, and fielding of defense systems. The nine areas, which have the same chapter numbers in this Extension as in the *PMBOK® Guide*, are depicted in Figure 1-1 "Wheel." While the nine areas are the core of DoD's project management concept, there are five other defense-intensive knowledge areas or processes that are key to defense acquisition. These five defense-intensive areas, as well as defense-related aspects of the basic nine knowledge areas, are addressed herein. The new areas and their respective position in this *U.S. DoD Extension* are:

- Chapter 13: Project Systems Engineering Management.
- Chapter 14: Project Software Acquisition Management.
- Chapter 15: Project Logistics Management.
- Chapter 16: Project Test and Evaluation Management.
- Chapter 17: Project Manufacturing Management.

The format of this Extension is keyed to the structure contained in the *PMBOK® Guide*, including the *PMBOK® Guide's* input — tools and techniques — output methodology to describe the knowledge areas as they relate to defense acquisition. Inputs, tools and techniques, and outputs taken directly from the *PMBOK® Guide* are printed in regular type whereas defense-specific inputs, tools and techniques, and outputs added through this Extension are printed in **bold type**. Additionally, the text regarding inputs, tools and techniques, and outputs indicates additional defense-specific material or else the reader is referred back to the *PMBOK® Guide.*

Chapter titles for Chapters 1-12, and sub-chapter (that is, *PMBOK® Guide* processes) paragraph numbers, titles, and summary descriptive words for each sub-chapter appearing on the first page of Chapters 4-12 are all taken from the *PMBOK® Guide* except for three additional sub-chapter items added in Chapter 7.

At this point we will address some basic DoD processes and terminology as a means of orienting the reader.

1.1 Background

While the *PMBOK® Guide* knowledge areas and the defense-intensive areas have distinctive characteristics, they are related in that the defense-intensive areas each rely on several of the *PMBOK® Guide* areas to be successful. A description of the relationship between the core *PMBOK® Guide* knowledge areas and the defense-unique knowledge areas is shown in Figure 1-1.

Note that many of the defense-intensive knowledge areas cut across the *PMBOK® Guide* knowledge "pie." There is room for debate regarding the linkages as shown in the chart. In this Extension, we will describe each of the defense-peculiar areas separately, while also describing their links to the core *PMBOK® Guide* knowledge areas. It should be mentioned that much work on identifying the defense-intensive knowledge areas is contained in a thesis presented by Captains Korina L. Kobylarz and Gregory D. Best, USAF, in 1991, titled "Establishing a Department of Defense Program Management Body of Knowledge." Information contained in that thesis, as well as other documents and articles published over the past several years, have been utilized in developing this Extension.

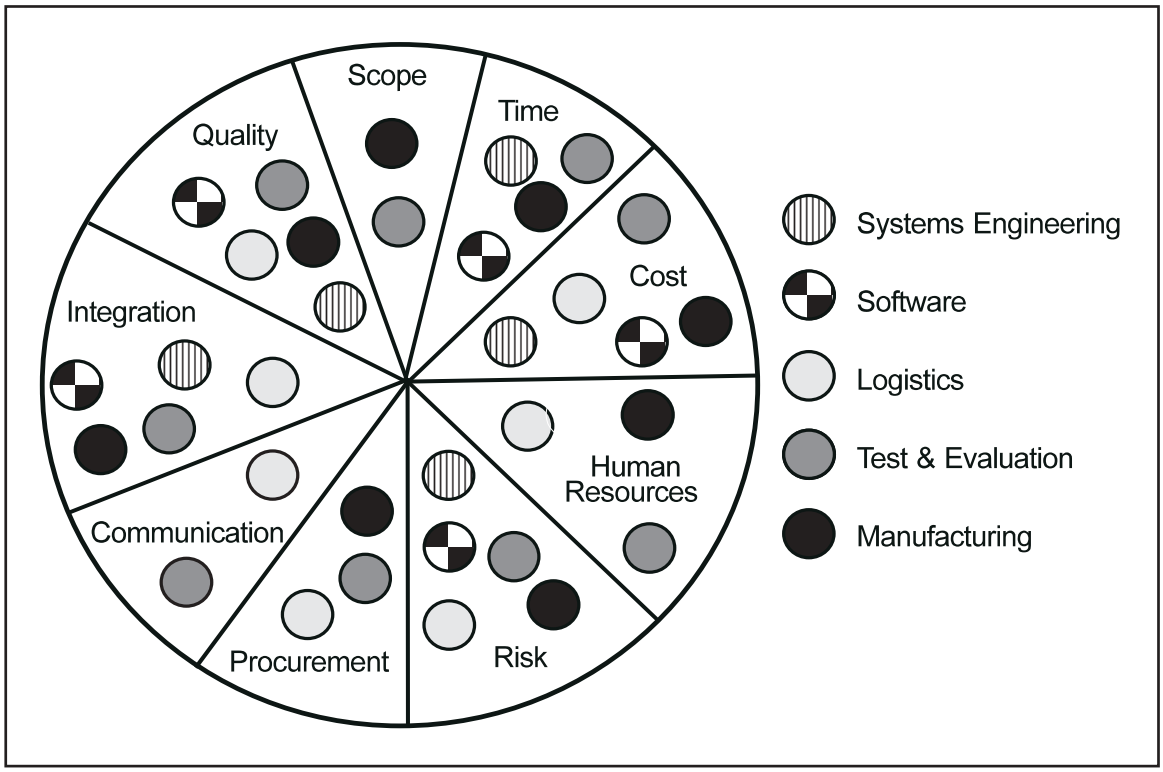


Figure 1-1. Primary Linkages Between PMI *PMBOK® Guide* Knowledge Areas and Defense-Intensive Knowledge Areas

1.1.1 "Project" versus "Program"

The *PMBOK® Guide* describes a "program" as a group of projects managed in a coordinated way to obtain benefits not available from managing them individually. The

PMBOK® Guide also notes that many programs include elements of ongoing field operations. It states: "For example: The XYZ airplane program includes both the project or projects to design and develop the aircraft, as well as the ongoing manufacturing and support of that craft in the field." Defense system development, production, and fielding is normally described as "program management"; that term will be used throughout this Extension. In addition, the material in this Extension tends to be oriented more toward the inputs, processes, and output of Government program management as opposed to the industry/contractor program or project manager. Nevertheless, many of the same principles and practices (and increasingly commercial practices) apply to both, and the intent is to include these defense industry and commercial practices where appropriate.

1.2 DoD Program Management Environment

Program management in the DoD is characterized by a continuing interface between the Congress, the Executive Branch (DoD, developer and buying commands, user commands), and industry. Figure 1-2 shows those relationships and how the defense (Government) program manager (PM) and Program Management Office (PMO) must work within that environment. Similar environments exist in other industrialized countries as well.

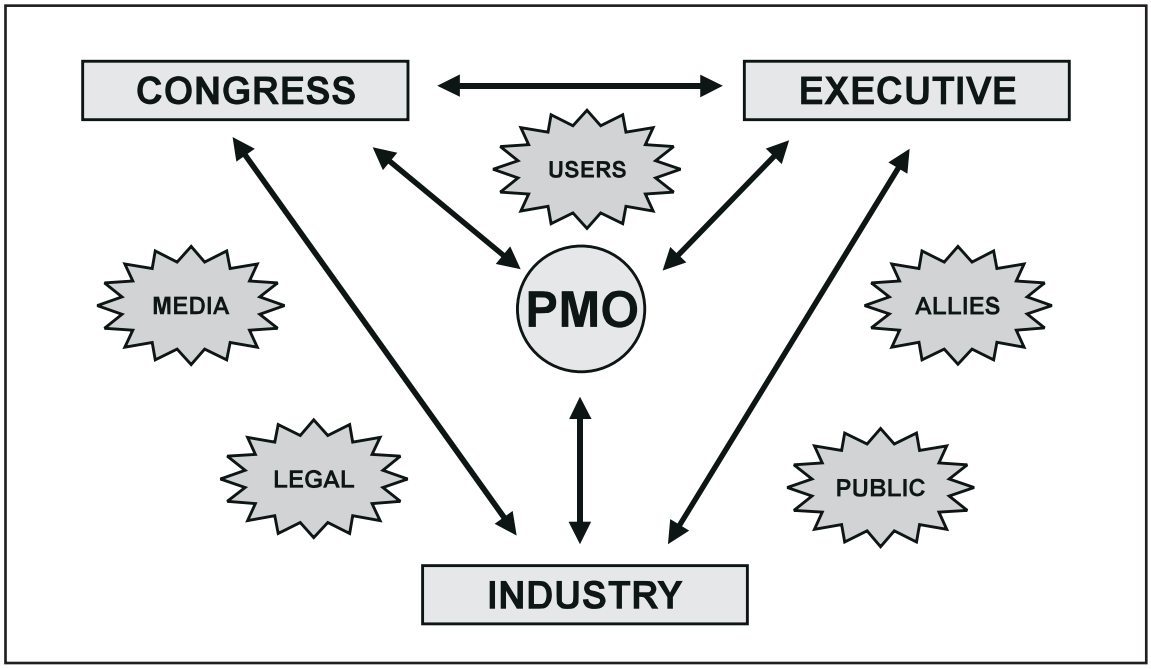


Figure 1-2. The Program Manager's Environment

The DoD acquisition processes and procedures are directed and guided by three key documents: DoD Directive (DoDD) 5000.1, DoD Instruction (DoDI) 5000.2, and *the Interim Defense Acquisition Guidebook (IDAG)*. Revised 5000 Series documents – DoDD 5000.1 and DoDI 5000.2 – were published on 12 May 2003. The "old" DoD 5000.2-R has been repackaged into the IDAG, which is dated 30 October 2002.

Direction and instructions from the 12 May 2003 versions of the Directive and Instruction – along with guidance from the IDAG – are depicted in the text and charts in this Extension. To keep the text relatively generic and free from needing continual changes,

references to these three documents will be made throughout this Extension in terms of the "5000 Series."

Information in this series covers: a.) *The Defense Acquisition System* (DoDD 5000.1), where management principles for all DoD programs are described; b.) *Operation of the Defense Acquisition System* (DoDI 5000.2), which establishes a simplified and flexible management framework for translating mission needs and technology opportunities into stable, well-managed and affordable acquisition programs/systems; and c.) the *IDAG* – which provides guidance on procedures for operation of the acquisition system and is based on an integrated management framework formed by three primary decision support systems: the Requirements Generation System, the Defense Acquisition System, and the Planning, Programming, and Budget System (PPBS). This integrated management framework is depicted in Figure 1-3.

The 5000 Series provides a general approach for managing all defense acquisition programs, while recognizing that every technology project and acquisition program is unique and the process described in the instruction must be tailored to reflect these unique attributes.

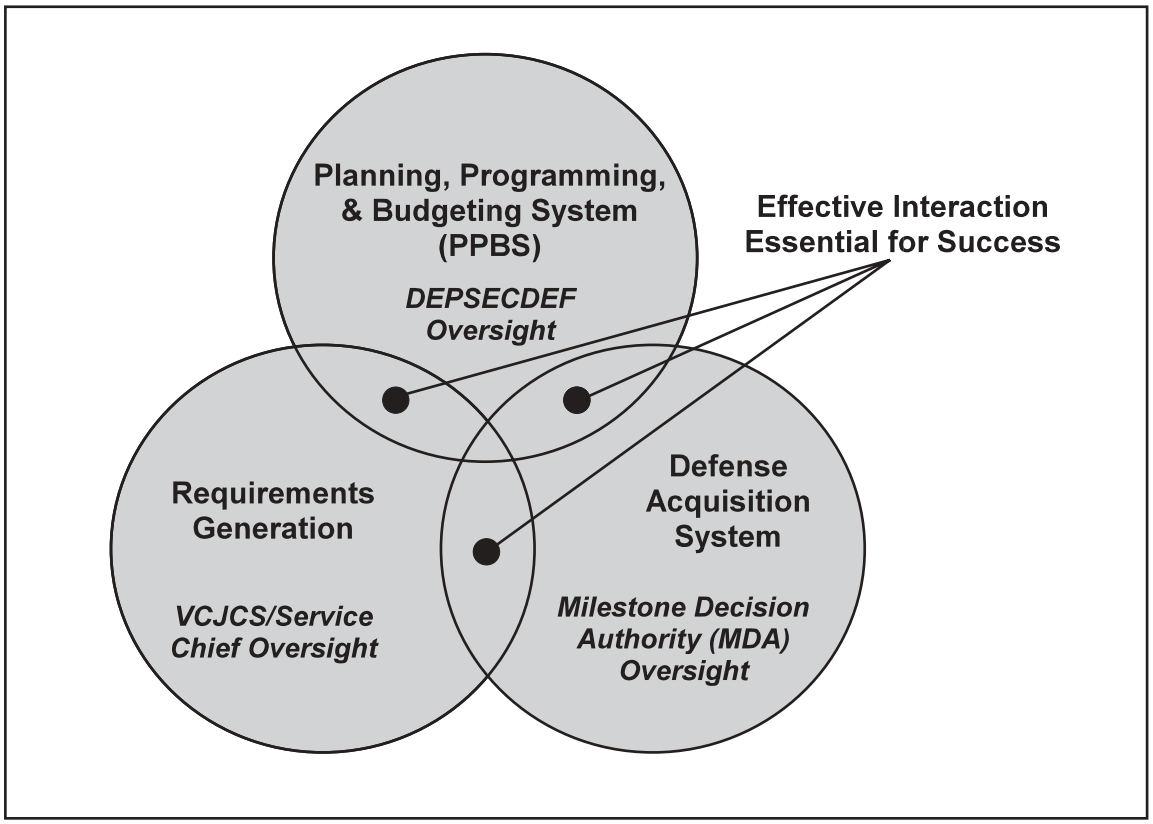


Figure 1-3. The Major Decision Support Systems

When examining DoD acquisition processes and procedures, it is important to understand that the Government PM is the direct customer of the contractor (defense industrial firm) project manager. On the other hand, the Government PM is the supplier of the product to field units ("users"). The "users" (also referred to as "warfighters") are the direct customers of the Government PM.

Chapter 2

The Project Management Context

This chapter of the *U.S. DoD Extension* of the *PMBOK® Guide* provides a brief overview of the DoD defense acquisition life cycle. The defense acquisition life-cycle model/ process that is described in Figure 2-2 of the *PMBOK® Guide* has been modified in subsequent versions of the DoD 5000 Series. Nevertheless, the acquisition life-cycle process continues to be based on the industrial life-cycle model that has applicability throughout the developed nations of the world. Program Managers tailor/streamline this model to the maximum extent possible, consistent with technical risk, to provide new systems to operational commanders as fast as possible. The model/process begins with a determination of a requirement or mission need for a military hardware/software system. Figure 2-1 (below) displays the new (current) DoD Acquisition Life-Cycle Process and related activities.

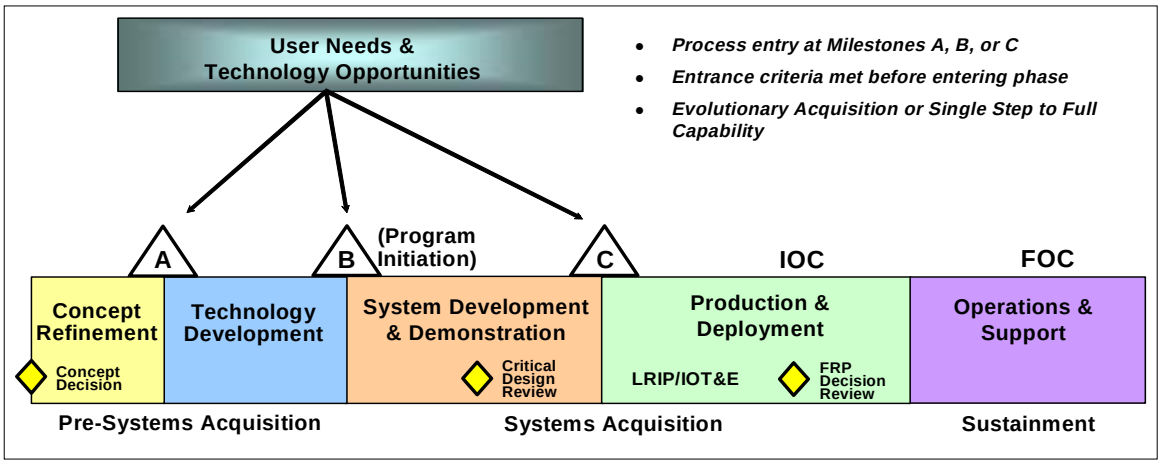


Figure 2-1. Current DoD Acquisition Life-Cycle Process

A prior process, established by the 1996 version of DoD 5000 Series guidance, is generally applicable to programs already beyond the "old" Milestone II (conclusion of "old" Program Development and Risk Reduction (PDRR) and start of "old" Engineering and Manufacturing Development (EMD)). That process contained Roman numerals for milestones, and did not adequately depict the evolutionary nature (block changes) of current defense acquisition.

The process illustrated in Figure 2-1 provides for entry points consistent with a program's technical maturity, validated requirements and/or capabilities, and funding. Entrance criteria for each phase of the life-cycle guide the Milestone Decision Authority (MDA) in determining the appropriate point for a program to enter the acquisition process.

A key feature of the new process — alluded to earlier — is the preferred use of evolutionary acquisition in designing, developing, producing, fielding and supporting a defense system.

The life-cycle process consists of periods of time called phases, each consisting of two work efforts, in some cases separated by decision points called milestones, decision reviews, or design reviews. These decision points provide both the PM and MDAs the framework with which to review acquisition programs, monitor and administer progress, identify problems, and make corrections. The MDA will approve entrance into the appropriate phase of the acquisition process, or passage from one work effort to the next, by signing an acquisition decision memorandum (ADM) upon completion of a successful review.

As previously noted, the life cycle of a program begins with planning to satisfy a mission need before the program officially begins. Program initiation normally occurs at Milestone B, although it could take place later depending on technology maturity. The life-cycle process takes the program through research, development, production, deployment (fielding), support, upgrade, and finally, demilitarization and disposal. Initial Operational Capability, or IOC, is that point at which a selected number of operational forces have received the new system and are capable of conducting and supporting an operational or training mission. References to “life-cycle costs” in defense acquisition include all costs (Research and Development, Procurement, Military Construction, Personnel, and Operations and Support) associated with a program/system. This life-cycle cost is sometimes referred to as Program Total Ownership Cost (TOC). However, another top-level version of TOC also includes all other indirect overhead costs associated with DoD ownership cost of a system. For our purposes, the former usage of TOC, i.e., program/system life-cycle costs, will be used in this Extension.

All acquisition programs are categorized based on location in the acquisition process, dollar value, and complexity. An Acquisition Category (ACAT) is assigned to all programs. ACAT levels are I (Major Defense Acquisition Program, or MDAP); IA (Major Automated Information System, or MAIS); II (Major System); and III (less-than-major system)

2.1 Technological Opportunities and User Needs

The Defense Science and Technology Program identifies and explores technological opportunities within DoD laboratories and research centers, academia, and commercial sources. The aim is to provide the user with revolutionary war-winning capabilities, and reduce the risk associated with promising technologies before they are introduced into the acquisition system. Three mechanisms are available to facilitate the transition of innovative concepts and superior technology to the acquisition process: 1) Advanced Technology Demonstrations (ATDs), 2) Advanced Concept Technology Demonstrations (ACTDs), and 3) Experiments. See Chapter 5 for a discussion of paths into system acquisition.

2.2 Phases and Milestones

Following is a brief discussion of each of the phases, work efforts, milestones, and other decision reviews. There is no "one size fits all." Each program structure must be based on that program's unique set of requirements and available technology. The process of adjusting the life cycle to fit a particular set of programmatic circumstances is often referred to as "tailoring." The number of phases, work efforts, and decision points are tailored by the PM, based on an objective assessment of the program's technical maturity

and risks and the urgency of the mission need.

- **Concept Decision.** The requirements generation and acquisition management systems shall use joint concepts, integrated architectures, and an analysis of doctrine, organization, training, materiel, leadership, personnel, and facilities (DOTMLPF) in a collaborative process to define desired capabilities to guide the development of affordable systems. Requisite capabilities will then be defined in an Initial Capabilities Document (ICD). Representatives of the DoD will examine multiple concepts and materiel approaches to optimize the way the DoD provides those capabilities. Entrance into the Concept Refinement Phase (Concept Decision in Figure 2-1) depends on a validated ICD, and approved plan for conducting an analysis of alternatives (AoA) for the selected concept, as documented in the approved ICD.

- **Concept Refinement.** The purpose of this phase is to refine the initial concept and develop a Technology Development Strategy (TDS). The Milestone Decision Authority (MDA) designates the lead DoD Component(s) to refine the initial concept selected in an AoA, approves the AoA plan, and establishes a date for a Milestone A. The results of the AoA will provide the basis for the TDS, to be approved by the MDA at Milestone A.

- **Milestone A.** A successful Milestone A includes approval of the TDS (which is a truncated program acquisition strategy focusing on the total research and development program) and authorizes entry into the Technology Development (TD) Phase. Technology Development is intended to reduce technology risk and to determine the appropriate set of technologies to be integrated into a full system. An Interim Capabilities Document (ICD) shall guide TD. If time-phased requirements are used, the initial capability represents only partial fulfillment of the overall capability described in the ICD, and successive technology development efforts shall continue until all capabilities have been satisfied. During TD, the user shall prepare the Capability Development Document (CDD) to support subsequent program initiation and to refine the integrated architecture. A Milestone B decision follows the completion of TD.

- **Milestone B.** Milestone B will normally be program initiation for defense acquisition programs. Program initiation depends on three things: a valid requirement (documented in a CDD), maturity of technology, and funding. Prior to making the program initiation decision, the MDA will confirm that technology is mature enough for systems-level development to begin, a CDD has been approved, and funds are in the budget and the out-year program for all current and future efforts necessary to carry out the acquisition strategy. A successful Milestone B authorizes entry into the System Development and Demonstration (SDD) Phase, which has two main work efforts or parts – System Integration and System Demonstration. A critical design review (CDR) will be the entry decision point for System Demonstration part of the SDD Phase.

- **Milestone C.** The purpose of Milestone C is to authorize entry into low-rate initial production (LRIP) for applicable systems, into production or procurement for systems for which LRIP is not applicable, and into limited deployment for software-intensive systems with no production components. Milestone C can be

reached directly from pre-systems acquisition (i.e., from the TD Phase), or from SDD. A successful Milestone C (Full-rate production (FRP) decision review) authorizes entry into the Production and Deployment Phase. Entrance criteria for this phase include: acceptable performance in development, test and evaluation (to include Independent Operational Test and Evaluation (IOT&E)); mature software capability; no significant manufacturing risks; manufacturing processes under control, acceptable interoperability, supportability and affordability, and a validated Capability Production Document (CPD). Initial Operational Capability (IOC) is achieved in the Production and Deployment (P&D) Phase.

- **Operations and Support.** During this phase, Full Operational Capability (FOC) is achieved as specified in the CDD, each element of logistics support is evaluated (e.g., supply and provisioning, maintenance, training, technical data, support equipment), and operational readiness is assessed. Logistics and readiness concerns and issues dominate this phase. Post-fielding supportability and assessment reviews are conducted, as appropriate, to resolve operational and supportability problems. Especially critical is the approach to long-term supportability for information technology systems or systems with a significant information technology component. During this "Post Deployment Software Support," the PM must successfully implement the supportability concept to ensure system readiness and continued satisfaction by the user. The supportability concept may rely on a Government activity, a commercial vendor, or a combination of both, to provide support over the life of the system. System status is monitored to ensure the system continues to meet the user's needs.

- **Sustainment Work Effort**. The purpose of the sustainment work effort is to support the tenets of evolutionary acquisition. This work effort ensures that system support and life-cycle affordability considerations that were addressed and contained in the program overall acquisition strategy are carried out. The PM implements the support strategy for life-cycle sustainment and continuous improvement of product affordability, while sustaining readiness. The PM also ensures that a flexible, performance-oriented strategy to sustain systems is developed and executed. The support strategy defines the supportability planning, analyses, and trade-offs for the system. The support strategy contains sufficient detail to define how the program will address the support and fielding requirements that meet readiness and performance objectives. Sustainment strategies must evolve and be refined throughout the life cycle, particularly during modifications, upgrades, re-procurement, and development of subsequent blocks of an evolutionary strategy.

- **Disposal Work Effort**. The purpose of the disposal work effort is to demilitarize and dispose of a system at the end of its useful life. The PM addresses demilitarization and disposal requirements in the acquisition strategy, and ensures that sufficient information exists so that disposal can be carried out in a way that is in accordance with all legal and regulatory requirements relating to safety, security, and the environment. Disposal of the system occurs at the end of its useful life. The PM should have planned for disposal early in the system's life cycle and ensured that system disposal minimizes DoD's liability resulting from environmental, safety, security, and health issues. Environmental considerations are particularly critical during disposal as there may be international treaties or other legal considerations requiring intensive management of the system's demilitarization and disposal.

- **Follow-on Blocks**. Evolutionary acquisition is an approach that fields an operationally useful and supportable capability in as short a time as possible. With an evolutionary acquisition approach, the ultimate capability delivered to the user is divided into two or more blocks, with increasing increments of capability. This approach is particularly useful if software is a key component of the system, and the software is required for the system to achieve its intended mission. Evolutionary acquisition delivers an initial capability with the explicit intent of delivering improved or updated capability in the future. The scope, performance capabilities, and timing of subsequent blocks are based on continuous communications among the requirements, acquisition, intelligence, logistics, and budget communities.

- **Product Improvement or Service Life Extension Programs.** Product improvement programs or service life extension programs, may be initiated as a result of experience with the systems in the field. During deployment and throughout operational support, the potential for modifications to the fielded system continues.

2.3 Program Acquisition Strategy

The program acquisition strategy must define what approach will be followed to achieve Full Operational Capability (FOC). There are two approaches: single step to full capability and evolutionary acquisition. The approach to be followed depends on the availability of time-phased requirements in the CDD, maturity of technologies, cost analyses, supportability considerations, and training. For evolutionary approaches, software and hardware development and integration will follow either an incremental or spiral development process. Spiral development follows an iterative development process in which continually expanding system versions are released based on learning from earlier development activity and user experience from earlier deployments. Simply stated, spiral development is an iterative process for developing a defined set of capabilities within one increment or block of a system.

2.4 Key Activities

All acquisition programs – regardless of acquisition category (ACAT) – must accomplish certain key activities. These activities generate information that structures and defines the program, and facilitates planning and control by the PM and oversight by a MDA. The information generated by key activities may be contained in stand-alone documents or may be structured in accordance with the desires of the MDA. Most of this information and documentation is carefully constructed by the PM using integrated product teams.

Key activities include requirements determination, selection of a preferred alternative, cost estimating, formulation of an strategy acquisition and program structure, contract planning and management, budget execution, formulation of an acquisition program baseline, test planning, interoperability planning, and technical management. One key difference between DoD and commercial practices is that lessons learned are collected during program execution processes rather than only as part of a closing process. This is necessary because of the more rapid turnover of DoD program personnel.

Chapter 3

Project Management Processes

This *U.S. DoD Extension* subscribes fully to the content of Chapter 3 of the *PMBOK® Guide*. Of particular note are the "Relationships Among Controlling Processes" shown in Figure 3-7 of the *Guide*. These relationships fit the "plan-do-assess" cycle utilized by many defense PMs. The central focus of the figure — the controlling function — works off the variances flowing from monitoring and measuring (assessing). Once a manager "assesses" how well his/her program is on target vis-à-vis cost, schedule, and performance, plans may be amended and/or redrafted ("plan"), and the plan (or changes) executed ("do"). The cycle then moves again into the "assess" phase.

While Government and industry PMs engaged in DoD acquisition programs utilize processes described in Chapter 3 (Project Management Processes) of the *PMBOK® Guide*, they are also governed by three unique DoD decision making support systems:

- The Requirements Generation System,
- The Defense Acquisition System, and
- The Planning, Programming, and Budgeting System (PPBS).

The Requirements Generation System will be described in this Extension under Project Scope Management (Chapter 5). The Defense Acquisition System (with an overview in Chapter 2) contains two sub-systems: the Life-Cycle Process, which will be addressed throughout the project management area discussions, and the Contracting Process, which will be discussed under Project Procurement Management (Chapter 12). The PPBS will be discussed under Project Cost Management (Chapter 7).

SECTION II

THE PROJECT MANAGEMENT KNOWLEDGE AREAS

4. Project Integration Management
5. Project Scope Management
6. Project Time Management
7. Project Cost Management
8. Project Quality Management
9. Project Human Resource Management
10. Project Communications Management
11. Project Risk Management
12. Project Procurement Management

Chapter 4

Project Integration Management

The Department of Defense (DoD) Program Manager (PM), in the case of applicable contracts, will obtain integrated cost and schedule performance data to monitor program execution and to aid in risk management. The PM will require contractors to use internal management control systems that produce data that: (a) indicate work progress; (b) properly relate cost, schedule, and technical accomplishment; (c) are valid, timely, and able to be audited; and (d) provide DoD PMs with information at a practical level of summarization. The PM shall require that contractors' management information systems used in planning and controlling contract performance meet the Earned Value Management Systems (EVMS) guidelines set forth in *American National Standards Institute/EIA 748-98,* Chapter 2.

4.1 **Program Plan Development** – taking the results of other planning processes and putting them into a consistent, coherent document.

4.2 **Program Plan Execution** – carrying out the plan by performing the activities included therein.

4.3 **Integrated Change Control** – coordinating changes across the entire project.

The DoD PM will apply EVMS guidelines on applicable contracts within acquisition, upgrade, modification, or materiel maintenance programs, including highly sensitive classified programs, major construction programs, and other transaction agreements. EVMS guidelines shall apply to contracts executed with foreign Governments, project work performed in Government facilities, and contracts by specialized organizations such as the Defense Advanced Research Projects Agency (DARPA). EVMS guidelines will apply to research, development, test, and evaluation contracts, subcontracts, other transaction agreements, and intra-Government work agreements with a value of $73 million or more (in fiscal year (FY) 2000 constant dollars), or procurement or O&M (Operation and Maintenance) contracts, subcontracts, other transaction agreements, and intra-Government work agreements with a value of $315 million or more (in FY 2000 constant dollars). Department of Defense Federal Acquisition Regulation Supplement (DFARS) Clauses 252.234-7000 and 252.234-7001 are to be used to place EVMS requirements in solicitations and contracts.

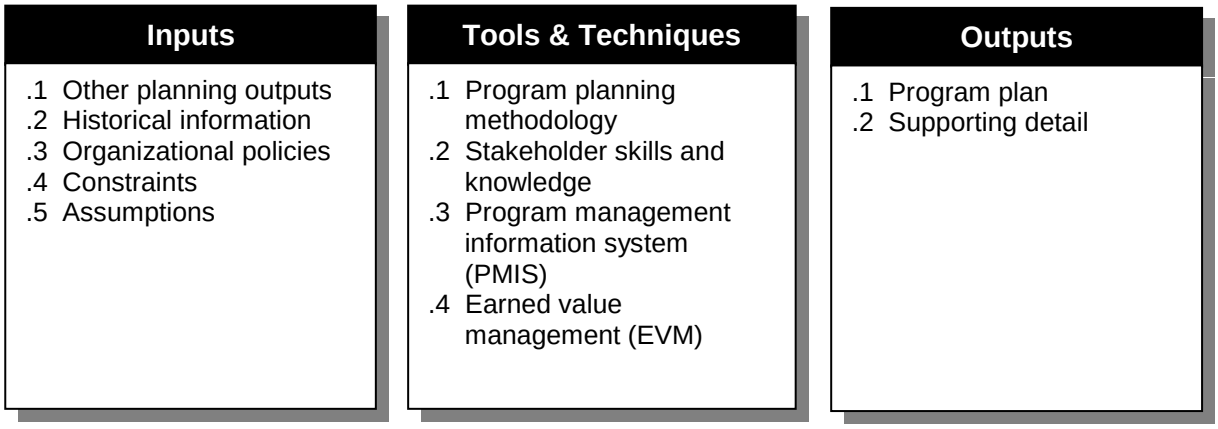
The Defense Contract Management Agency (DCMA) is the DoD Executive Agent for the EVMS for the Office of the Secretary of Defense (OUSD(AT&L)). Given its DoD Joint (Army, Navy, Air Force) organizational structure, the DCMA has responsibility for contractor

compliance with the EVMS Standard. Contractors may evaluate their own systems and attest that their management processes meet the industry standard; DCMA will then certify that management system as consistent with the standard, and ensure the contractor maintains compliance. In this role, DCMA is responsible for DoD's acceptance of contractors' EVMS, and performs system surveillance and program assessment on programs and contracts.

4.1 Program Plan Development

In addressing the roles and functions of the DoD PM as applied to EVMS planning, it is worthwhile noting that "the functions of the Department of Defense (DoD) program manager are not those classically associated with the term 'manager.' This stems from the fact that the Defense Department does not normally develop or produce its weapon systems in-house. Hence the principal function of the project manager and staff are contracting for, controlling, and evaluating the technical performance of the contractor(s)."[1]

This section provides procedures for Government personnel applying the EVMS to Government contracts along with the policy and general guidance for pre-contract activities associated with the EVMS.



4.1.1 Inputs to Program Plan Development

.1 *Other planning outputs.* The EVMS benefits greatly from the years of planning that have gone into the defining the above mentioned guidelines. The guidelines are intended to be objective and applicable to large, risky, cost-based Government programs. To repeat, the purpose of the EVMS guidelines is to provide the contractor and the Government PMs with accurate data to monitor execution of their program and to:

- Preclude the imposition of specific cost and schedule management control systems by providing uniform evaluation guidelines to ensure contractor cost and schedule management control systems are adequate.

- Provide an adequate basis for responsible decision making by both contractor management and DoD Component personnel by requiring that contractors' internal management control systems produce data that: (a) indicate work progress; (b) properly relate cost, schedule, and technical accomplishment; (c) are valid, timely, and able to

be audited; and (d) provide DoD Component managers with information at a practical level of summarization.

- Bring to the attention of DoD contractors, and encourage them to accept and install management control systems and procedures that are most effective in meeting requirements and controlling contract performance.

- Provide a baseline requirement against which industry standards, both national and international, may be evaluated for authorization by the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD(AT&L)) as substitutes for DoD EVMS guidelines.

.2 *Historical information.* In years past, DoD encouraged industry to take ownership of its EVMS processes. As a result, an industry-developed standard for integrated cost, schedule, and technical performance management was established that contained 32 criteria. This standard — American National Standards Institute/EIA 748-98 — was determined to be equivalent to an earlier set of 35 DoD cost/schedule control systems criteria. The industry standard provided for self-evaluation and/or customer evaluation of EVMS compliance. DoD accepted this approach, but reserved the right to conduct Government reviews of contract management systems of DoD contractors. Guidance for implementing these guidelines on DoD contracts can be found in the *Earned Value Management Implementation Guide (EVMIG*) in the *Defense Acquisition Deskbook*. Other industry guidance on earned value can be found in Chapter 7 (Project Cost Management) of the *PMBOK® Guide*.

.3 *Organizational policies.* DoD and industry PMs, in preparing to manage EVMS activities, should be aware of organizational roles and responsibilities of applicable DoD offices and their inputs to the process as follows:

- Performance Management Advisory Council (PMAC). The PMAC is an Integrated Product Team (IPT) that assists DCMA, the Office of the Secretary of Defense (OSD), the Services and other participating federal agencies to promote and improve the utility and practice of the EVMS. The DCMA Website is: http://www.dcma.mil/.

- Focal Points. Each component establishes a focal point to serve as a point of contact for coordination and exchange of information on EVM. The focal point is responsible for effective policy implementation within its respective component, including ensuring consistency with DoD policy and the provisions of the *EVMIG*. Lists of appropriate contacts for component and other agency focal points are available at the OSD Earned Value Website: http://www.acq.osd.mil/pm/.

- Procuring Activity. The responsibility for implementation of EVMS guidelines on a contract is assigned to the organization tasked with executing the procurement. This organization is normally referred to as the Procuring Activity. For purposes of the *EVMIG*, the procuring activity is composed of the Program Management Office (PMO), the contracting organization, and the integrated component activities that support the PMO. The DoD EVMS Executive Agent will organize a team of qualified individuals, in coordination with the procuring activity, to conduct, when necessary, in-plant reviews of the contractor's management control systems.

- Contract Administration Office (CAO). The CAO is the cognizant office that is assigned to administer contractual activities at a specific facility in support of the PMO.

- Contract Auditor. The Defense Contract Audit Agency (DCAA) is responsible for conducting audit reviews of the contractor's accounting system policies, procedures, and activities.

.4 *Constraints.* This section will address constraints applicable to preparation of the solicitation that will contain EVMS provisions:

- When applicable, the contract will require that any system used by the contractor in planning and controlling the performance of the contract must meet the guidelines set forth in Appendix 4 of the *Interim Defense Acquisition Guidebook (IDAG)* (1 of 3 documents in the DoD 5000 Series).

- Unless waived by the MDA or a designated representative, compliance with the EVMS guidelines will be required on significant contracts and subcontracts within all acquisition programs, including highly sensitive classified programs and major construction programs. This also includes significant contracts executed for foreign Governments and for specialized organizations such as the DARPA, and significant acquisition effort performed by Government activities.

- Compliance with the EVMS guidelines is not required on some firm fixed-price (FFP) contracts (including FFP contracts with economic price adjustment provisions), or the entire contract, time and materials contracts, and contracts that consist mostly of level-of-effort work. However, the contractor's PM team should consider EVM for their own management purposes.

.5 *Assumptions.* The PM will not require a contractor to change its system provided it meets these guidelines, nor will the PM impose a single system or specific method of management control. These guidelines shall not be used as a basis for reimbursing costs or making progress payments.

4.1.2 Tools and Techniques for Program Plan Development

.1 *Program planning methodology. Work Breakdown Structure (WBS).* The development of the contract work breakdown structure (CWBS) is very important to the effectiveness of an EVMS. A too-detailed or poorly structured CWBS can increase the cost of implementing and maintaining an Integrated Management System (IMS) (see 4.1.2.3 below) on a project. The PM should exercise considerable care in its development. A preliminary top-level WBS, or program WBS, is made part of the solicitation. This preliminary/program WBS should be structured in accordance with the guidelines established by the acquiring Government agency. Guidance for DoD procurements, for example, is provided in DoD Military Handbook (MIL-HDBK) 881 (latest version), Chapter 5 of the *PMBOK® Guide* and Chapter 5 of this *U.S. DoD Extension*. This preliminary WBS is expanded by the contractor to: (a) reflect the manner in which the work will be accomplished on the contract; and (b) facilitate management, data collection, and reporting. This expanded WBS is called the contract WBS (CWBS).

Cost and Schedule Reporting. Excessive cost and schedule reporting requirements can be a source of increased contract costs. Careful consideration must be given when preparing

the contract data requirements list (CDRL) to ensure that it identifies the minimum data needs of the program and the appropriate Data Item Descriptions (DIDs) that provide data formats. The CDRL provides contractor guidance for preparation and submitting of reports, including reporting frequency, distribution, formatting, and tailoring instructions.

.2 *Stakeholder skills and knowledge.* The *EVMIG* provides the policy and general guidance for pre-contract activities associated with preparing a solicitation, in conducting source selection activities, and preparing a contract. The PM must be involved in evaluating the management system and reporting requirements placed on the contract, and be an active user of the information contained in the resulting reports. The PM tailors reporting requirements based on a realistic assessment of the management information needs for effective program control. The EVM Support Office (EVMSO) can provide assistance in tailoring. The PM, in structuring contract requirements, ensures that only the minimum information required for effective program management is requested. Management system requirements are defined in the contract statement of work (SOW) and in the applicable solicitation/contract clauses.

.3 *Program management information system (PMIS). The EVMIG, Appendix D,* addresses an Integrated Management System (IMS). It is defined as the management system and related sub-systems that establish the relationship between the cost, schedule, and technical aspects of the work. It is intended to measure progress, accumulate actual costs, analyze deviations from plans, forecast achievement of milestones and completion of contract events, and incorporate changes to the contract in a timely manner. Attention by the Government and industry PMs should lead to an effective IMS.

.4 *Earned Value Management (EVM).* See above.

4.1.3 Outputs from Program Plan Development

.1 *Program plan.* The DoD equivalent of the *PMBOK® Guide* Project Plan is normally promulgated in the form of a Single Acquisition Management Plan (SAMP) — containing a program Acquisition Strategy (AS) and program structure/schedule. The SAMP is a U.S. Air Force document, whereas the other Services have similar plans, but with different names.

When required by the Solicitation, each offeror's proposal shall include a description of the EVMS to be used. Normally, the offeror would be expected to propose use of an existing system provided that it meets the guidelines. An offeror proposing to use an EVMS previously accepted by the Government may satisfy the system description requirement by citing the Advance Agreement, Letter of Acceptance, or Certificate of Validation. Each offeror’s proposal should include a listing of procuring activity points of contact for contracts where the proposed EVMS has been previously used. An offeror not having a previously accepted system submits a plan to obtain system acceptance. This may involve self-evaluation with appropriate Government involvement, third party certification or Government review. EVM source selection evaluation activities will also cover:

- System Descriptions. If the offeror proposes a system that has not previously been accepted by the Government, the description of the offeror's EVMS must be in sufficient detail to show how it complies with the guidelines. The offeror's system description may be in his/her own format but must address applicable areas of Appendix B of the *Earned Value Management System Evaluation Guide.*

- Evaluation. Evaluation of the proposed EVMS is normally undertaken as part of the proposal evaluation process. This evaluation is basically an assessment to determine the probability of the system meeting the guidelines. If an offeror has proposed using a previously accepted system, the evaluation may consist of a confirmation that: 1) the previous acceptance was of an appropriate type (Development/Production), and 2) the system is currently in use and surveillance has not identified significant, uncorrected problems. The DCMA representative should be requested to provide insight regarding each offeror's EVMS capability, quality, and past performance.

- Clarification. An on-site examination of an offeror's proposed system is normally not required during proposal evaluation.

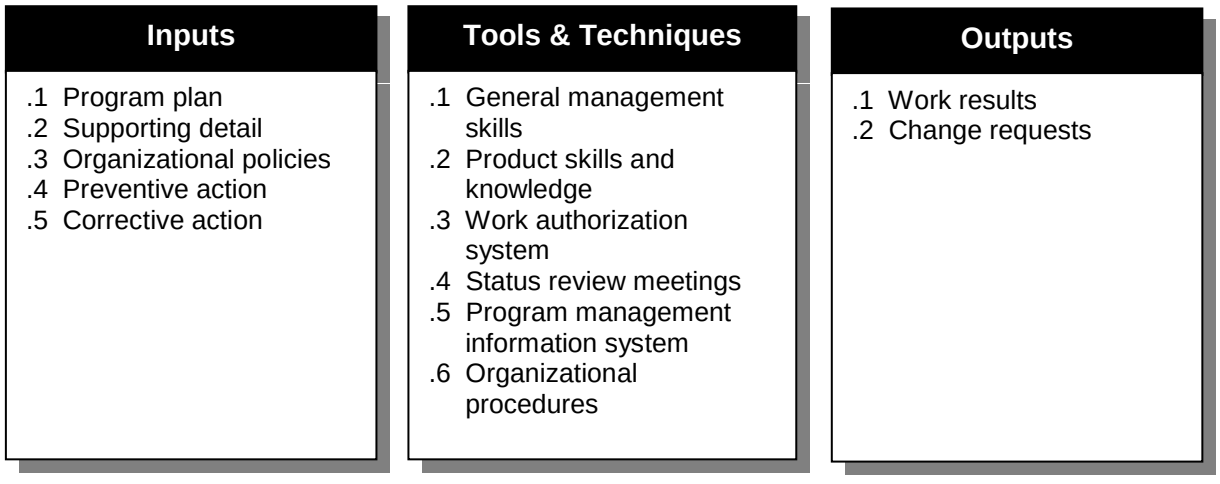
- Proprietary Information. Care must be exercised to avoid improper disclosure of information obtained from offerors, especially in competitive situations, in which the degree of compliance with the guidelines is a factor in contract award.

.2 *Supporting detail.* Preparation of the Contract. The contract provisions shall require that the contractor's system comply with the guidelines throughout performance of the contract. Applicable Government clauses are in the *EVMIG* Appendix A. The SOW tasks and the CDRL items from the solicitation also become part of the contract. Various clauses will cover the requirements of the guidelines and other conditions.

In addition to the contract — a charter between the PM and supplier — the acquisition program baseline (APB) serves as charter of cost, schedule, and performance requirements between the PM and his/her supervisors.

4.2 Program Plan Execution

This section describes earned value implementation actions following contract award.



4.2.1 Inputs to Program Plan Execution

.1 *Program plan.* Execution activities subsequent to contract award include EVMS surveillance, processing of contractor-generated changes to approved systems (see 4.3), training of Government personnel in the use of earned value, and conduct of post-award reviews of contractor data and systems.

.2 *Supporting detail.* The CAO has the primary responsibility for surveillance of the contractor's EVMS. A number of organizations are involved in the surveillance of contractor's EVMS. The grouping of organizations is referred to as the Integrated Surveillance Team (IST). EVMS surveillance begins prior to contract award, continues through system compliance evaluation and acceptance (when required), and extends throughout the duration of the contract.

.3 *Organizational policies.* The responsibilities of the Government PMO include: negotiating and updating a Memorandum of Agreement (MOA) with the CAO; keeping the CAO informed of actions and matters that could affect EVMS surveillance; assisting resolution of problems cited in surveillance reports by providing required support to the Contract Performance Management (CPM) monitor; reviewing, evaluating, and analyzing contractor performance reports and bringing issues to the attention of the CAO; apprising the CAO of the adequacy and usefulness of the surveillance reports, and where necessary, stating required changes to reporting practices; and obtaining assistance from the procuring activity's EVMS support organization in resolving EVMS issues. See Figure 4-1.

.4 *Preventive action.* See Chapter 11.

.5 *Corrective action.* See 4.3 below.

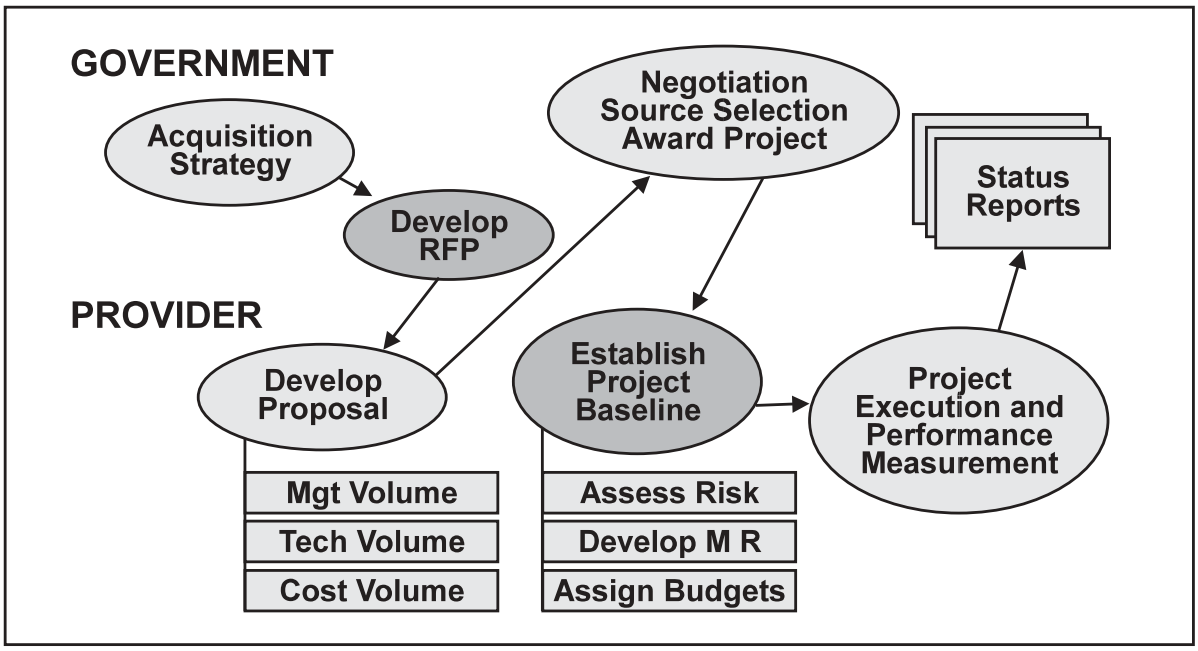


Figure 4-1. Earned Value and the Contracting Process

4.2.2 Tools and Techniques for Program Plan Execution

.1 *General management skills.* Personnel participating in EVM activities should be capable of determining if the contractor's system:

- Provides timely and reliable cost, schedule, and technical performance measurement information summarized directly from the contractor's internal management system. See Figure 4-1. Earned Value and the Contracting Process.

- Complies with the guidelines.

- Provides timely indications of actual or potential problems.

- Maintains baseline integrity.

- Provides information that depicts actual conditions and trends.

- Provides comprehensive variance analysis at the appropriate levels including proposed corrective action in regard to cost, schedule, technical, and other problem areas.

.2 *Product skills and knowledge.* In order to effectively utilize the information generated by the contractor's EVMS and reported in the external reports, program office, CAO, DCAA, and contractor personnel should receive training in the analysis of earned value data. There are three general sources of training: formal training classes (e.g., DoD schools); contractor-sponsored training; and, informal, on-the-job training.

.3 *Work authorization system.* Tools include three key documents:

- An Advance Agreement (AA) is executed between the Government and a contractor specifying that the contractor will maintain and use the accepted EVMS as an integral management process on the current as well as future contracts.

- A Memorandum of Agreement (MOA) is a negotiated agreement that identifies the key individuals, specific responsibilities, priorities, reporting requirements, and working relationships between the PMO and the CAO, or between CAOs where multiple prime contractors are involved. The MOA describes the activities necessary to achieve and maintain effective program surveillance.

- The contract.

.4 *Status review meetings.* The *EVMIG***,** Part II, Section 4, addresses the subject of EVMS reviews. It defines the process for performing Integrated Baseline Reviews (IBRs), initial compliance evaluations of proposed EVMS, and reviews for cause of subsequent implementations of accepted systems. It provides guidance on the approaches to, preparations for, and the performance of these reviews. The preparation of reports resulting from these reviews is covered in Appendix C to the *EVMIG*. To resolve disputes and to achieve a coordinated team effort, joint supplier/buyer status review meetings need to be held often to maintain program plan focus.

- Integrated Baseline Review. The IBR is a joint assessment by the Government and the contractor of the contractor's performance measurement baseline (PMB). See Figure 4-2 for PMB description. It is conducted within six months of the award of a new contract or a major change to an existing contract. The responsibility for conducting the IBR lies with the PM and the PMO technical staff. This action is also

aimed at institutionalizing a process that facilitates the involvement of the PM and the program technical staff in the use of performance measurement information.

- Initial Compliance Evaluations. The compliance evaluation is a formal review conducted to assess the contractor's proposed EVMS relative to compliance with the Guidelines. It focuses on those processes defined and used by the contractor to manage major acquisitions in an earned value environment.

- Post Acceptance Reviews for Cause. After the initial acceptance of a contractor's EVMS, no further system evaluation reviews will be conducted unless there is a serious need determined by the Government. The decision to conduct a post-acceptance review may occur when conditions warrant (e.g., solving a major system application problem identified by the PM or surveillance monitor on a specific contract). To the extent possible, problems should be resolved as part of the normal surveillance process rather than by invoking additional reviews.

- Deficiencies in the Previously Accepted System. In those instances where surveillance activities, program office analysis of performance data, or a review team determine that the contractor's accepted management system does not meet the guidelines requirements, the contractor and Administrative Contracting Officer (ACO) should be promptly notified. The information provided must detail the specific area of deviation. The procuring activity and EVMSO should be notified of major deficiencies, and advice should be obtained from all parties. If the contractor disagrees that there is a problem and does not propose an acceptable change to the system, the appeal procedures outlined in the *EVMIG* will apply.

.5 *Program management information system.* This includes the EVMS.

.6 *Organizational procedures.* See 4.2.1.3, 4.2.2.3, and 4.2.2.4 above.

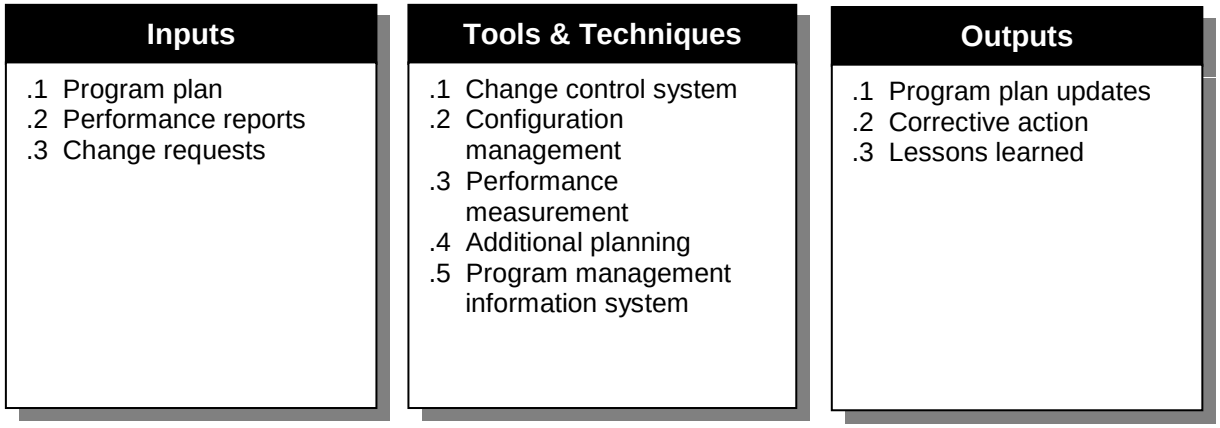
4.2.3 Outputs from Program Plan Execution

.1 *Work results.* Cost Performance Reports (CPR). Contractually required reports, prepared by the contractor, containing information derived from the internal EVMS, provide status of progress on the contract. See *PMBOK® Guide* 10.3.3.

.2 *Change requests.* See 4.2.2.4 above.

4.3 Integrated Change Control

Changes in major programs are inevitable. This discussion addresses the controlled process whereby projects incorporate formal changes, conduct internal re-planning, and adjust past, present, and future information to accommodate changes. The keys are timeliness, documentation (for historical purposes and to justify approval/rejection of change requests) and control.



4.3.1 Inputs to Overall Change Control

.1 *Program plan.* Baselines in Excess of Contract Value. During the life of a project, situations may arise whereby available budgets for the remaining work are insufficient to ensure valid performance measurement. Under these circumstances, a requirement may exist for the total budget allocated to work to exceed the recognized Contract Budget Base (CBB). The resulting value is referred to as an Over-target Baseline (OTB). Establishment of an OTB may entail re-planning future work, re-planning in-process work, and/or adjusting variances (cost, schedule, scope/quality/performance, or any combination). This allows the project to increase the amount of budget for the remaining work to a more realistic amount to adequately provide for reasonable budget objectives, work control, and performance measurement.

.2 *Performance reports.* Control of Internal Changes to the PMB. Future plans may significantly vary from the original baseline, and the program may choose to realign scope, schedule, or budget. Some examples of when it may be appropriate to do internal re-planning (i.e., within the program target cost or approved Total Allocated Budget (TAB)) include:

- Changes resulting from a Preliminary Design Review (PDR) or a Critical Design Review (CDR) that modify future requirements;
- A major shift in the resource profile to accomplish the remaining effort;
- Funding restrictions or modifications that affect future resource availability;
- Rate changes that are significant enough to warrant re-planning.

.3 *Change requests.* Customer-directed changes to the program can impact virtually all aspects of the internal planning and control system, such as organization structures, work authorizations, budgets, schedules, and Estimates at Completion (EAC). The incorporation of authorized changes should be made in a timely manner and strictly controlled. This will ensure the PMB can be accurately maintained.

4.3.2 Tools and Techniques for Overall Change Control

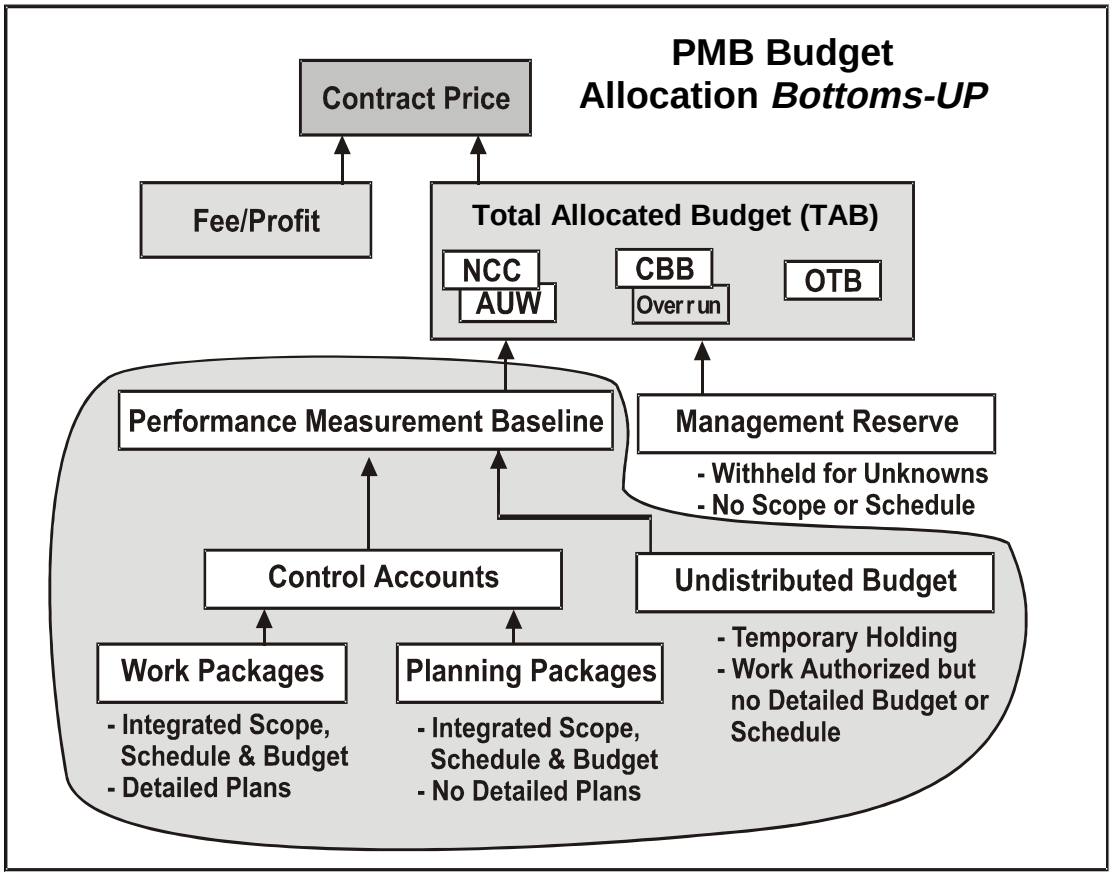


Figure 4-2. PMB Budget Allocation

.1 *Change control system.* For adjusting plans the following applies:

- Program plan/baseline. A thorough analysis of contract status is necessary before the implementation of an OTB. The contractor should perform a detailed estimate of all costs necessary to complete the remaining effort. If the difference between the estimated cost to complete and the remaining budget is significant, the contractor will notify the appropriate parties of the need to increase the remaining budgets. It is imperative that the contractor consult with the Government PM prior to implementing the OTB. This consultation shall include a discussion regarding project cost, schedule, funding, and technical implications expected as a result of implementing the proposed OTB. See Figures 4-2 and 4-3.

- Provide Traceability to Previous Budgets. The original budget established for the project should constitute a traceable basis against which project growth can be measured. The starting point or base on which these original budgets are built is the project target cost. This value increases or decreases only as a result of authorized changes. For definitized changes, the project target cost changes by the negotiated amount. For authorized work that has not been negotiated, the project target cost increases by

the amount of cost estimated for that effort. Where a specified Not-to-Exceed (NTE) amount has been established, the project target cost will only increase by this amount unless both parties mutually agree to a different amount for performance measurement purposes. After negotiations, the project target cost is adjusted to reflect the negotiation results. Adequate records of all changes shall be maintained to provide the basis for reconciliation back to the original budgets assigned during the base-lining process.

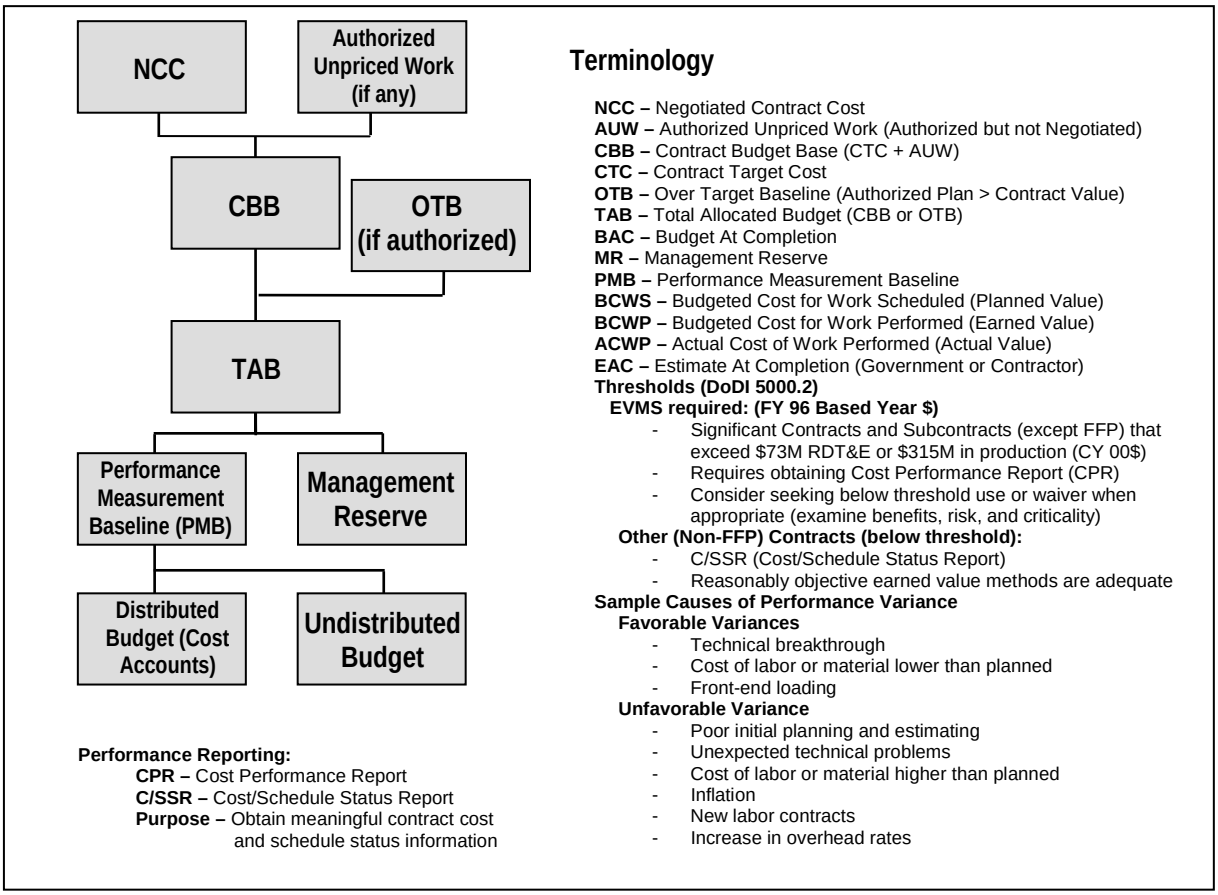


Figure 4-3. Earned Value Management Methods

.2 *Configuration management.* See same in *PMBOK® Guide*; although the DoD supplier often executes configuration management, the DoD buyer must ensure adequate configuration control measures are established by contract.

.3 *Performance measurement.* See Figure 4-4; also see same in *PMBOK® Guide*.

.4 *Additional planning.* See same in *PMBOK® Guide*.

.5 *Program management information system.* Five additional major tools and techniques of change control are described in the *EVMIG*:

- Control account re-planning;

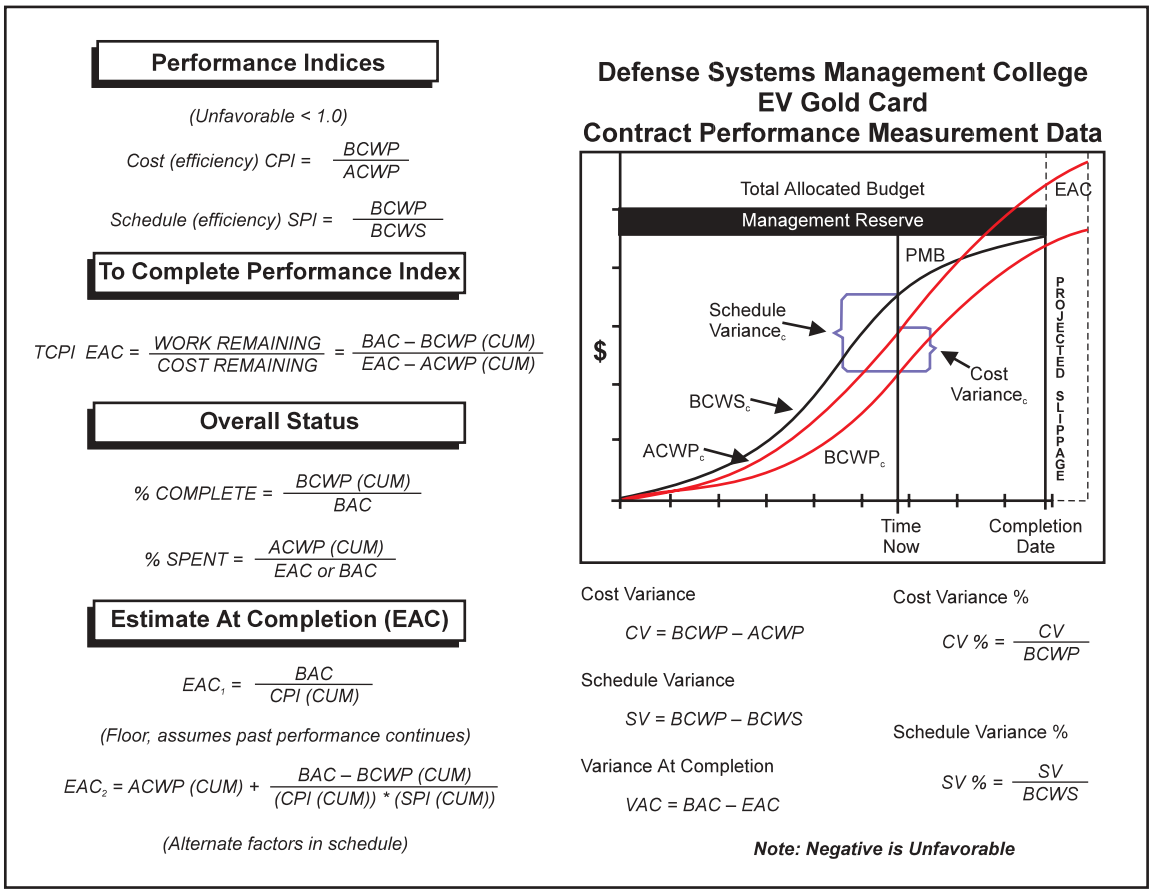


Figure 4-4. Contract Performance Measurement Data

- Manufacturing work package changes;
- Correlation of internal project cost with the CBB;
- Maintenance of change traceability;
- The “Revision and Data Maintenance” section of the *EVMS Guidelines*.

4.3.3 Outputs from Overall Change Control

.1 *Program plan updates.* When the program managers are satisfied that the new baseline represents a reasonable plan for completing the contract, the new baseline becomes the basis for future performance measurement. In implementing an OTB, the changes to baseline budgets must be fully documented and traceable. If variances are adjusted, their cumulative values before adjustment will be retained to ensure traceability. Establishment of management reserve within the OTB is acceptable. OTBs or changes to OTBs should be limited to situations where needed to improve the quality of future cost and schedule performance management.

.2 *Corrective action.* Internal replanning is intended for in-scope changes to future budgets. The objective of internal replanning is to reflect a revised project plan. Changes to near term effort (scheduled to start in the next accounting period) must be minimized. Also see 4.3.2.5 above.

.3 *Lessons learned.* See same in *PMBOK® Guide*.

Endnotes

1. General Henry Miley, USA, letter to the Assistant Secretary of the Army, 11 July 1984.

Chapter 5

Project Scope Management

Project Scope Management includes the processes required to ensure that the program includes all the work required, and only the work required, to complete the program successfully. It includes the following key activities:

5.1 Initiation – committing the organization to begin the next phase of the program.
5.2 Scope Planning – developing a written scope statement as the basis for future program decisions.
5.3 Scope Definition – subdividing the major program deliverables into smaller, more manageable components.
5.4 Scope Verification – formalizing acceptance of the program scope.
5.5 Scope Change Control – controlling changes to program scope.

Scope management is primarily concerned with defining and controlling what is or is not included in the program. In the *PMBOK® Guide*, paragraph 1.2, the question is asked, "What is a project?" Although the answer provided therein generally applies to the definition of a DoD program, some differences exist. The operative words in DoD are "Acquisition Program," defined in the *Defense Acquisition University Glossary* as:

> A directed, funded effort designed to provide a new, improved or continuing materiel, weapons, or information system or service capability in response to a validated operational or business need. Acquisition programs are divided into different categories that are established to facilitate decentralized decision-making, execution, and compliance with statutory requirements.

Within DoD today, it is equally important to understand the definition of a Technology project; that is:

> A directed, incrementally funded effort designed to provide new capability in response to technological opportunities or an operational or business (e.g., accounting, inventory cataloging, etc.) need. Technology projects are "pre-systems acquisition," do not have an acquisition category, and precede program initiation (Milestone B and/or C). Technology is the output of the science and technology program that is used in systems acquisition. The decision authority and information necessary for decision making on each technology project will be specified by the appropriate S&T (Science and Technology) Executive (for projects not yet approved for Milestone A) or

by the Milestone Decision Authority (MDA) (for projects past Milestone A). Technology projects are not acquisition programs.

Continuing with a definition of scope, The *PMBOK® Guide* makes a distinction between "operations" and "projects." Within DoD, the distinction also exists. However, as noted in the *PMBOK® Guide* definition, the DoD PM must manage a portion of both. A major element of this is a long-standing policy within DoD of accounting for the life-cycle cost of a weapon system or automated information system (AIS). The DoD policy of the late 1990s and beyond, directs DoD PMs to manage and reduce the Program Total Ownership Costs (TOC), (also called Life-Cycle Cost (LCC)), of their system. In effect this policy creates a major sub-task or project within DoD acquisition programs that blends with *PMBOK® Guide* operations and projects (*PMBOK® Guide* 1.2). Thus, DoD PMs will be actively concerning themselves with cost management actions, including costs relative to operations, which may have a horizon of 30 years or more. As of 2001, for example, the Navy F-14 fighter aircraft program was over 30 years old, and the Navy F-18 aircraft program was over 20 years old and both are still the Navy's front-line aircraft. These aircraft will continue to operate well into the twenty-first century, and their TOC will be a continuing responsibility for DoD acquisition program PMs.

5.1 Initiation

The DoD Requirements Generation System (referred to in Chapter 1 of this Extension) may be started by studies and analyses defining an operational need, by identifying mature technology already available in the Federal Government or commercial industry, or by a combination of those processes. This process includes the study and analysis of mission areas and joint policy, a functional area analysis (FAA) to determine if a non-materiel solution is best, an assessment of alternative non-materiel user solutions to meet operational deficiencies, and the development of system specific performance requirements in an Initial Capabilities Document (ICD). The Chairman of the Joint Chiefs of Staff (CJCS) is responsible for policies and procedures for determining requirements.

The determination of mission capabilities is based on the FAA. This is a continuing process of assessing the capabilities of the current force structure (mission areas, people and materiel) to meet the projected threat, while taking into account opportunities for technological advancement, cost savings, and changes in national policy or doctrine. Mission areas are broad categories of responsibility, such as fire support for the Army.

Once identified, deficiencies (i.e., mismatches between current and projected capabilities and the future threat) need to be resolved. First considered (by user/warfighter community) are changes in doctrine, organization, training, materiel, leadership, personnel and facilities. These alternatives, often called "non-materiel alternatives," are investigated first because of their relatively low cost and ease (i.e., speed) of implementation. Should non-materiel alternatives prove incapable of resolving the deficiency, DoD will look for materiel solutions. The requirement for a materiel solution is documented in an Initial Capabilities Document (ICD). It describes an operational deficiency, or an opportunity to provide new capabilities, in broad operational, not system-specific, terms. See Figure 5-1.

Previously, DoD used Capstone Requirements Documents (CRD) to describe overarching system requirements for a broad mission need, such as surveillance or missile defense, from which may emerge a "system of systems." CRD information will now be included in mission area architectures. Nevertheless, CRDs will continue to be used until joint force integrated architectures are developed and implemented. A follow-on document to the ICD is the Capability Development Document (CDD). The CDD translates broad ICD requirements into more detailed and refined performance capabilities and characteristics of a

proposed system concept. The CDD also contains Key Performance Parameters (KPPs). KPPs are performance parameters deemed so critical to the success of the system that failure to attain their minimal values (called the "threshold values") would cast doubt on the desirability/viability of the program. Multiple CDDs could emerge from a single integrated architecture.

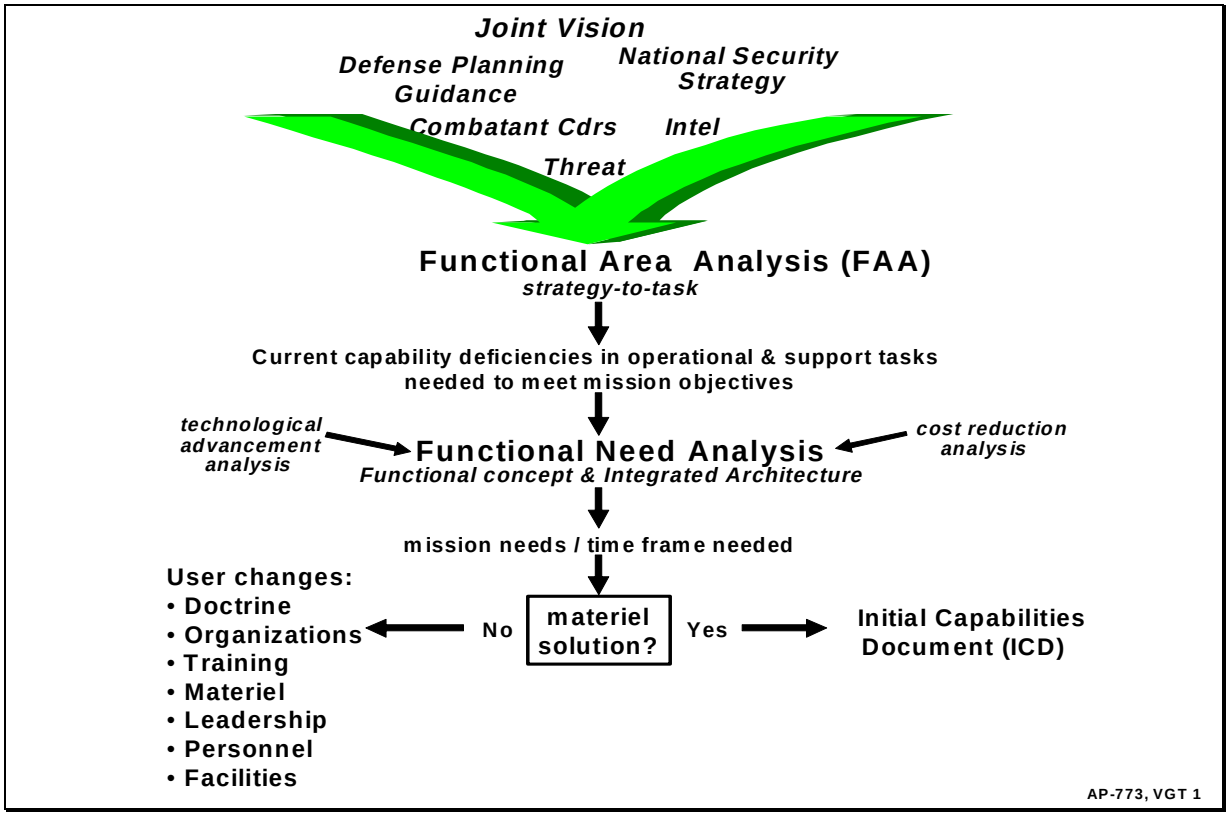


Figure 5-1. Mission Need Determination

Pre-system acquisition is composed of ongoing activities in development of user needs (addressed above), in concept development and refinement work related to an analysis of alternatives (AoA), and in science and technology (S&T) projects related to advanced technology demonstrations.

After the requirements authority validates and approves an Initial Capabilities Document (ICD), the MDA (through the IPT process) will review the ICD, consider possible technology issues (e.g., basic research advances, etc.), and identify possible alternatives before making a Concept Decision to enter the Concept Refinement Phase.

Concept Refinement (CR) Phase. The work effort during the CR phase will be guided by the validated ICD. Acquisition information (e.g., the Technology Development Strategy (TDS) — a truncated program acquisition strategy — and an Analysis of Alternatives (AOA)) is necessary for a Milestone A. In fact, a program may enter Technology Development at Milestone A only when the MDA has approved the Service's Technology Development Strategy (TDS). A favorable Milestone A decision does not mean that a new acquisition program has been initiated; a new program is not initiated until Milestone B. Milestone A shall not be held until a thorough analysis of multiple concept variations has been conducted,

including international systems from Allies and cooperative opportunities. If an international system is selected, the program may be able to enter systems acquisition activities at either Milestone B or C.

Technology Development (TD) Phase. Later, during TD, a CDD will be developed to support program initiation, and decisions made on what technology will initially be incorporated into the system. Technological opportunities within DoD laboratories and research centers, from academia, or from commercial sources are identified within the Defense S&T Program. The DoD S&T Program mission is to provide the users of today and tomorrow with superior and affordable technology to support their missions, and to enable them to have revolutionary war-winning capabilities. The S&T Program is uniquely positioned to reduce the risks of promising technologies before they are assumed in the acquisition process. The Deputy Under Secretary of Defense (Science and Technology) (DUSD(S&T)) is responsible for the overall direction, quality, content, and oversight of the DoD S&T Program (including software capability). The DUSD(S&T) is also responsible for promoting coordination, cooperation, and mutual understanding of the S&T Program within the DoD, other Federal Agencies, and the civilian community.

To ensure the transition and demonstration of innovative concepts and superior technology to the user and acquisition customer, the DoD Component S&T Executives use three mechanisms: Advanced Technology Demonstrations (ATDs), Advanced Concept Technology Demonstrations (ACTDs), and Experiments, both joint and Service-specific. The specific plans and processes for these transition mechanisms are described in the Joint Warfighting S&T Plan and the individual DoD Component S&T Plans. S&T activities will be conducted in a way that facilitates or at least does not preclude the availability of competition for future acquisition programs. See Figure 5-2.

System Development and Demonstration (SDD). The TD effort is normally followed by entry into the SDD phase after a Milestone B decision by the MDA. As relates to materiel solutions, DoD Components, before proposing such a system acquisition, are expected to affirmatively answer the following three questions:

- Does the acquisition support core/priority mission functions that need to be performed by the Federal Government?

- Does the acquisition need to be undertaken by the DoD Component because no alternative private sector or Governmental source can better support the function?

- Does the acquisition support work processes that have been simplified or otherwise redesigned to reduce costs, improve effectiveness, and make maximum use of commercial off-the-shelf technology?

The role of the Services should be noted here. United States Code Title 10 Sections 3013, 5013, and 8013, state that the Service Secretaries subject to the authority, direction, and control of the Secretary of Defense and subject to the provisions of Chapter 6 of Title 10 are responsible for, and have the authority necessary to conduct, all affairs of their Service department. This includes, among other functions, equipping (including research and development), supplying, training, servicing, and related functions in order to meet the current and future operational requirements of the combatant commands.

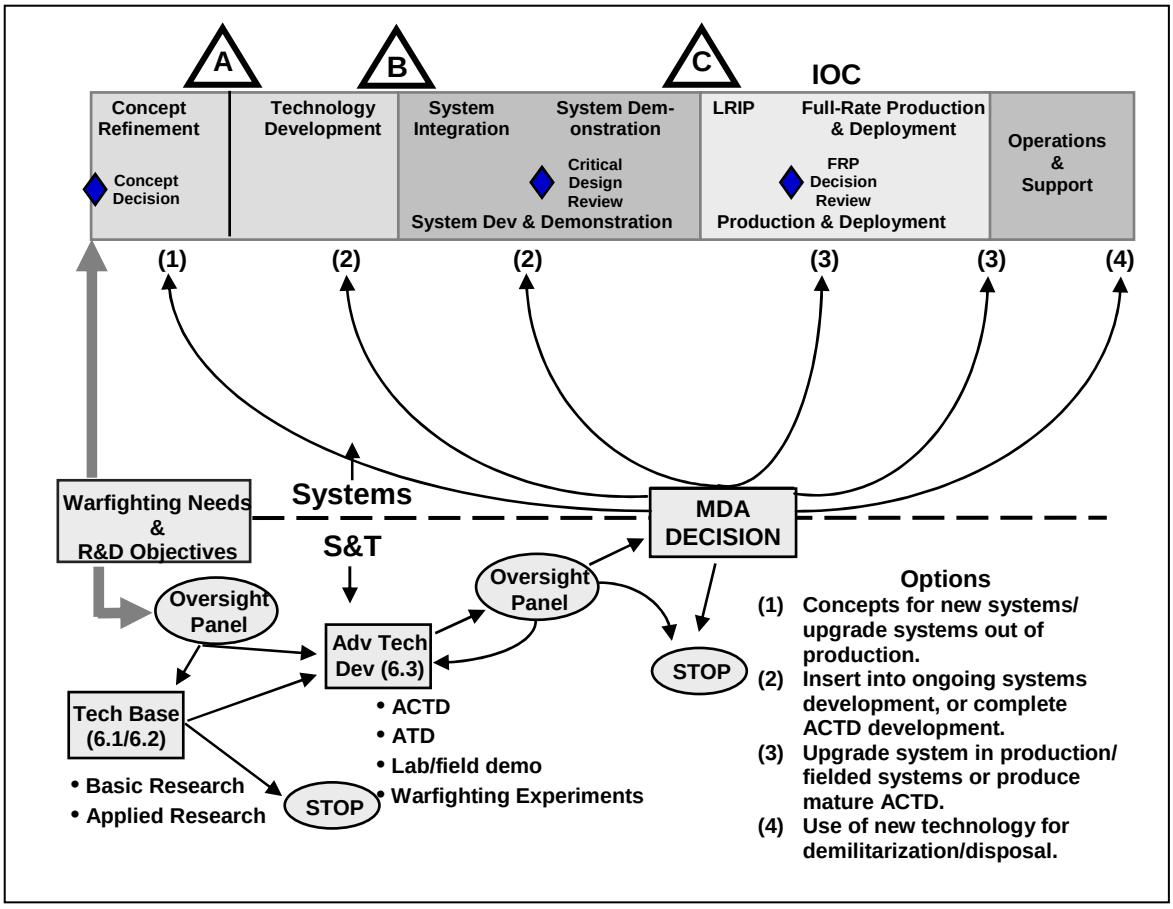


Figure 5-2. Science and Technology Linkage to Acquisition Process

Inputs	Tools & Techniques	Outputs
.1 Product description .2 Strategic plan .3 Program selection criteria .4 Historical information	.1 Program selection methods .2 Expert judgment	.1 Program charter .2 Program manager identified/assigned .3 Constraints .4 Assumptions

5.1.1 Inputs to Initiation

.1 *Product description.* The product or system is defined at Milestone B in terms of a performance or system specification, i.e., what the system must be able to perform in operational terms. This will set the functional baseline of the system. The system specification is based on the system performance requirements contained in the ICD and later the CDD at Milestone B. After Milestone B, the product is further defined in terms of a work breakdown structure (WBS).

.2 *Strategic plan.* During both concept refinement and technology development, plans call for examining alternative concepts, including cooperative opportunities and procurement or modification of Allied systems or equipment, to meet a stated mission need. In addition, planned technology assessments will be conducted to determine the maturity of critical system technologies for possible transition to the system acquisition process. At Milestone B, a preferred system concept and specific variation or approach of that concept is selected by the MDA. It will be defined in terms of objectives for cost, schedule, and performance; identification of interoperability, security, survivability, operational continuity, technology protection, operational support, and infrastructure requirements within a family of systems. Opportunities for tradeoffs, and an overall program acquisition strategy and test and evaluation strategy (including Development Test and Evaluation (DT&E), Operational Test and Evaluation (OT&E), and Live Fire Test and Evaluation (LFT&E)) will also be considered.

Prior to approving entry into SDD at Milestone B, the MDA shall consider several plans, analyses, and documents for the proposed program. Many of these items will require the MDA's specific approval at the time of Milestone B. Among these are:

- Goals. Every acquisition program shall establish program goals — thresholds and objectives — for the minimum number of cost, schedule, and performance parameters that describe the program over its life cycle. Each parameter shall have a threshold value and an objective value.

- Acquisition Program Baseline (APB). Every acquisition program shall establish an APB beginning at program initiation. The PM shall base the APB on users' performance requirements, schedule requirements, and estimate of total program cost. The APB will describe objectives and thresholds (program goals) for key performance parameters.

- The Department shall link program goals to the DoD Strategic Plan and other appropriate subordinate strategic plans, such as Component and Functional Strategic Plans and the Strategic Information Resources Management Plan.

- Cost as an Independent Variable (CAIV). In establishing realistic objectives, the user shall treat cost as a military requirement.

- Program Acquisition Strategy (AS). The PM shall develop and document a program AS to guide program execution from initiation through re-procurement of systems, sub-systems, components, spares, and services beyond the initial production contract award and during post-production support. It will evolve through an iterative process and become increasingly more definitive in describing the relationship of the essential elements of a program. The AS shall define not only the approach to be followed in SDD, but also how the program is structured

to achieve full capability. As noted in 2.3 of this Extension, *there are two such approaches,* evolutionary and single step to full capability. An evolutionary approach is preferred. Evolutionary acquisition is an approach that fields an operationally useful and supportable capability in as short a time as possible. This approach is particularly useful if software is a key component of the system, and the software is required for the system to achieve its intended mission. Evolutionary acquisition delivers an initial capability with the explicit intent of delivering improved or updated capability in the future.

.3 *Program selection criteria.* Subsequent to Milestone A, technology development work will proceed towards development of the functional baseline and further refinement of the CDD. Subsequent to Milestone B, program selections will be aided by the work done to develop the allocated and product baselines. Program selections for work performed in both the CR and TD Phases and in the SDD Phase will be supported by evaluated test results, including those flowing from modeling and simulation.

.4 *Historical information.* Lessons learned from similar (previous and ongoing) defense programs are available to assist in developing a rational and viable AS. Additionally, cost, reliability, and maintainability data on similar systems are available along with related methods for applying such data. A good source of this information is the Program Management Community of Practice (PMCoP), located at http://www.pmcop.dau.mil.

5.1.2 Tools and Techniques for Initiation

.1 *Program selection methods.* Subsequent to Concept Decision and during Concept Refinement, an Analysis of Alternatives (AoA) is the key decision-making tool for selecting among several alternatives. An AoA is an essential part of the CAIV process. It aids and documents the decision-making process by highlighting risk and uncertainty, and portrays the relative advantages and disadvantages of the alternatives being considered. Further, it is intended to show the sensitivity of each alternative to possible changes in key assumptions (e.g., threat) or variables (e.g., selected performance capabilities). Where appropriate, it will include a discussion of interoperability and commonality of components/systems similar in function to other DoD Component programs or Allied programs. Second, the analysis will aid decision makers in judging whether any of the proposed alternatives, including possible refinements to an existing system, offer sufficient military and/or economic benefit to be worth the projected life-cycle cost. There shall be a clear linkage between the AoA, system requirements, and system evaluation measures of effectiveness. Other tools used in selecting alternatives can include Kepner-Tregoe Decision Analyses, Decision Tree Analyses, Fishbone Analyses, Pareto Analyses, Cost Estimating Relationships, etc.

Subsequent to both Milestone A and B, discovery and development are aided by the use of simulation-based acquisition and test and evaluation, and guided by a system AS and test and evaluation master plan (TEMP). System modeling, simulation, test, and evaluation activities will be integrated into an efficient continuum planned and executed by a test and evaluation integrated product team (T&E IPT). This continuum will feature coordinated test events, access to all test data by all involved agencies, and independent evaluation of test results by involved agencies. Modeling, simulation, and development test will be under the direct responsibility of the PM or a designated test agency.

.2 *Expert judgment.* Consultants from industry, or experts from within the functional staffs of acquisition commands (matrix management), are often called in to advise the defense

program office on cost, schedule, performance, and risk issues. See Chapter 11, Project Risk Management.

5.1.3 Outputs from Initiation

.1 *Program charter.* Successful completion of the Milestone B program review signals the official initiation of a DoD acquisition program. Upon designation, the PM will be given budget guidance and a written charter (varies between Services) of his or her authority, responsibility, and accountability for accomplishing approved program objectives. It is normally issued by a program executive officer (PEO) or an acquisition commander, i.e., the individual to whom the PM reports in the acquisition chain of authority. For ACAT III programs, this authority is sometimes exercised at the system program office level.

However, the key document from Milestone B is the Acquisition Decision Memorandum (ADM) issued by the MDA. The coordinated ADM will note the initiation of a new DoD acquisition program, and will approve the following (also see Section 5.2.3.3 of this Extension):

- Program Acquisition Strategy (AS);
- Acquisition Program Baseline (APB), which will include objectives and thresholds for KPPs;
- System Development and Demonstration exit criteria;
- Numerous other (appropriate) documents and information items listed in the DoD 5000 Series.

.2 *Program manager identified/assigned.* A PM will be designated for each acquisition program. This designation will be made no later than program initiation (Milestone B). It is essential that the PM have an understanding of user needs and constraints, familiarity with development principles, and requisite management skills and experience. If the acquisition is for services, the PM shall be familiar with DoD guidance on acquisition of services. A PM and a deputy PM of an ACAT I or II program shall be assigned to the position at least until completion of the major milestone that occurs closest in time to the date on which the person has served in the position for four years in accordance with the Defense Acquisition Workforce Improvement Act (DAWIA). Prior to Milestone B, CR and TD phase activities will be directed by a team leader, working with and as a part of various IPTs, and guided by the ICD. When an MDA designates a program as “joint,” a lead executive service will also be specified.

.3 *Constraints.* See 5.1.3.1 above.

.4 *Assumptions.* Some program plans approved/accepted at Milestone A or B may be based on assumptions because factual data is not available. These assumptions may play a critical role in program actions and plans for several years. They should be based on the best engineering, financial, and schedule information available. To be valid, an assumption must make a difference if it fails to come true. Caution is necessary when employing assumptions and the MDA should be made aware of all assumptions by the PM. See 12.1.1.7.

5.2 Scope Planning

5.2.1 Inputs to Scope Planning

.1 *Product description.* See 5.1.1.1 above..

.2 *Program charter.* See 5.1.3.1 above.

.3 *Constraints.* See 5.1.3.3 above.

.4 *Assumptions.* See 5.1.3.4 above.

5.2.2 Tools and Techniques for Scope Planning

.1 *Product analysis.* DoD program management relies heavily on the trade-off techniques of systems engineering to accomplish scope planning. The unique aspects of DoD systems engineering will be examined later in this document; see Chapter 13, Project Systems Engineering Management.

.2 *Benefit/cost analysis.* A benefit/cost analysis may be provided in the AoA. In several other instances, DoD specifically requires a benefit/cost analysis, e.g., certain low rate initial production decisions, major AIS systems, and procurements involving automatic test systems. See 5.1.2.1 of this Extension and the same section of the *PMBOK® Guide*.

.3 *Alternatives identification.* See same in *PMBOK® Guide.*

.4 *Expert judgment.* See Section 5.1.2.2 above and 5.1.2.2 *PMBOK® Guide*.

5.2.3 Outputs from Scope Planning

.1 *Scope statement.* The overall scope of a DoD acquisition program and the PM's basic responsibilities are contained in 5.1.3.1 of this Extension. Program performance specifications and deliverables will be established in the contract or inter-agency agreements.

.2 *Supporting detail.* See 5.2.3.2 *PMBOK® Guide*.

.3 *Scope management plan.* Within DoD, the documents noted in 5.1.1 and 5.1.3.1 are the "Scope Management Plan" and contain the essential program management goals for that specific phase of the program and perhaps for the entire period of system development, testing, and manufacturing. Briefly, the content and purpose of the "Scope" documents flowing from the ADM that initiates the acquisition program and sustains it through each of its milestone reviews:

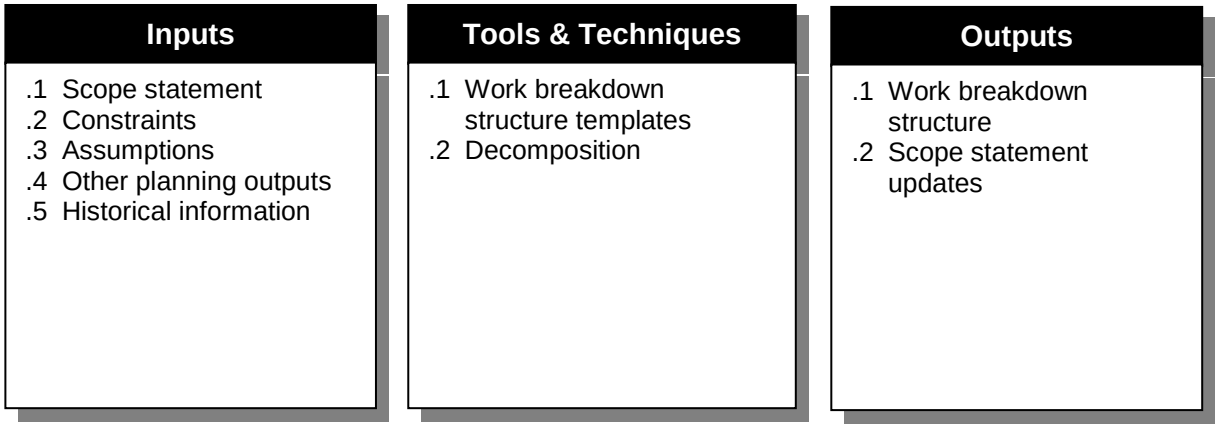
- Acquisition Decision Memorandum (ADM). Issued by the MDA after each program milestone review, whether an actual review is held or not. It is coordinated with other Defense Acquisition Board (DAB) principals for major ACAT I and II programs or special interest programs. It will contain decisions, specific direction, restraints, approvals, criteria, time limits, performance requirements and almost any other management decision or discussion the MDA chooses to offer a service and/or program.

- Acquisition Strategy (AS). Each PM shall develop and document an AS that shall serve as the roadmap for program execution from program initiation through post-production support. A primary goal in developing an AS shall be to minimize the time and cost of satisfying an identified, validated need, consistent with common sense and sound business practices. The AS shall evolve through an iterative process and become increasingly more definitive in describing the relationship of the essential elements of a program. Essential elements in this context include, but are not limited to, open systems, sources, risk management, CAIV, contract approach, management approach, environmental considerations, and source of support. The PM shall also address other major initiatives that are critical to the success of the program. The event-driven or objective criteria AS shall explicitly link program decisions to demonstrated accomplishments in development, testing, initial production, and life-cycle support. The events set forth in contracts shall support the appropriate exit criteria for the phase, or intermediate development events, established for the AS. The event-driven or objective criteria should be briefed at the AS briefing to the MDA.

- Acquisition Program Baseline (APB). Every acquisition program shall establish an APB to document the cost, schedule, and performance objectives and thresholds of that program beginning at program initiation. Performance shall include supportability and, as applicable, environmental requirements. Note that in DoD program management, quality is one of many features of performance.

- Exit Criteria. MDAs shall use exit criteria to establish goals for all programs during an acquisition phase. At each milestone review, the PM will propose exit criteria appropriate to the next phase of the program. The MDA shall approve the exit criteria. Exit criteria are normally selected to track progress in important technical, schedule, or management risk areas.

5.3 Scope Definition



5.3.1 Inputs to Scope Definition

.1 *Scope statement.* See Section 5.2.3.1 above.

.2 *Constraints.* See 5.1.3.3 above.

.3 *Assumptions.* See 5.1.3.4 above.

.4 *Other planning outputs.* See same in *PMBOK® Guide*.

.5 *Historical information.* See same in *PMBOK® Guide*.

5.3.2 Tools and Techniques for Scope Definition

.1 *Work breakdown structure templates.* Guidance on how to develop a WBS and templates for use in designing a program product and WBS are contained in MIL-HDBK 881 and *PMBOK® Guide* 5.3.2.

.2 *Decomposition.* See MIL-HDBK 881 and *PMBOK® Guide* 5.3.2.

5.3.3 Outputs from Scope Definition

.1 *Work breakdown structure.* See MIL-HDBK 881 and *PMBOK® Guide* 5.3.2.

.2 *Scope statement updates.* See same in *PMBOK® Guide*.

5.4 Scope Verification

In addition to the scope verification tasks noted in *PMBOK® Guide* 5.4, DoD processes include several major disciplines with structured oversight responsibilities, tailored reviews, and reports for acquisition program in-process reviews and phase completion. (See Chapter 2 of this Extension). For example:

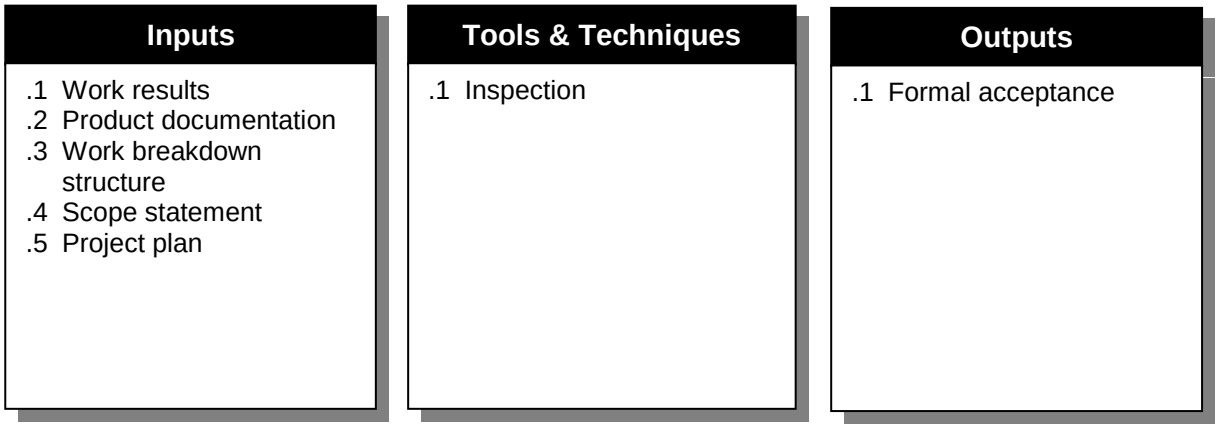
- At each milestone or program review, the MDA will determine that the program being reviewed is progressing satisfactorily and is still required under the current DoD Strategic Plan**.**

- Test and evaluation programs will be structured to integrate all DT&E, OT&E, LFT&E, and modeling and simulation activities conducted by different agencies as an efficient continuum. See Chapter 16 of this Extension for further detail.

- The Defense Acquisition Executive Summary (DAES) report will be the mechanism for status reporting of exit criteria for ACAT I programs. The Assistant Secretary of Defense (Command, Control, Communications, and Intelligence (ASD(C3I)) shall designate ACAT IA programs subject to DAES reporting.

- The APB will contain only the most important cost, schedule, and performance parameters. The most important parameters are those that, if the thresholds are not met, the MDA would require a reevaluation of alternative concepts or design approaches.

- Earned Value Management Systems (EVMS) criteria provide the contractor and the Government PMs with accurate data to monitor execution of their programs. EVMS may be more appropriate for cost-plus contracts in which financial data is essential for program management. Fixed-price contracts may not require EVMS data since the cost risk is leveraged on the contractor and may save program funding.



5.4.1 Inputs to Scope Verification

.1 *Work results.* In addition to the internal DoD procedures and reporting noted above, deliverables will have been established in the contract along with criteria. The costs incurred will be reported in Earned Value or similar documents, and cost will be further stated in contractor invoices.

.2 *Product documentation.* The technical data package will be established in the contract.

.3 *Work breakdown structure.* See same in *PMBOK® Guide*.

.4 *Scope statement.* See same in *PMBOK® Guide*.

.5 *Project plan.* See same in *PMBOK® Guide*.

5.4.2 Tools and Techniques for Scope Verification

.1 *Inspection.* Internal DoD review processes plus systems engineering portions of the contract will establish inspection procedures for deliverables.

5.4.3 Outputs from Scope Verification

.1 *Formal acceptance.* Internal DoD review process plus processes established in the contract for deliverables.

5.5 Scope Change Control

In addition to the scope change control tasks noted in *PMBOK® Guide* 5.5, DoD processes include several internal methods to control. These are:

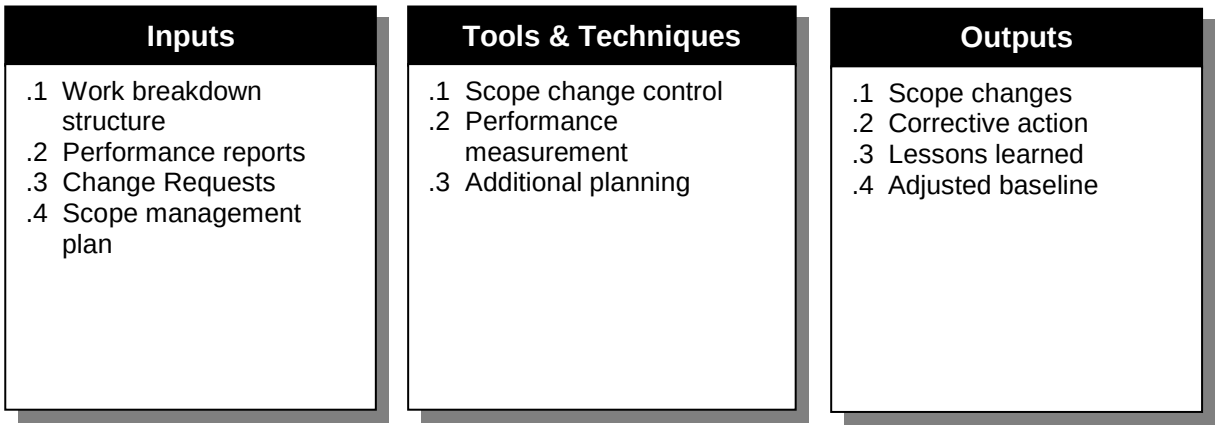
- Maximizing PM and contractor flexibility to make price/cost/performance trade-offs is essential to achieving cost objectives. Trade-offs — within the objective-to-threshold "trade space" — shall not require higher-level permission, but shall require coordination with the operational requirements developer. The operational requirements developer shall strictly limit the number of threshold and objective items in requirements documents and APBs. Performance threshold values shall represent true minimums, with requirements stated in terms of capabilities rather than as technical solutions and specifications. Cost threshold values shall represent true maximums. Cost objectives shall be used as a management tool. When a program has time-phased requirements and utilizes an evolutionary AS, each block shall have a set of parameters with thresholds and objectives specific to the block.

- The Cost/Performance Integrated Product Team (CPIPT) (normally led by the PM) shall be empowered to recommend to the PM performance or engineering and design changes as long as the threshold values in the CDD and APB can be achieved. If the changes require CDD/APB threshold value changes, the leader of the CPIPT shall notify the PM and the Overarching IPT (OIPT) leader. The PM shall ensure that proposed changes are quickly brought before the CDD and/or APB approval authorities for decision. The PM shall have responsibility for the conduct and integration of all cost performance trade-off analyses conducted.

- The MDA shall establish tailored milestone decision points for each acquisition program as early as possible in the program life cycle. At each milestone or program review, the MDA shall determine that the program being reviewed is progressing satisfactorily and is still required under the current DoD Strategic Plan.

- MDAs shall use exit criteria to establish goals for ACAT I and ACAT IA programs during an acquisition phase. At each milestone decision point and at each decision review, the PM shall propose exit criteria appropriate to the next phase or effort of the program. The MDA shall approve and publish exit criteria in the ADM.

Phase-specific exit criteria normally track progress in important technical, schedule, or management risk areas. The exit criteria shall serve as gates that, when successfully passed or exited, demonstrate that the program is on track to achieve its final program goals and should be allowed to continue with additional activities within an acquisition phase or be considered for continuation into the next acquisition phase. Exit criteria shall not be part of the APB and are not intended to repeat or replace APB requirements or the entrance criteria specified *in the DoD 5000 Series.* They shall not cause program deviations. The DAES shall report the status of exit criteria.



5.5.1 Inputs to Scope Change Control

.1 *Work breakdown structure.* See same in *PMBOK® Guide.*

.2 *Performance reports.* Some of the key progress reports by the Government PM up through the PMs chain of command are the DAES, Selected Acquisition Report (SAR), and Program Deviation Report (PDR). These reports are also used to notify higher authority of potential or actual breaches in the APB. Required reports are described in the DoD 5000 Series. Within DoD, periodic reports provide MDA with adequate information to oversee the acquisition process and make necessary decisions. Periodic reports are limited to only those required by the MDA or by statute. With the exception of the reports outlined in the 5000 Series, the scope and formality of reporting requirements will be tailored by the MDA.

In addition to the above internal DoD processes for controlling scope change, other important contributing information includes reports from the system contractor. These are reports integrating technical accomplishments with cost and schedule and linked to the EVMS and the CWBS.

.3 *Change requests.* Scope changes within DoD must be approved up through the acquisition chain of command. The level of approval depends on the ACAT of each specific program. At the ACAT I level (MDAPs), the MDA, who is either the Defense Acquisition Executive or the Component Acquisition Executive, may call for a program review of the proposed changes.

.4 *Scope management plan.* See Section 5.2.3.3 above.

5.5.2 Tools and Techniques for Scope Change Control

.1 *Scope change control.* Generic guidelines for change control are described in the 5000 Series for all defense acquisition programs. Guidelines covering specific program change control are contained in the program Acquisition Strategy, APB, WBS, CDD, system specification, and the program charter or equivalent document for the program.

.2 *Performance measurement.* See section 5.4 (fifth bullet in opening paragraph), and 5.5.2 above.

.3 *Additional planning.* See same in *PMBOK® Guide*.

5.5.3 Outputs from Scope Change Control

.1 *Scope changes.* MDA, Joint Requirements Oversight Council (JROC), and Principal Staff Assistant (PSA) approved changes, as appropriate, to the AS, APB, exit criteria, WBS, CDD, system specification and program charter.

.2 *Corrective action.* See same in *PMBOK® Guide.*

.3 *Lessons learned.* Lessons learned should be captured in the annual command chronology prepared by the Government defense program office. Copies of key program documents are retained on file in the program office, and/or in the Defense Technology Information Center (DTIC) operated by the Defense Logistics Agency (DLA) located at Fort Belvoir, Virginia. Major program lessons learned are also sometimes documented in publications of the Defense Acquisition University, Fort Belvoir, Virginia.

.4 *Adjusted baseline.* See same in *PMBOK® Guide*.

Chapter 6

Project Time Management

The objective of DoD Program Time Management is to establish a program schedule that will ensure timely completion of the Defense program. Time Management balances the needs for the IOC and deployment of the system with the ability to achieve those needs with acceptable risk. The major processes are:

6.1 **Activity Definition** – identifying the specific activities that must be performed to produce the various program deliverables.

6.2 **Activity Sequencing** – identifying and documenting interactivity dependencies.

6.3 **Activity Duration Estimating** – estimating the number of work periods that will be needed to complete individual activities.

6.4 **Schedule Development** – analyzing activity sequences, activity durations, and resource requirements to create the program schedule.

6.5 **Schedule Control** – controlling changes to the program schedule.

The product of Time Management is the Integrated Master Schedule (IMS), that is the integrated schedule of the program. It is a networked, multi-layered schedule of program tasks and is directly traceable to the Integrated Master Plan (IMP) and other program documentation. Figure 6-1 depicts the relationship between the IMP, IMS, and other elements of the program definition.

The IMS is the tool that provides the detailed tasks and timing of the tasks that support the work effort the IMP delineates. It supports all the criteria, accomplishments, and events of the IMP. It includes process tasks as required to ensure the fully integrated plan for the content of the program. The IMS ties them together by showing their logical relationships, any interrelationships between pieces of work, and any constraints that control the start or finish of each piece of work. The IMS thereby becomes the source that depicts the planned dates when each major event is expected to occur as well as all the expected completion dates for all work necessary to get to the event.

The IMS is used for identification of problem areas, both during program planning and execution, and to help define priorities for management attention and action, particularly as problem areas develop and are identified. As changes appear to be required, the schedule is used as a basis for evaluating changes, and is a significant tool for comparing actual to planned progress. The IMS is also a key ingredient to providing performance measurement and evaluating remaining work scope and duration. Figure 6-2 is an example of IMS as it is used for management of schedule progress.

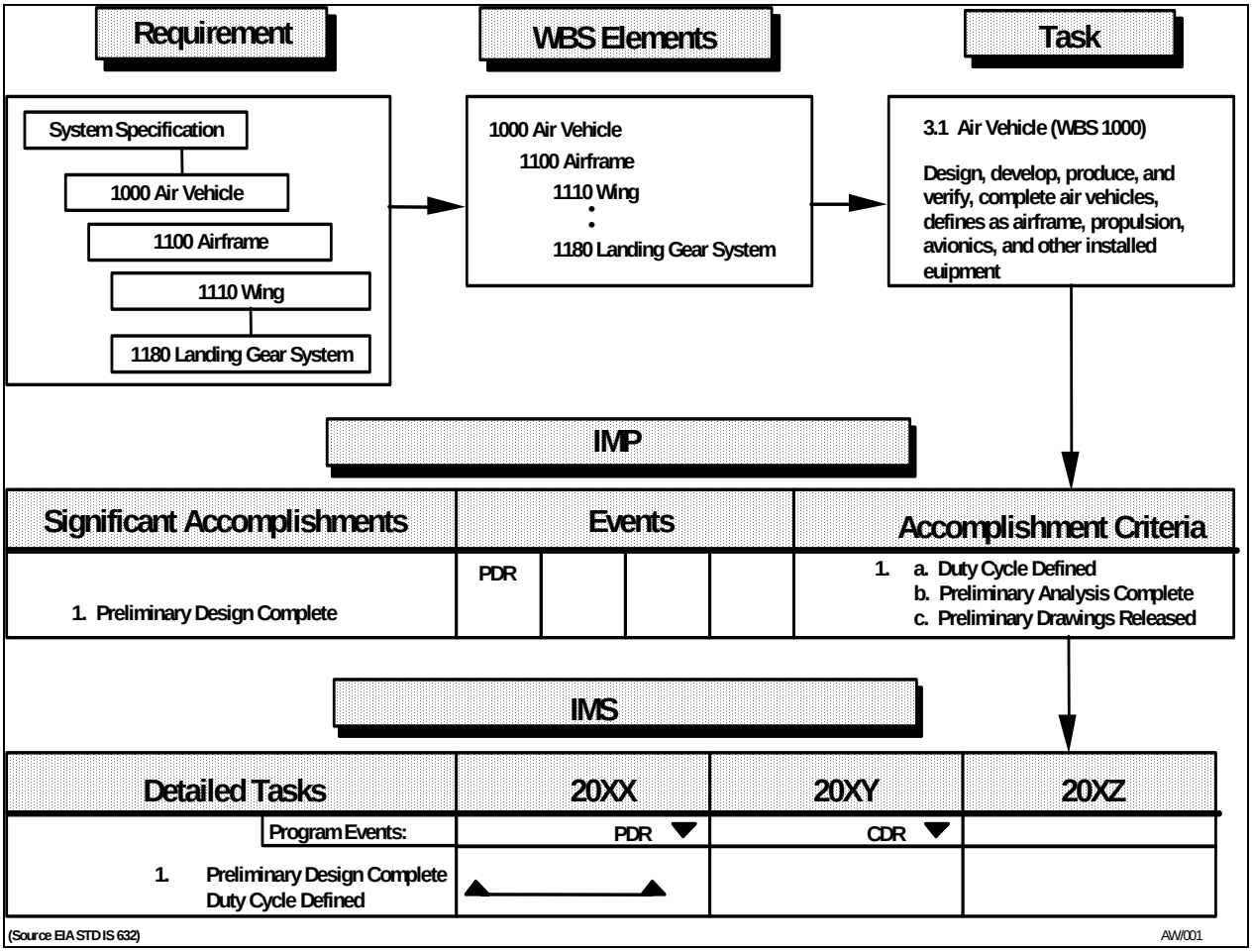


Figure 6-1. IMP vs. IMS Relationships

Prior to contract award. The planning IMS for a particular contract is developed by the Government prior to release of the RFP. This planning IMS is intended to determine whether or not the Government's expected schedule is achievable given the program requirements that are to be communicated in the RFP. Therefore, the planning IMS is developed to the level necessary to capture the activities for the entire contract effort, including Government-only tasks. Figure 6-3 shows an example of a top-level defense planning template (program structure) for a Defense/Aerospace program. Experienced program personnel provide data regarding critical and high-risk efforts and identify as realistically as possible the expected schedule. Early industry involvement is essential in the identification of these critical and high-risk efforts. Schedule uncertainty is discussed with industry in the bidders' conference(s) before release of the draft RFP (DRFP) and further comment is encouraged from them in response to the DRFP. An IMP may be prepared to further define program scope. IMPs are also sometimes referred to as Program Master Plans (PMP) or Master Program Plans (MPP).

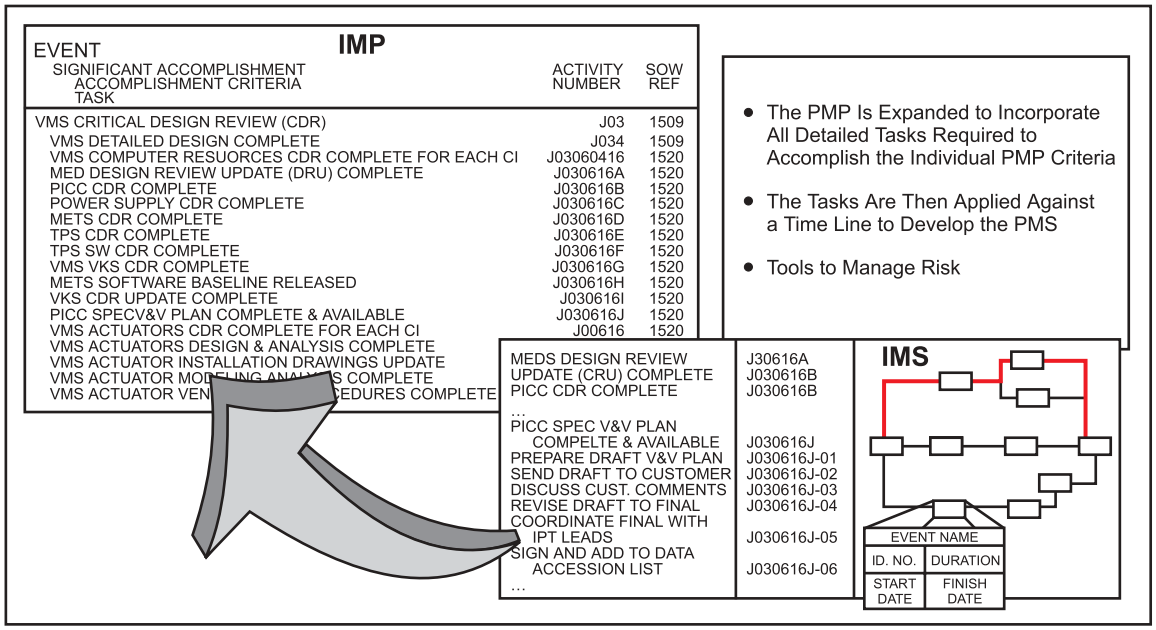


Figure 6-2. IMS: Managing Schedule Progress

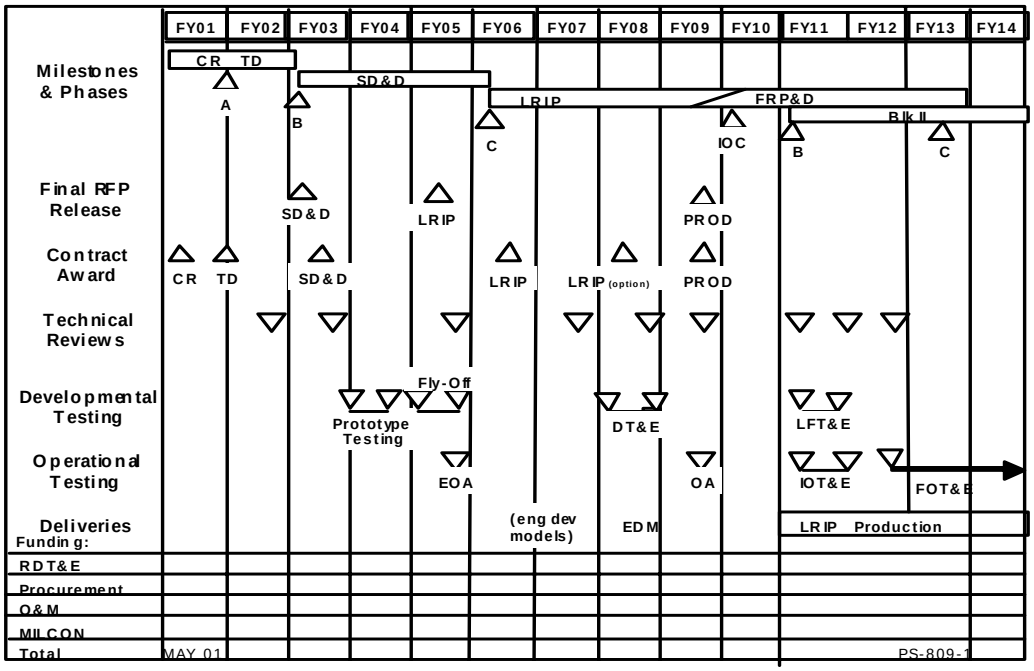


Figure 6-3. Program Structure (Example)

For Source Selection. The offerors develop their proposed Contract IMS for source selection by capturing all tasks that constitute the work required for successful completion of the program. Therefore, IMP events, accomplishments, and criteria are used as the skeletal structure to determine the detailed tasks as well as any appropriate integration work that might be described in the SOW. Detailed tasks are individual pieces of work effort that consume resources, potentially work package details or work packages that are completed in support of each of the specific criteria.

The Government source selection team uses each offeror's proposed IMS to determine the most probable schedule for each particular offeror's approach by conducting a schedule assessment on each proposed IMS as a part of the assessment of each proposal.

For Program Execution. When the program execution phase begins, the Contract IMP/IMS will become an essential tool for the management of program performance, cost, and schedule objectives. The Contract IMP/IMS, when properly designed and maintained, becomes the formal program baseline for all management activities. The contractor/Government team must agree on the level of detail required for tracking the IMS and define the specifics for the use of the IMS in the management review process. After the contractor has expanded his proposed IMS to the required lower levels, the IMS task responsibilities must be assigned and the IMS baselined. From that time on, status reviews and performance tracking should be performed from this baseline. The IMS will also support the more frequent performance tracking at the working level for critical or high-risk tasks.

The IMS is also the vehicle that ensures the communication of interfaces among various IPTs, functional staff, and other Government and contractor groups, and that work-arounds that might impact others are identified, communicated, and approved by those who are affected. It is used to evaluate alternative courses of action and to pinpoint the source of any program schedule problems.

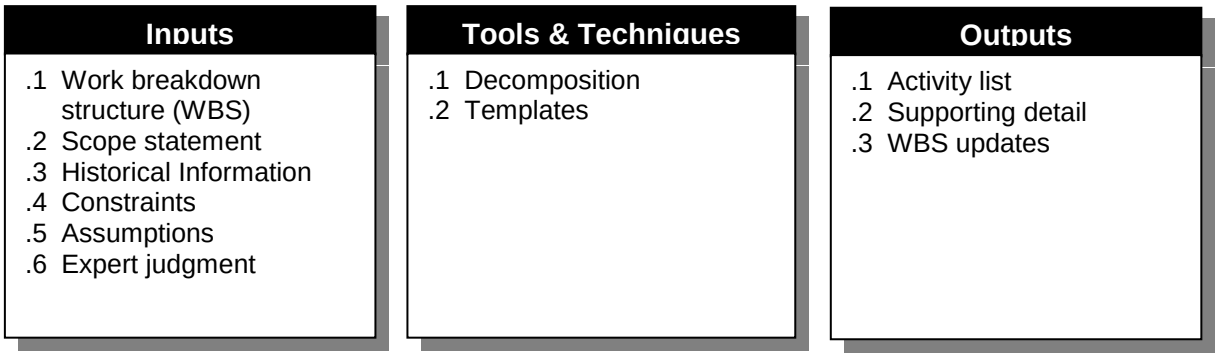
The Contract IMP/IMS must also support or directly feed the other tools used to manage the program, such as Technical Performance Measures, Metrics, and Risk Assessments. The Contract IMP/IMS should also provide data to support the program office estimating and budgeting processes and aid in "what-if" analyses during program life.

The scheduling system utilized by Defense/Aerospace industry programs is governed by the EVMS (see Chapter 4 of this Extension). This system requires a master schedule and related subordinate schedules (intermediate, detailed and/or cost account) to provide a logical sequence from the detail to the summary level.

The scheduling system must also provide for the identification of interdependencies between organizations and/or contract WBS elements. The criteria rely on logical project activity networks for managing the schedule interdependencies as defined by PMI's *PMBOK® Guide*. Most contractors utilize network-based planning as standard procedure.

Following are the elements of the *PMBOK® Guide* which are extended to comply with DoD requirements for Program Time Management.

6.1 Activity Definition



6.1.1 Inputs to Activity Definition

.1 *Work breakdown structure (WBS).* The initial WBS contains at least three levels of detail, using MIL-HDBK 881B, Section 5.3.2 of this Extension, and the *PMBOK® Guide.*

.2 *Scope statement.* The following products are typically used by the contractor to define schedule activities:

- Acquisition Strategy (AS) – This document — prepared by the Government program office — is a business and technical management approach designed to achieve program objectives within specified resource constraints. It is a framework for planning, organizing, staffing, coordinating, and leading a program. It provides a master schedule for research, development, test, production, fielding, and other activities essential for program success, and for formulating functional strategies and plans.

- Statement of Work (SOW) – The SOW is prepared by the Government program office. It is normally refined, however, with inputs from industry sources, in the sequence of Government solicitation, leading to industry proposal, followed by source selection and contract award. The SOW is prepared in terms of actual tasks to be completed, stated in terms of required performance outcomes, and eventually is included in Section C of the contract. The contractor or subcontractor typically uses the SOW to expand the WBS to lower levels of detail. The WBS should always correlate with the SOW, and changes to the SOW are likely to require a parallel change to the WBS.

- Integrated Master Plan (IMP) – The IMP is also known as the Program Master Plan (PMP). It is prepared by the Contractor program office from Government instructions, i.e., the SOW. It includes the events, accomplishments, and criteria that become the basis for the IMS.

- Product Description – A product description, or system specification, is based on system performance and defines the primary elements of hardware and software. It is prepared by the Government. Later in system development, an Item Performance Specification (an allocated baseline) is used for expansion of the WBS to lower levels of detail.

- Test and Evaluation Master Plan (TEMP) – Normally the initial TEMP is prepared by the Government with contractor participation. This document is also used for expansion of the WBS to lower levels of detail in the Test and Evaluation segment.

- Master Equipment List (MEL) for Contractor-Furnished Equipment (CFE) – The MEL/CFE defines the quantities of equipment to be provided by the contract. It also establishes the number of development, test, and other non-deliverable articles to be utilized by the contractor. The allocation of this equipment to major activities is used to expand the WBS and activity lists.

- Make or Buy Plan – The Make or Buy Plan defines the source of equipment to be provided by the contract; it is developed by the contractor. Items are designated for design and fabrication by the prime contractor, or for purchase from a subcontractor or supplier. The plan is used to expand the WBS and activity lists.

- Government-Furnished Property (GFP) List – The GFP list is initially prepared by the Government for insertion in the Request for Proposal (RFP). The availability of GFP is often a key driver in the program schedule. Milestones for "GFP On-Dock" are included in the activity lists.

- Standards and Procedures – Required standards and procedures for system acquisition are identified by the Government. The activities required to comply with these standards are included in the WBS and activity lists.

- Process Documentation – Contractor processes to be utilized in performance of the contract provide the basis for activities required to comply with the Government standards and procedures. Process activities are included in the WBS.

.3 *Historical information.* Process flows and activities used to acquire like and similar systems are used as a guide when available.

.4 *Constraints.* See same in *PMBOK® Guide*.

.5 *Assumptions.* See same in *PMBOK® Guide* and 12.1.1.7.

.6 *Expert judgment.* See same in *PMBOK® Guide*.

6.1.2 Tools and Techniques

.1 *Decomposition.* The WBS is the primary tool for decomposition of program activities. Using MIL-HDBK 881B as a guide for the upper-level elements, it is expanded to the level of detail that describes the tasks to be accomplished. Further detail is provided in Section 5.3.2 of this Extension.

The assignment of lower-level Contract Work Breakdown Structure (CWBS) elements to responsible lower-level managers is a key control mechanism for management purposes and cost collection. This is called a cost account (C/A). Integration of the CWBS and organizational breakdown structure (OBS) at the C/A level may be visualized as a matrix with the organizations listed on one axis and the applicable CWBS elements listed on the other. This is

the Responsibility Assignment Matrix (RAM) and is prepared as part of Scope Management. Conceptually, this is shown in Figure 6-4.

A critical aspect of planning and scheduling is to establish organizational responsibility for segments of the work and to define in-house effort versus subcontracted effort. The level of detail in a subcontract CWBS is independent of the level of detail in the prime contract CWBS and is also independent of the level of the prime contract CWBS element into which the subcontract feeds. Accordingly, if subcontracted work is large enough or complex enough to warrant EVMS flow-down, the subcontract work tasks should be broken down by the subcontractor as if it were a prime contract.

.2 *Templates.* Documented processes, as well as activities and logic that exist from analogous programs, and functional processes may be used as templates for the system acquisition. They include (but are not limited to) activities related to product development, logistics, training, facilities construction, hardware procurement, fabrication, assembly and test flows, and software development.

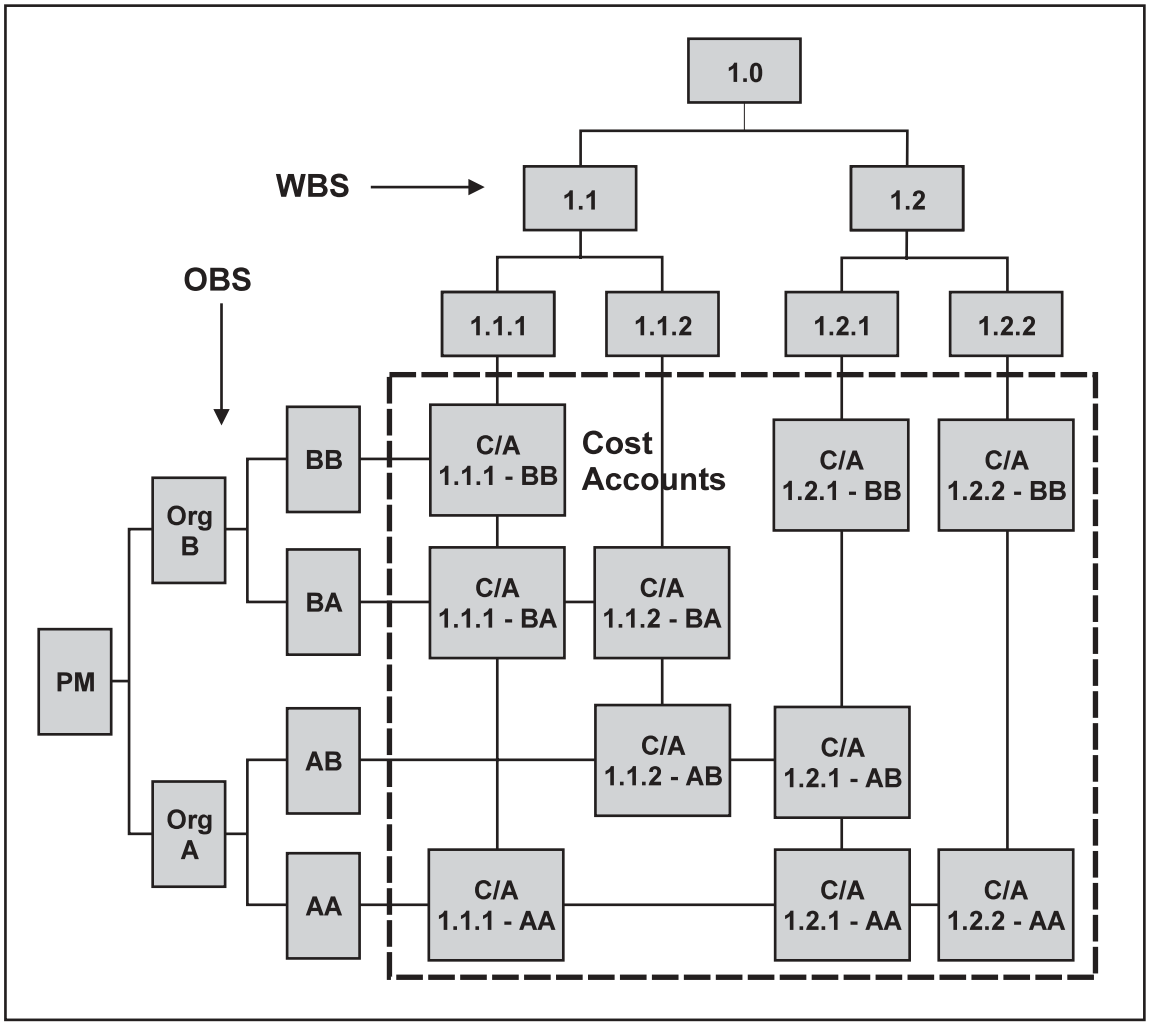


Figure 6-4. Responsibility Assignment Matrix

6.1.3 Outputs from Activity Definition

.1 *Activity list.* Activity lists are created by further decomposition of WBS product hierarchy and processes to be utilized.

.2 *Supporting detail.* The WBS is updated to the level required by the contractor's PM. The WBS at this level aids in the creation of the WBS Dictionary definitions of the higher-level elements.

.3 *WBS updates.* See same in *PMBOK® Guide*.

6.2 Activity Sequencing

Inputs	Tools & Techniques	Outputs
.1 Activity list .2 Product description .3 Mandatory dependencies .4 Discretionary dependencies .5 External dependencies .6 Milestones	.1 Precedence diagramming method .2 Arrow diagramming method .3 Conditional diagramming method .4 Network templates	.1 Project network diagram .2 Activity list updates

6.2.1 Inputs to Activity Sequencing

.1 *Activity list.* See same in *PMBOK® Guide*.

.2 *Product description.* See same in *PMBOK® Guide*.

.3 *Mandatory dependencies.* See same in *PMBOK® Guide.*

.4 *Discretionary dependencies.* See same in *PMBOK® Guide.*

.5 *External dependencies.* See same in *PMBOK® Guide.*

.6 *Milestones.* See same in *PMBOK® Guide.*

6.2.2 Tools and Techniques

.1 *Precedence diagramming method.* See same in *PMBOK® Guide*.

.2 *Arrow diagramming method.* See same in *PMBOK® Guide*.

.3 *Conditional diagramming method.* See same in *PMBOK® Guide.*

.4 *Network templates.* See same in *PMBOK® Guide.*

6.2.3 Outputs from Activity Sequencing

.1 *Project network diagram.* See same in *PMBOK® Guide*.

.2 *Activity list updates.* See same in *PMBOK® Guide*.

6.3 Activity Duration Estimating

6.3.1 Inputs to Duration Estimating

.1 *Activity list.* See same in *PMBOK® Guide*.

.2 *Constraints.* See same in *PMBOK® Guide*.

.3 *Assumptions.* See same in *PMBOK® Guide.*

.4 *Resource requirements.* See same in *PMBOK® Guide.*

.5 *Resource capabilities.* See same in *PMBOK® Guide.*

.6 *Historical information.* See same in *PMBOK® Guide.*

.7 *Identified risks.* See same in *PMBOK® Guide.*

6.3.2 Tools and Techniques for Duration Estimating

.1 *Expert judgment.* See same in *PMBOK® Guide*.

.2 *Analogous estimating.* See same in *PMBOK® Guide*.

.3 *Quantitatively based durations.* See same in *PMBOK® Guide.*

.4 *Reserve time (contingency).* See same in *PMBOK® Guide.*

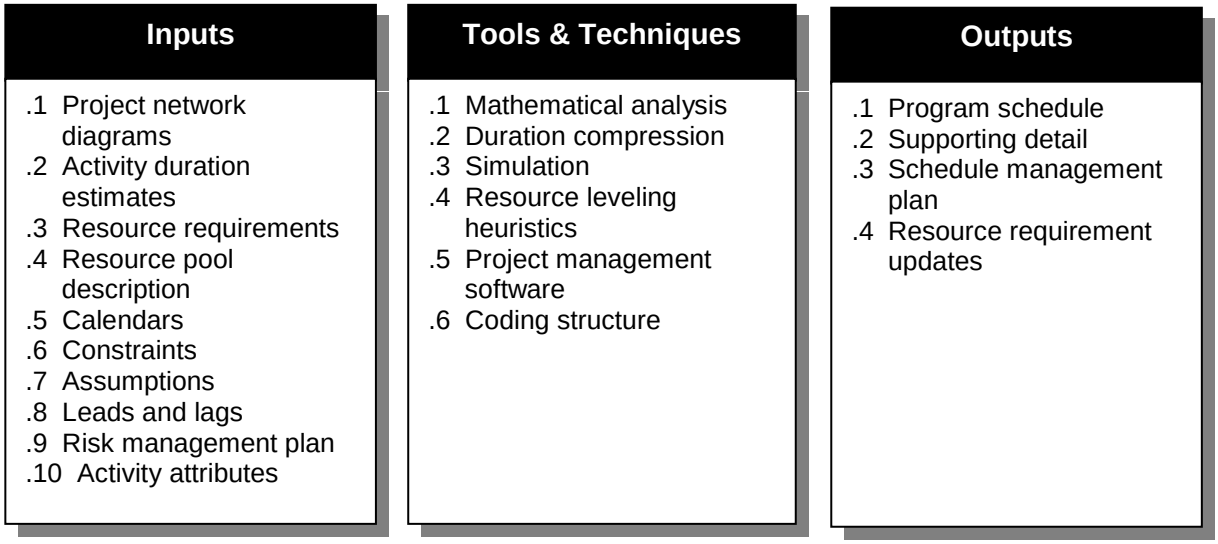
6.3.3 Outputs from Duration Estimating

.1 *Activity duration estimates.* See same in *PMBOK® Guide*.

.2 *Basis of estimates.* See same in *PMBOK® Guide*.

.3 *Activity list update.* See same in *PMBOK® Guide.*

6.4 Schedule Development



6.4.1 Inputs to Schedule Development

.1 *Project network diagrams.* See same in *PMBOK® Guide*.

.2 *Activity duration estimates.* See same in *PMBOK® Guide*.

.3 *Resource requirements.* See same in *PMBOK® Guide*.

.4 *Resource pool description.* See same in *PMBOK® Guide*.

.5 *Calendars.* See same in *PMBOK® Guide*.

.6 *Constraints.* See same in *PMBOK® Guide*.

.7 *Assumptions*. See same in *PMBOK® Guide*.

.8 *Leads and lags.* See same in *PMBOK® Guide*.

.9 *Risk management plan.* See same in *PMBOK® Guide*.

.10 *Activity attributes.* See same in *PMBOK® Guide*.

6.4.2 Tools and Techniques

.1 *Mathematical analysis.* See same in *PMBOK® Guide*.

.2 *Duration compression.* See same in *PMBOK® Guide*.

.3 *Simulation.* See same in *PMBOK® Guide*.

.4 *Resource leveling heuristics.* See same in *PMBOK® Guide*.

.5 *Program management software.* The scheduling criteria require the system to be formal, complete, and consistent. They do not require the use of any specific scheduling system or methodology. Various scheduling techniques are available that will satisfy these requirements. Such techniques may be employed at the summary and detail level but must remain consistent with, and be supportive of, the master schedule. Clear and adequate relationships between the various techniques employed at differing levels must be maintained, including vertical and horizontal traceability. Consideration should be given to the employment of Enterprise Resource Planning software.

.6 *Coding structure.* See same in *PMBOK® Guide*.

6.4.3 Outputs from Schedule Development

.1 *Program schedule.* After contract award, the IMS delivered in the proposal is expanded using DI-MISC-81183A (Integrated Master Schedule) as a guide. The IMS establishes the expected dates for the events by logically linking together every piece of work to its appropriate predecessor(s)/successor(s). Using expected duration for every task, schedule-networking techniques calculate expected dates for all of the work contained in the network. The linking together ensures that all the interfaces that must occur between the various program-team products are planned and communicated, and in turn lead to successful program execution. All constraints that apply toward the start or finish of any items should be included. Since Government decisions, facilities and equipment availability, and similar actions often impact the successful flow of work and the success of the program, these interfaces are also included in the Program IMS. Figures 6-5 and 6-6 show generic IMS examples in Gantt and Program Evaluation Review Technique (PERT) format.

ID	Name	Start	Qtr 2, 2002			Qtr 3, 2002			Qtr 4, 2002			Qtr 1, 2003		
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	Event 1	28/4/02												
2	Accomplishment 1.1	28/4/02												
3	Criteria 1.1.1	28/4/02												
4	Task 1.1.1.1	28/4/02												
5	Criteria 1.1.2	12/5/02												
6	Task 1.1.2.1	12/5/02												
7	Accomplishment 1.2	5/5/02												
8	Criteria 1.2.1	5/5/02												
9	Task 1.2.1.1	5/5/02												
10	Event 2	3/5/02												
11	Accomplishment 2.1	3/5/02												
12	Criteria 2.1.1	26/7/02												
13	Task 2.1.1.1	26/7/02												
14	Criteria 2.1.2	3/5/03												

Figure 6-5. IMS Example in Gantt Chart Format

The scheduling system computes the amount of time required based on estimates of work duration. The amount of time available is computed based on the task's interdependencies with other tasks. The result determines the program's critical path, i.e., it identifies those tasks that will cause slippage to the program/contract if the tasks themselves slip. The “critical path” is the longest path through the network. This means that the network also defines the interfaces and interdependencies within the program, and is correlated with other schedule documents generated on the program.

The "critical path" defined in the network alerts management to potential program delays should planned events not occur on time. Network schedules are often required by the Government to ensure accurate establishment of functional or hardware interdependencies. The schedules derived from the logic network integrate the information into a set of schedules from the highest to lowest levels of detail. Using this technique, the milestones are traceable from the highest level to the lowest level of detail, and the schedule is integrated horizontally through the WBS elements from the beginning to end (left to right) of the program.

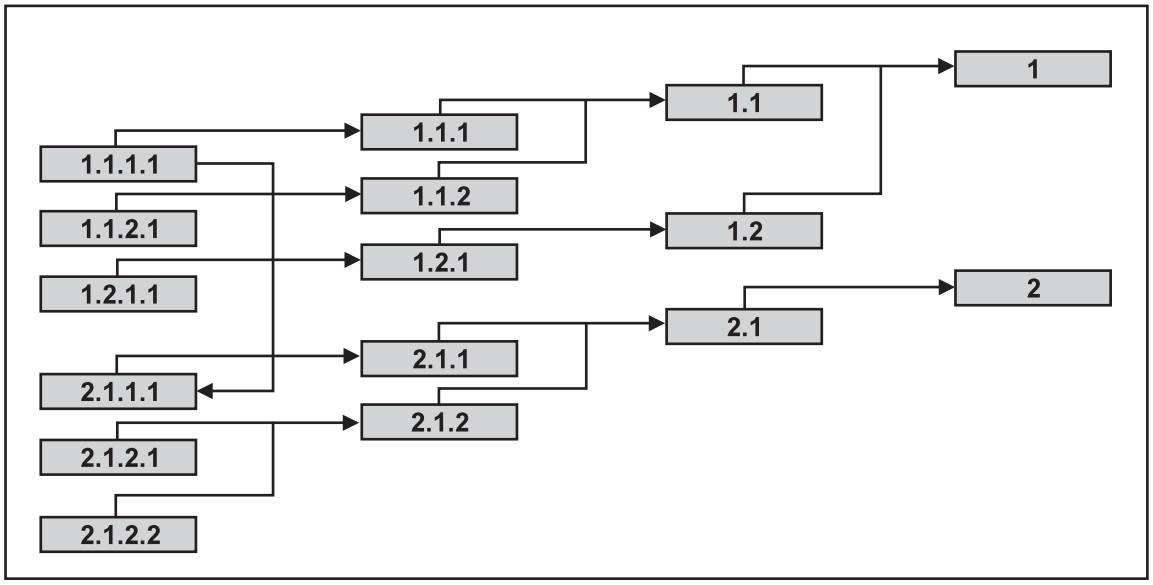


Figure 6-6. IMS Program Evaluation and Review Techniques (PERT) Chart Showing Dependencies

Following is a description of the levels of schedules to be included in the schedule hierarchy:

- Integrated Master Schedule/Master Program Schedule – The IMS (or MPS) establishes the major parameters for program execution. These parameters include the contractual period of performance, program milestones identified in the contract, and other program milestones identified by the contractor. The IMS is broken down by WBS element.

- Intermediate Schedules – Intermediate schedules may be established to define interfaces among organizational elements in the performance of the effort. The interfaces include key decision points such as Critical Design Reviews (CDR), Functional Configuration Audits (FCAs), and major test events. Organizations that provide inputs to, or support for, these key decision points should establish organizational schedules that reflect related interdependencies and interfaces.

- Subcontractor Schedules – Major subcontracted elements are scheduled to reflect the appropriate interface between the subcontractor and the prime in support of work accomplishment. The subcontractor primarily develops these schedules based on contractual arrangements with the prime. Subcontract milestones are established to support prime contractor "need dates," and thus ensure proper integration of the two organizations.

- Detail Schedules and Schedule Integration – Detail schedules are used to correlate the activities of the working-level organizations within a function, a WBS element and/or between lower-level functions. These schedules may take any form, provided that they:
  - support upper-level schedules;

- ensure that performing organizations are planning their efforts to support intermediate (if appropriate) and/or contractual-level milestones; and
- provide the basis for establishment of the Performance Measurement Baseline (PMB) when resources are applied to them.

Work packages are natural subdivisions of cost accounts and constitute the basic building blocks used by the contractor in planning, controlling, and measuring contract performance. A work package is simply a low-level task or job assignment. It describes the work to be accomplished by a specific organizational entity, and serves as a vehicle for monitoring and reporting work progress.

The assignment of budgets to work packages produces a plan against which actual performance can be compared — the PMB. The establishment, maintenance, and use of the PMB are extremely important aspects of performance measurement and should be in place as early as possible.

.2 *Supporting detail.* See same in *PMBOK® Guide*.

.3 *Schedule management plan.* See same in *PMBOK® Guide*.

.4 *Resource requirement updates.* See same in *PMBOK® Guide*.

6.5 Schedule Control

Inputs	Tools & Techniques	Outputs
.1 Program schedule .2 Performance reports .3 Change requests .4 Schedule management plan	.1 Schedule change control system .2 Performance measurement .3 Additional planning .4 Program management software .5 Variance analysis	.1 Schedule updates .2 Corrective action .3 Lessons learned

6.5.1 Inputs to Schedule Control

.1 *Program schedule.* See same in *PMBOK® Guide*.

.2 *Performance reports.* The contractor will provide periodic reports detailing the schedule status of work in progress on the contract. Technical issues and accomplishments will be integrated into the analysis of schedule performance in required reports and as part of Government/contractor meetings.

- Integrated cost and schedule reporting is required on subcontracts that, based on risk, schedule criticality, or dollar value, have the potential to impact the successful completion of the prime contract. The Government and the contractor shall agree on the selection of subcontracts requiring integrated cost and schedule reporting, and whether full or partial compliance with EVMS criteria should be included in the sub-

contract. The report format and contents will conform with the requirements outlined in the contract CDRLs.

.3 *Change requests.* See same in *PMBOK® Guide*.

.4 *Schedule management plan.* See same in *PMBOK® Guide*.

6.5.2 Tools and Techniques

.1 *Schedule change control system.* See same in *PMBOK® Guide*.

.2 *Performance measurement.* Successful performance management requires contractors to integrate the technical, schedule, and cost aspects of program/contract management. Schedules that result from this integration show the planned time required for completion of the technical scope of the contract. When contractors experience problems in technical performance, it may result in schedule delays, cost problems, or both. An adequate scheduling system will facilitate the depiction of the contractor's plan to accomplish the technical scope (the baseline or plan), the actual technical progress against that plan (correlating to earned value), and estimates of the additional cost to complete the remaining technical scope.

One aspect of schedule integration that provides unique problems for contractors is the integration of subcontractor schedule information into the schedule hierarchy. This integration should be accomplished in a manner that provides the most accurate depiction of the impact of subcontractor performance on the program schedules.

The contractor will periodically report progress against the baseline plan in a manner specified in the contract. This status reporting may take any form as long as it correlates with true, physical progress on the contract. Schedules that only show the passage of time with no relationship to accomplishment are normally not acceptable (i.e., level-of-effort activities excluded). The contractor will provide analysis of the most significant schedule variances in a given period. See Figure 6-7.

The Government PM and the contractor will jointly determine the CWBS and organizational elements that constitute high cost, schedule, and/or technical risk on the contract. The contractor will provide analysis of these elements if they exceed pre-established cost or schedule thresholds.

All variances that exceed a certain percentage and/or dollar amount, i.e., all schedule variances that exceed plus or minus x% and plus or minus $x of the cumulative Budgeted Cost for Work Scheduled (BCWS), must be reported. All variances at completion that exceed plus or minus x% will be analyzed.

As part of the status process, the contractor must include an assessment of available resources and capabilities, and provide forecasts that indicate the expected completion date of the effort. The scheduling system should readily display areas where forecast completion dates differ from the planned dates. The contractor must continually reconcile schedule information with performance measurement information.

Scheduling should interface with other planning and control systems to the extent necessary for measurement and evaluation of contract status. The scheduling system should provide current status and forecasts of completion dates for authorized work. The contractor's summary and detailed schedules should enable a comparison of planned and actual status of program accomplishment based on milestones or other indicators used for control purposes.

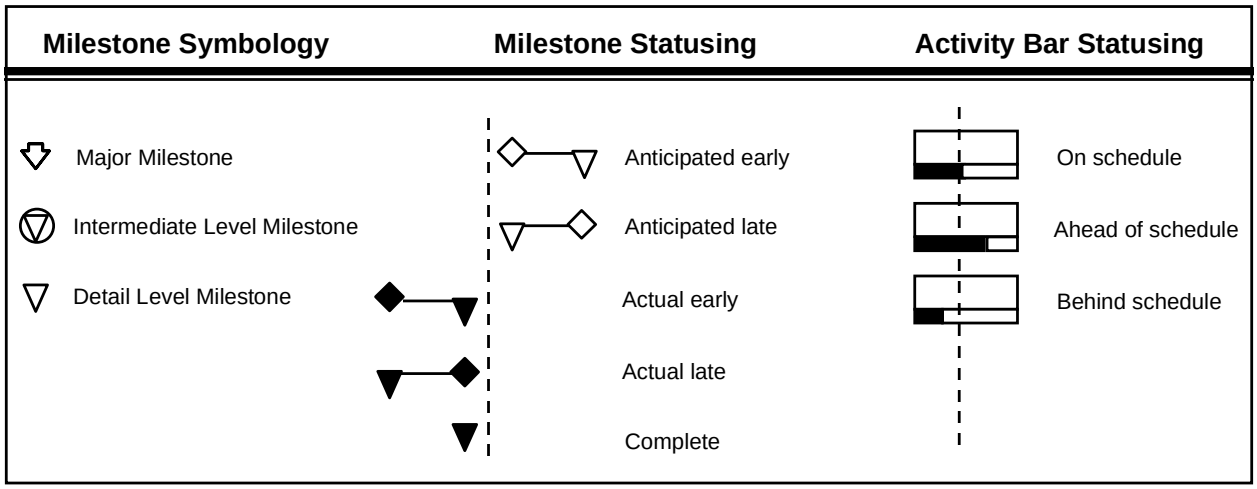


Figure 6-7. Schedule Status Symbols/Legend

.3 *Additional planning.* See same in *PMBOK® Guide*.

.4 *Program management software.* See same in *PMBOK® Guide*.

.5 *Variance analysis.* See same in *PMBOK® Guide*.

6.5.3 Outputs from Schedule Control

.1 *Schedule updates.* As contract changes are generated, the baseline schedule must be revised to reflect the new plan. Internal re-planning actions that are accomplished as part of the normal management process may affect some scheduled activities, but may not always change the baseline. In either case, the resulting schedule must reflect the current contractual requirements as well as the contractor's best estimate of activity completions. Where contractual actions, internal re-planning, and/or formal reprogramming have taken place, the scheduling system should retain traceability from current indicators of work progress back to original plans and activities.

.2 *Corrective action.* See same in *PMBOK® Guide*.

.3 *Lessons learned.* See same in *PMBOK® Guide*.

Chapter 7

Project Cost Management

Department of Defense program cost and funds management includes a requirements determination process, establishment of resource needs, a cost analysis process, application of funds planning policies, and a structured budget execution methodology. The following is an overview of the major DoD cost and funds management topics with emphasis on Program Management responsibilities and interactions:

7.1 **DoD Staff Participants in Resource Planning** – Identifies players in DoD involved in resource planning and allocation.

7.2 **Resource Planning** – describing the DoD Planning, Programming, Budgeting and Execution System (PPBES) and the Planning, Programming, Budgeting, and Execution (PPBE) process within the PPBES.

7.3 **Cost Estimating** – developing program cost estimates.

7.4 **Cost Budgeting** – program funds management interfaces and building a program budget within the DoD structure.

7.5 **Cost Control** – defining Analysis of Alternatives (AoA) as a means of aiding decision-maker in determining whether an item is worth the cost.

7.6 **Setting Objectives** – defining DoD use of Cost As an Independent Variable (CAIV) as relates to cost and performance objectives.

7.7 **DoD Program Budget Execution/Funds Management** – defining the Program Office resource allocation process.

Within DoD program cost and funds management functions are a small part of a much larger semi-closed loop system involving DoD, the White House, the Congress, and the Department of the Treasury.[1] Entering the loop at a place we will call Operational Concepts (system justification or the requirements process within DoD), the process flows to DoD Cost Estimating, and then to funding policies, and then to DoD PPBES activities including program and budget inputs to the President's Budget, as displayed in Figure 7-1. Congressional Enactment (Authorization and Appropriation Laws) follows. The apportionment of funds process by the Office of Management and Budget (OMB) to DoD agencies and services is next. This is followed by the Program Office budget execution process leading to equipping the force (program management of a funded research, development, and production program). At the same time, there is a loop back into Operational Concepts for additional funds in order to initiate new requirements and modify existing systems.

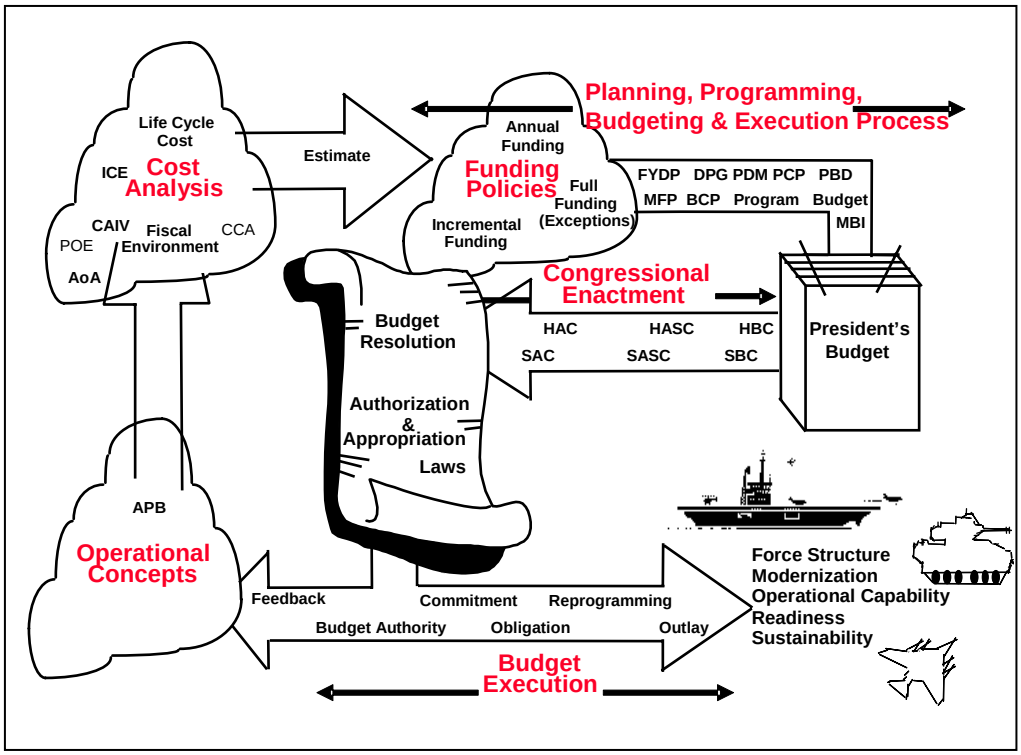


Figure 7-1. Funding Cycle

The DoD's program cost and funds management system is governed by: 1) the DoD's Planning, Programming, Budgeting and Execution System (PPBES) and the Planning, Programming, Budgeting and Execution (PPBE) process within that System, 2) the laws addressing funds management within the Federal Government and DoD, and 3) specific DoD cost management and acquisition policies pertaining to Program Management. Policy statements and directives address such subjects as procedural matters, long range planning requirements, affordability, acquisition excellence (reform), manpower, and administrative processes. Life-Cycle Cost (LCC) Management within Program Cost Management includes the DoD cost estimating structure with its own special processes and organizations. In this regard Chapter 7 will address the administrative and policy processes related to cost estimating, but makes no attempt to address cost estimating methodologies that are included in *PMBOK® Guide 7.2*.

Without funding, an acquisition program cannot survive. A budget is a financial plan to achieve the goals of the organization or the program within a given time frame within administration priorities. As a plan, a budget is a managerial instrument, and it allows the leadership to assess achievements against the plan and make appropriate adjustments. A budget identifies a dollar ceiling and, therefore, also acts as an accounting instrument. It establishes the notion that a PM must manage within dollar constraints. In a macro sense, a budget redistributes funds amongst different programs at different locations, and in doing so, it serves as an economic instrument. But above all, a budget is inherently a political instrument, because it reflects the distribution of dollars in relation to the key policies of the executive and legislative leadership. The funds management process is one of fierce competition, marketing, knowledge, influence, and negotiation. All program claimants compete for a portion of the limited

funds available to fulfill all requirements. Thus the funds management process is a principal means by which DoD determines the relative priorities among its many diverse programs.

Acquisition programs typically are funded by five categories of DoD appropriations. Appropriations have their basis in the Constitution. The five categories are:

- Research, Development, Test, and Evaluation (RDT&E) – Research and development activities are typically funded out of the RDT&E appropriation. This appropriation covers many different types of activities, from basic research, to testing, to fabricating an engineering model.

- Procurement – The Procurement appropriation applies to production items (i.e., weapon systems). All costs necessary to deliver a complete useful end item to the user are procurement funded.

- Operations and Maintenance (O&M) – The O&M appropriation provides funds for operating and support costs, such as Civil Service salaries, fuel, depot maintenance, purchases from the defense working capital funds (e.g., spare parts), base operations support, etc.

- Military Personnel (MILPERS) – The Military Personnel appropriation provides funds for compensation of uniformed personnel.

- Military Construction (MILCON) – The Military Construction appropriation provides funds for major construction programs, bases, buildings, etc.

The Financial Management Regulation (DoD 7000.14R) addresses financial management regulations, including appropriation categories, budget activities, and budget processes. Each acquisition-related appropriation has a legal time limit for the obligation of funds. Beyond this window of availability, funds are said to have “expired.” Once expired, funds remain on the accounting books for five additional years. During this five-year period, expired funds may to used for obligation adjustments, such as claims, administrative adjustments, award fees, etc. At the end of five years, any residual funds in the appropriation are canceled. Bills received after the five-year window are generally paid with currently available funds.

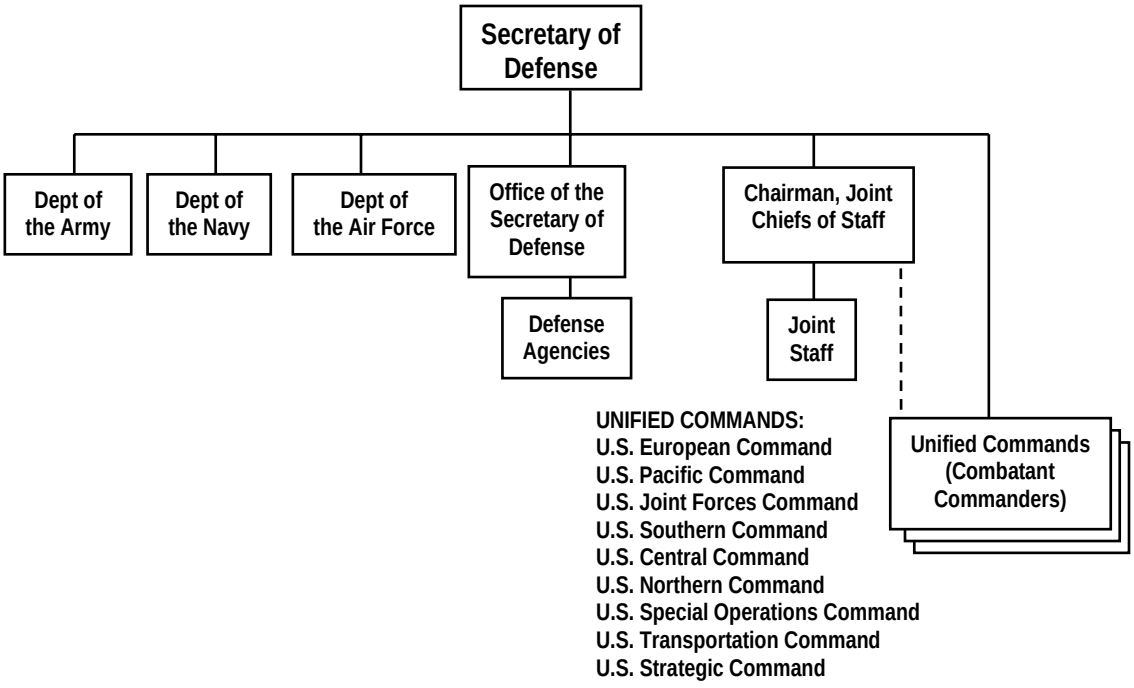
Prior to going further into DoD program cost and funds management, the reader should understand the role and definition of “affordability.” The 5000 Series defines affordability as the degree to which the life-cycle cost of an acquisition program is in consonance with the long-range investment and force structure plans of the DoD or individual DoD Components. Within DoD, it is a primary consideration and is essentially synonymous with “funding priority.” The affordability determination is made in the process of addressing cost in the requirements process beginning with the Initial Capabilities Document (ICD) prior to concept decision, and with the Capability Development Document (CDD) prior to Milestone B (normally Program Initiation). Addressing cost–including life-cycle or total ownership–continues with each milestone and decision review. Formal affordability assessments occur in preparation for Milestones B and C.

7.1 DoD Staff Participants in Resource Planning

Department of Defense Organization

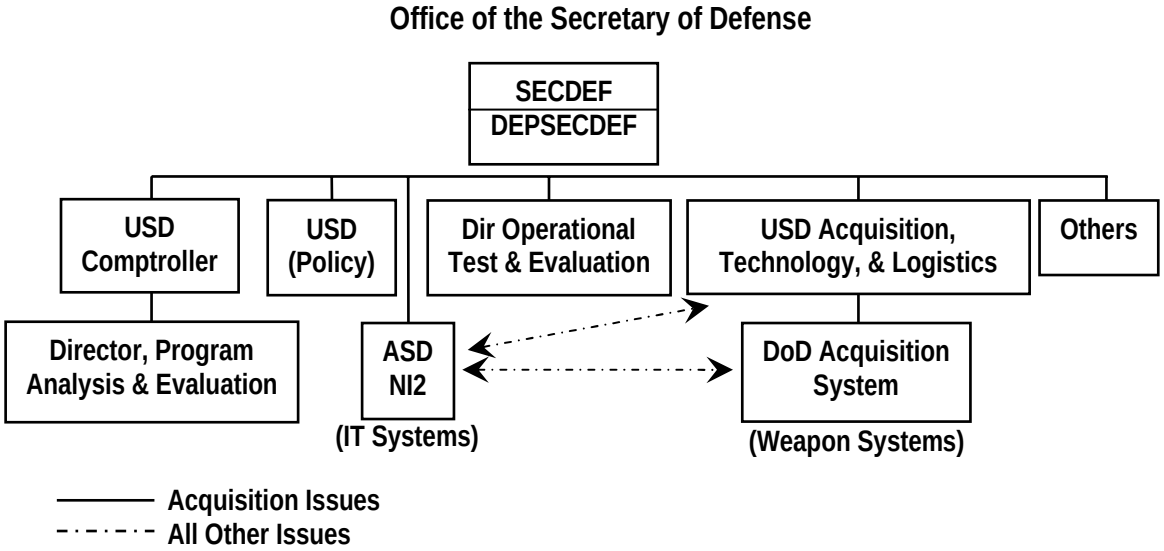
Secretary of Defense (SECDEF)
The Office of the Secretary of Defense (OSD)
Under Secretary of Defense (USD) Comptroller USD(C)
USD(Policy)
Director, Program Analysis & Evaluation (DPA&E)
Director, Operational Test & Evaluation (DOT&E)
Assistant Secretary of Defense Networks and Information Integration (ASD(NI2)); (formerly ASD C3I)
USD Acquisition, Technology, and Logistics (USD(AT&L))

Before looking at the PPBES activities, it is important to understand the role of the key players who have an impact on the PPBES, and the organizational structure within the Department of Defense.



Secretary of Defense. The Department of Defense is headed by the Secretary of Defense, also known as the SECDEF. The SECDEF is a Cabinet-level position created by the National Security Act of 1947. The Secretary of Defense is "the principal assistant to the President in all matters relating to the national security", is responsible for establishing the "general policies and programs" for the military departments and agencies, and exercises "general direction, authority, and control" over those entities.

The Office of the Secretary of Defense. The Secretary of Defense staff members are referred to as the Office of the Secretary of Defense (OSD). These staff members help the SECDEF manage the Armed Forces of the United States.



USD Comptroller. The Under Secretary of Defense (USD) Comptroller controls the budget and the release of funds. The USD Comptroller is responsible for the budgeting phase of the Planning, Programming, Budgeting and Execution System (PPBES).

USD(Policy). USD(Policy) is charged with approving certain aspects of programs involving other nations and is responsible for providing planning guidance for the Defense Planning Guidance during the planning phase of PPBES.

Director, Program Analysis & Evaluation (DPA&E). The Director, Program Analysis and Evaluation is responsible for the programming phase of PPBES. The Director conducts program analyses and reviews to ensure money is spent properly and in a timely manner.

Director, Operational Test & Evaluation (DOT&E). The Director, Operational Test and Evaluation provides independent assessment of the operational effectiveness and suitability of new weapon systems. The Director sends Operational Test & Evaluation reports directly to the SECDEF and Congress.

Assistant Secretary of Defense Networks and Information Integration (ASD(NI2)). Formerly ASD(C3I). Is Principal Staff Assistant (PSA) and advisor to the SECDEF and DEPSECDEF for information technology. Serves as the DoD's Chief Information Officer (CIO). Establishes software policy and practices.

Under Secretary of Defense Acquisition, Technology, and Logistics (USD(AT&L)). The USD(AT&L) is the Defense Acquisition Executive (DAE), establishes policy and procedures

for DoD acquisition matters, chairs the Defense Acquisition Board (DAB), and makes program milestone decisions for Major Defense Acquisition Programs (MDAPs).

7.2 Resource Planning

Within the DoD, the primary resource-management tool is the PPBES, which is implemented through the Planning, Programming, Budgeting, and Execution (PPBE) process. It links short-term, mid-term, and long-term planning. However, the PPBES is much more. It is the structured methodology within which DoD produces a set of prioritized objectives, a prioritized program, and finally a budget. The PPBES was first introduced into the DoD in the early 1960s and is a cyclic in nature, consisting of three distinct but interrelated phases: planning, programming and budgeting. It establishes the framework and provides the mechanisms for resource and related force decisions for future years and provides the opportunity to reexamine prior decisions in light of the present environment (i.e., evolving threat, changing economic conditions, etc.). The ultimate objective of the PPBES is to equip and man the force, i.e., provide the Unified Commanders (Combatant Commanders) with the optimum mix of trained manpower, equipment, and support that is attainable within established fiscal constraints.

The Future Years Defense Program (FYDP) is a database that summarizes the force structure, and all resources, equipment and changes to these programs approved by the Secretary of Defense (SECDEF) for the DoD. The FYDP contains prior year, current year, the biennial budget years, and the following four years for financial resources, plus three more years for force structure only. It is usually published twice during the PPBES process cycle: in August/September to reflect the Services' Program and Budget Submission; and in January to reflect the President's Budget submission. It displays the total DoD resources (dollars, equipment, people) programmed by fiscal year.

The FYDP is structured in three basic dimensions as reflected in Figure 7-2. For internal DoD program management, the FYDP is categorized into 11 Major Force Programs (MFPs), which are basically mission areas. For example, MFP 1 is known as Strategic Forces and is where all DoD resources available for strategic missions are captured. In a second dimension, the FYDP is arranged by appropriation (or commonly called "colors of money") for use by Congress when reviewing budget requests and enacting budget authority through the authorization and appropriation process. The third dimension displays resources by DoD components (e.g. Navy, Defense Agencies such as the Defense Logistics Agency (DLA), etc.).

A MFP is an aggregation of program elements that reflects a macro-level force mission or a support mission of DoD and contains the resources necessary to achieve an objective or plan. Each program element has an assigned numerical identification analogous to an account number. Groups of program elements over the FYDP reflect fiscal time phasing of mission objectives to be accomplished and the means proposed for their accomplishment.

The MFP most closely related to program management is MFP 6, Research and Development (R&D). To assist in the overall planning, programming, budgeting, and management/execution of the various R&D activities, the R&D program is sub-divided into budget activities that further identify the nature of the R&D effort. These categories are used throughout DoD;[2]

- Basic Research;
- Applied Research;
- Advanced Technology Development;
- Advanced Component Development and Prototypes;
- System Development and Demonstration;
- Management Support;
- Operational System Development.

The three steps or phases in the DoD resource allocation process are planning, programming and budgeting. The “execution” or “E” part of the PPBES is for measuring output and is not a distinct step per se. However execution under PPBES is different from the previous Planning Programming and Budgeting System (PPBS) which only asked “How much did you obligate and expend?” Now the question will be, “What did DoD actually get for the money provided by Congress?”

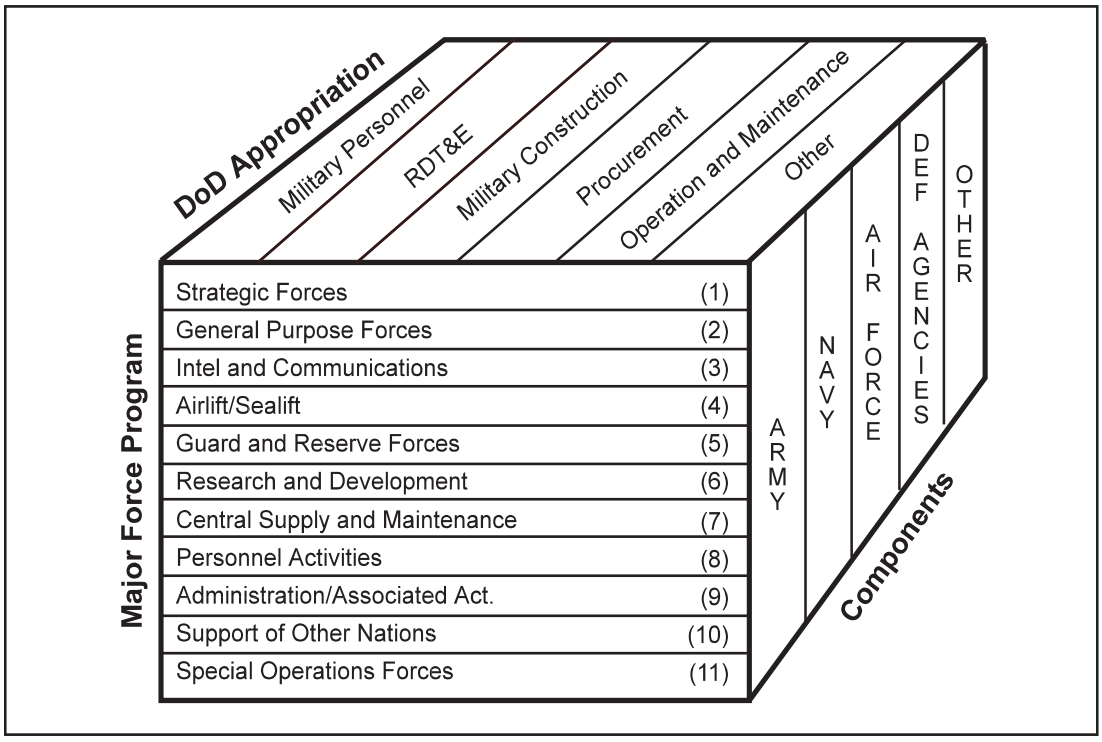


Figure 7-2. Future Years Defense Program (FYDP) Structure

The three steps or phases are discussed in turn in the following subparagraphs:

- Planning. The planning phase is the first step (see Figure 7-3). This phase considers current capability forces and identifies priorities needed to meet the stated threat and objectives. The planning phase begins about two years in advance of the fiscal year in which budget authority will be requested. The planning phase defines national defense policies, objectives, strategy, and guidance based on a perception of threat to U.S. interests for the upcoming programming phase. Several key planning documents include the National Security Strategy (NSS), National Military Strategy (NMS), Quadrennial Defense Review (QDR), Joint Planning Document (JPD) and Chairman's Program Recommendation (CPR). This phase ends with the issuance of the Defense Planning Guidance (DPG).

- Programming. The purpose of the programming phase at the Service and OSD level is to allocate resources to support Department of the Army, Navy, and Air Force roles and missions. Programming translates planning decisions, OSD programming guidance, and congressional guidance into a detailed allocation of time-phased resource requirements including forces, personnel, and funds. This is accomplished through systematic review and approval processes that "cost out" force objectives in financial terms and personnel resources six years into the future. This gives the SECDEF and the President insight to the impact that present day decisions have on the future defense posture. The Director, Program Analysis and Evaluation (DPA&E) is responsible for overall coordination of this PPBES phase. See Figure 7-4.

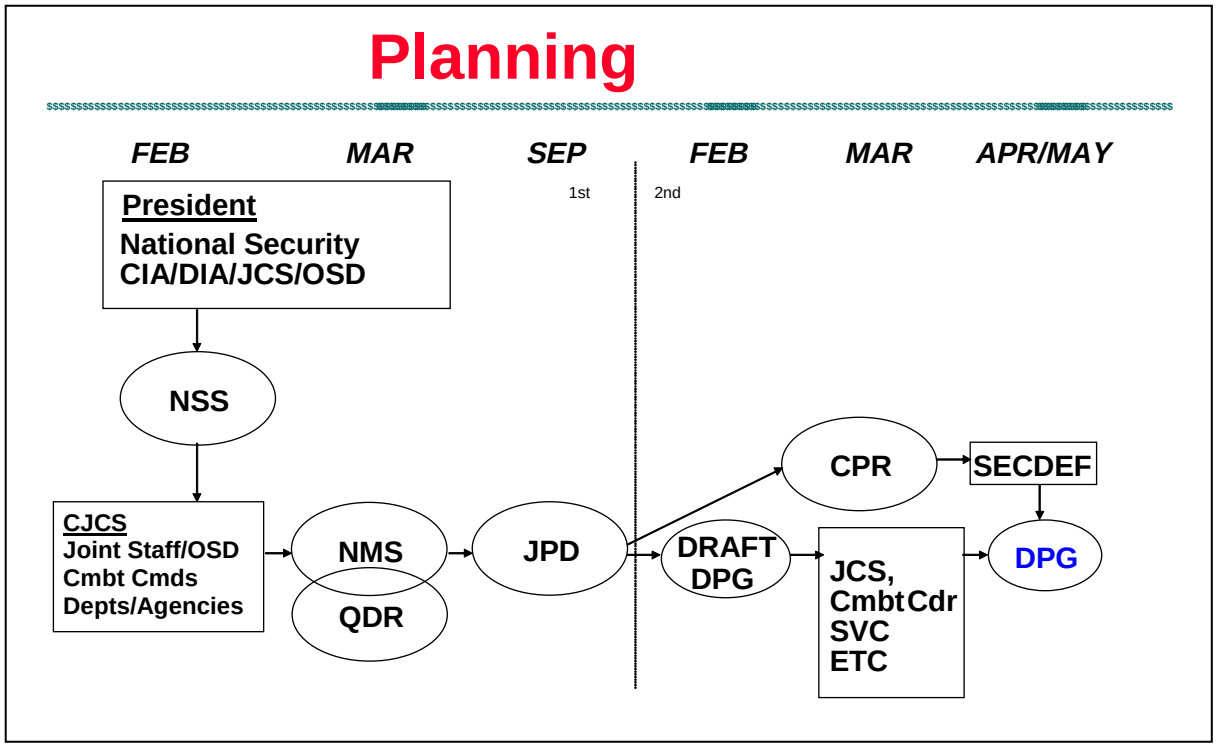


Figure 7-3. PPBES Planning Phase

In August of each even-numbered year, each Military Department and Defense Agency submits *a Combined Program/Budget* to the SECDEF. The programming portion covers the six-year FYDP and presents the component's proposal for a balanced allocation of all available service resources within specified constraints to satisfy the DPG. Significant force structure and end strength changes, as well as major system new starts, must be identified. Likewise, program imbalances and shortfalls in meeting DPG and Combatant Commanders' objectives are highlighted.

Soon after the *Combined Program/Budget* submission, the Director, Joint Staff conducts a review of the Service Program/Budget to assess compliance with the DPG and with the National Military Strategy (NMS). The document resulting from this review is called the Chairman's Program Assessment (CPA).

In the fall, the OSD PA&E staff conducts a detailed review of the Service programs and makes program change recommendations through Program Issue Papers. These documents define specific issues to review by comparing the proposed program with the objectives and requirements established in the DPG. The issue papers present alternatives and evaluate the implications of each alternative, including cost and personnel changes. The Services, Joint Staff, and OSD directorates may comment or reclama each issue with justification supporting the Service Program/Budget submission.

The Program/Budget is amended by the Program Decision Memoranda (PDM), which summarizes program decisions. This is fed into the budget process going on concurrently.

In the odd-year (off-year) of the PPBES process, an "execution review" will take place in which the DoD will use program change proposals (PCPs) to accommodate real world changes, in lieu of a full-up POM.

- Budgeting. The third phase of the PPBES is budgeting. After submission of the Combined Program/Budget, budget analysts within USD(C) and OMB conduct a joint review of the Budget from October to early December. OMB retains the authority to submit separate decisions on the reviews, but in practice, rarely does. Following the issuance of advance questions, the USD(C) may hold hearings to review appropriations or specific programs. Appropriate Service functional staff and OSD program advocates provide information as necessary during those hearings. As part of this review process, the budget analysts examine the Budget from each Service and Defense Agency to assess conformity with other higher-level guidance. There are four areas considered by the USD(C) and OMB analysts to be principal issue areas during the review and "scrub" of the budget submission from the Services and Agencies: program pricing, program phasing, policy, and program/budget execution.

  Following a thorough review of the Service Budgets and the questions/answers from the OSD/OMB Budget Hearings, the USD(C) analyst normally prepares Program Budget Decisions (PBDs) for the appropriations and/or programs under his/her oversight. These PBDs, which are related to the appropriations and budget activity structure, are used to adjust the Service Budgets and address the current year, the budget years, and an estimate of the resource impact on the four succeeding program years (out years).

  After considering the information in the draft PBDs and all reclamas (and alternative positions, if any) submitted by interested DoD organizations, the USD(C) analyst prepares a summary document that lays out all that information and provides it to the DEPSECDEF for decision and signature of the final PBD. Typically, the DEPSECDEF will decide on one of the alternative positions (or specifics from several alternatives)

and will sign the final document. In some cases, the USD(C) might sign the final PBD effecting items considered non-controversial or strictly financial accounting in nature. See Figure 7-4 below for a graphical presentation of the budgeting process.

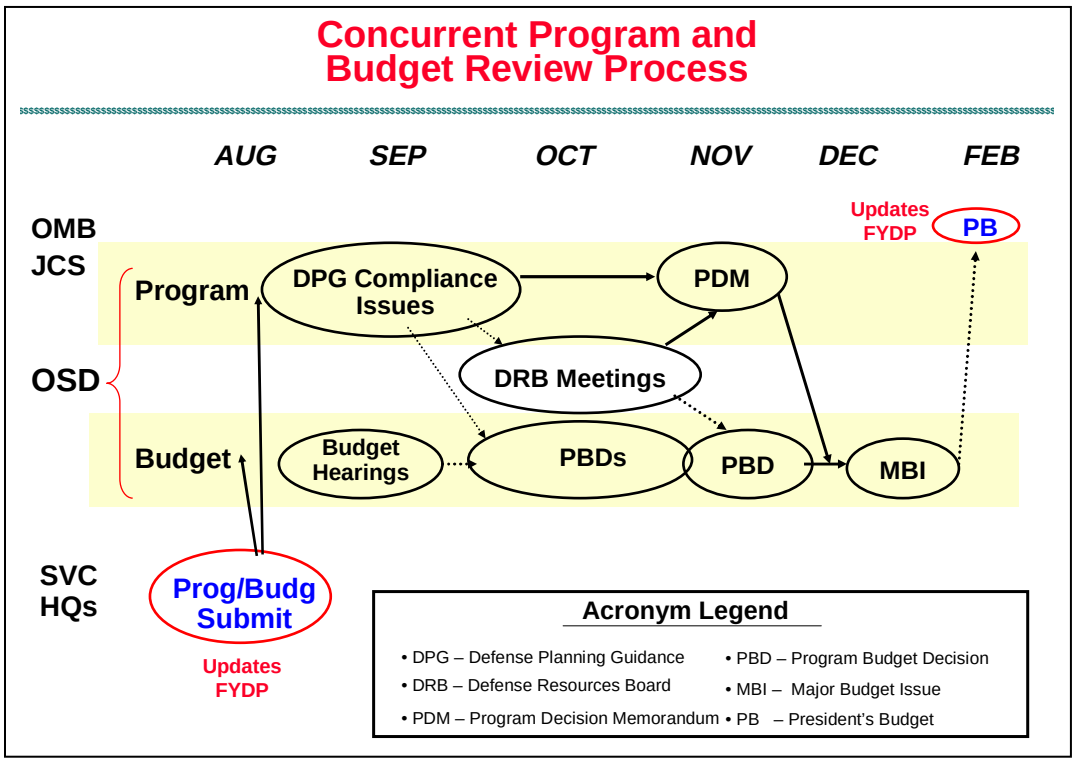


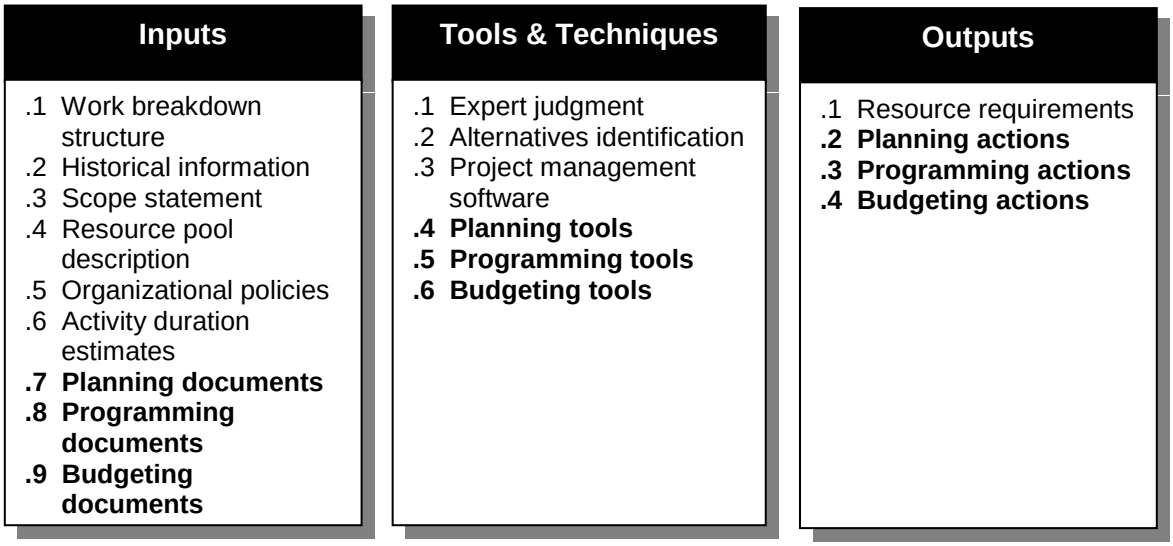
Figure 7-4. PPBES Programming and Budgeting Phases

After a review of "final" budget decisions, the Services have one last opportunity to identify issues serious enough to warrant a Major Budget Issue (MBI) meeting between the Service Secretary and SECDEF. Decisions resulting from these meetings are announced in signed PBDs. Services are usually required to provide funding offsets from other programs within that Service to "buy back" programs cited as MBIs.

The Services revise their budgets to support the decisions resulting from the programming phase PDMs and budget review process (signed PBDs) for inclusion in the DoD portion of the President's Budget. Following a top line meeting with the President, the President's Budget is finalized by early January and submitted to Congress through OMB by the first Monday in February. The FYDP is updated to reflect the President's Budget. This ends the budget formulation phase of the PPBES and begins the Congressional Enactment process.

In the even year (or off-year) execution review, the DoD will use budget change proposals (BCPs) instead of a full-up budget estimate submission to accommodate fact-of-life changes such as cost increases, schedule delays, management reform savings, etc.

In the following section, Inputs, Tools, and Outputs, the text represents the PPBES as viewed by the military departments (the Services). Some activities will involve all PMs, and other activities will impact only a few PMs. The Inputs, etc., should be read in conjunction with Figures 7-3 and 7-4.



7.2.1 Inputs to Resource Planning

.1 *Work breakdown structure.* See same in *PMBOK® Guide*.

.2 *Historical information.* See same in *PMBOK® Guide*.

.3 *Scope statement.* See same in *PMBOK® Guide*.

.4 *Resource pool description.* See same in *PMBOK® Guide*.

.5 *Organizational policies.* See same in *PMBOK® Guide*.

.6 *Activity duration estimates.* See same in *PMBOK® Guide*.

.7 ***Planning documents*** *(example below).*

- National Security Strategy (NSS).
- National Military Strategy (NMS).
- Quadrennial Defense Review (QDR).
- Defense Planning Guidance (DPG); (Also Programming Document).

.8 ***Programming documents*** *(examples below).*

- OSD originated issue papers.
- OSD Program Decision Memoranda (PDM).
- Program Change Proposals (PCPs); used in odd-year process in lieu of POM.

.9 Budgeting documents *(examples below).*

- Combined Program/Budget amended by the PDM.
- Future Years Defense Plan (FYDP) update.
- Draft or Advance Program Budget Decisions (PBD).
- Final PBDs.
- Major Budget Issues (MBI).
- Budget Change Proposals (BCPs); used in odd-year process in lieu of BES.

7.2.2 Tools and Techniques for Resource Planning

.1 Expert judgment. See same in *PMBOK® Guide*.

.2 Alternatives identification. See same in *PMBOK® Guide*.

.3 Project management software. See same in *PMBOK® Guide*.

.4 Planning tools.

- Various analytical methods based on needs, priorities, guidance, and restraints.

.5 Programming tools.

- Translation of planning decisions, and a systematic review and approval that "costs out" force objectives in financial terms and personnel resources six years into the future.

.6 Budgeting tools.

- Updates and adjustments for pay and pricing policies developed between OSD and Office of Management and Budget (OMB).
- Service comptroller; and OSD(C)/OMB budget hearings.
- Secretary of Defense Service Secretary MBI meeting.

7.2.3 Outputs from Resource Planning

.1 Resource requirements. See same in *PMBOK® Guide*.

.2 Planning actions.

- Coordinated staffing actions provided to the Joint Staff on the National Military Strategy, Quadrennial Defense Review, Joint Planning Document, Joint Warfighting Capability Assessment, Chairman's Program Recommendation, and the draft DPG.

- Coordinated Draft and Final DPG (OSD document).

.3 Programming actions.

- Service Combined Program/Budget to OSD in MFP format.

- FYDP update.

- Replies to OSD issue papers and PDMs.

.4 Budgeting actions.

- Service Combined Program/Budget in appropriation format.

- FYDP update.

- Reclamas to PBDs.

- Service Final Budget. All Service and agency budgets together make up the DoD budget and are included in the President's Budget.

7.3 Cost Estimating

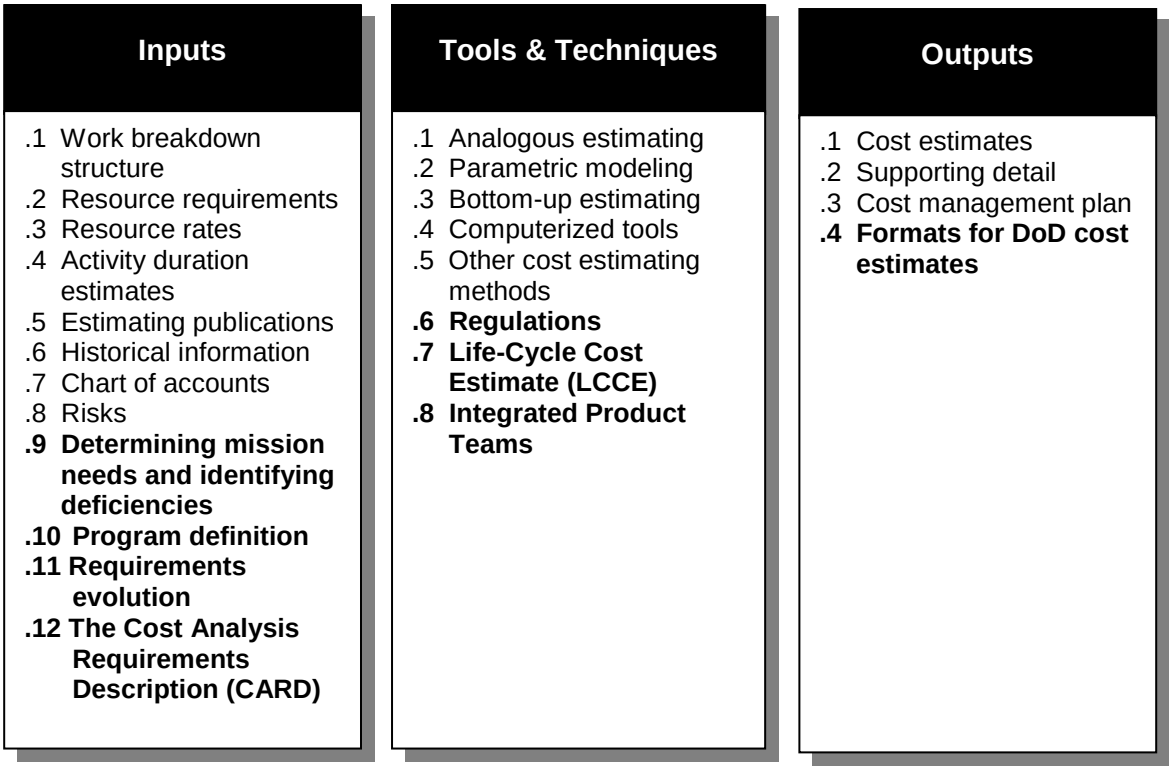
The cost estimating activity is preceded by a determination of mission needs and identifying deficiencies. This is part of the previously noted Operational Concept activities within the semi-closed loop DoD cost/resource management system (Figure 7-1). Cost estimating responsibility lies with the DoD Component, user, user's representative, Joint Requirements Oversight Council (JROC) or the OSD Principal Staff Assistant (PSA), as appropriate. The predecessor of a PM may be involved and later the PM once a program is initiated. Such activities may start with a threat as identified in the Initial Capabilities Document (ICD), and include the later Capability Development Document (CDD), and an Analysis of Alternatives (AoA), all to be addressed in more detail later.

As part of program cost management, the acquiring military departments and defense agencies prepare Life-Cycle Cost Estimates (LCCE) in support of acquisition programs for which they are responsible. A LCCE of an acquisition system is a very expansive effort; it attempts to identify all the costs of a program from initiation through removal of the system from the inventory. Because of the extensive time required to develop, produce and then operate/maintain an acquisition system, the time frames involved in such an estimate usually span decades. The number of contributing estimates or "pieces" of the program is generally quite large, thereby further complicating the estimate. As a program progresses through its life cycle, these estimates change, employing different mixes of estimating techniques as more information becomes available and, hopefully, more accurate. DoD has a structured cost estimating routine and employs an extensive review, reconciliation, and feedback process for its cost estimates.

LCCEs and manpower estimates have two primary purposes. First, they are used as the cost input to a series of decisions on whether or not to continue, modify, or terminate the development, production, and fielding of a system. Second, these estimates form the basis for budget requests to Congress that provide the funding for the program.

Manpower estimates project the resources needed to operate the fielded systems. These are often scrutinized based on the delta increase over the existing systems' operational needs. In an environment of technology providing labor-saving techniques and an emphasis to reduce infrastructure costs, delta increases in manpower are usually not welcomed.

Program cost analysis products or estimates should be structured within a life-cycle cost management model. This model should present the system's cost in several formats in order to meet the information needs of DoD decision makers, those who formulate budget requests, and the contractors who will do the development and production work. These formats will be discussed further in 7.3.3, Outputs of Cost Estimating.



The concept of Life-Cycle Cost (LCC) is extremely important. LCC is defined in DoD 5000.4M *Cost Analysis Guidance and Procedures,* and is roughly the total cost to the Government of a program over its full life, including research and development (R&D), investment, facilities, operations, maintenance, manpower, environmental, and disposal. "DoD Total Ownership Cost" (TOC) has two definitions. One addresses TOC for the headquarters oversight perspective and includes elements such as recruiting, training, and real property, which are well beyond the acquisition PM's cognizance. The other definition is defined as "Defense Systems TOC" and is the same as LCC (see DoD 5000.4M). The program cost estimates, when prepared, will provide a projection for every LCC element for every aspect of the program required to respond to the threat — as identified in the ICD and the CDD.

7.3.1 Inputs to Cost Estimating

.1 *Work breakdown structure.* See same in *PMBOK® Guide*.

.2 *Resource requirements.* See same in *PMBOK® Guide*.

.3 *Resource rates.* See same in *PMBOK® Guide*.

.4 *Activity duration estimates.* See same in *PMBOK® Guide*.

.5 *Estimating publications.* See same in *PMBOK® Guide*.

.6 *Historical information.* See same in *PMBOK® Guide*.

.7 *Chart of accounts.* See same in *PMBOK® Guide*.

.8 *Risks.* See same in *PMBOK® Guide*.

.9 ***Determining mission needs and identifying deficiencies.*** All acquisition programs are based on identified, documented, and validated mission needs. Mission needs result from ongoing assessments of current and projected capabilities. Mission needs may seek to establish a new operational capability, to improve an existing capability, or to exploit an opportunity to reduce costs or enhance performance. For a complete discussion of this topic, see Section 5.1 Initiation.

.10 ***Program definition.*** This is the process of translating broadly stated mission needs into a set of operational requirements from which specific performance specifications are derived. For a complete discussion of this topic, see Sections 5.1 Initiation, and Section 5.2 Scope Planning.

.11 ***Requirements evolution.*** As noted above, DoD Components identify deficiencies in current capabilities and opportunities to provide new capabilities. This action is documented in an Initial Capabilities Document (ICD) expressed in broad operational terms. The ICD identifies the mission deficiency; discusses the results of mission area analysis; describes why non-materiel changes (i.e., doctrine, tactics, etc.) are inadequate to correct the deficiency; provides potential materiel alternatives; and discusses any key boundary conditions and operational environments (such as information warfare) that may impact satisfying the need. The ICD is prepared in accordance with Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01_, *Requirements Generation System*. System performance objectives and thresholds are developed from, and remain consistent with, the initial broad statements of operational capability. The requirements are refined at successive milestone decision points as a consequence of CAIV-based cost-schedule-performance trade-offs during each phase of the acquisition process.

- At each milestone beginning with program initiation (usually Milestone B), thresholds and objectives initially expressed as measures of effectiveness or performance for the proposed concept or system shall be documented by the user or user's representative in a CDD. The threshold value is the minimum acceptable value that, in the user's judgment, is necessary to satisfy the need. If threshold values are not achieved, program performance is seriously degraded, the program may be too costly, or the pro-

gram may no longer be timely. The objective value is that desired by the user and which the PM is attempting to obtain. The objective value could represent an operationally meaningful, time critical, and cost-effective increment above the threshold for each program parameter. Thresholds and objectives in the CDD shall consider the results of the AoA and the impact of affordability constraints. Key Performance Parameters (KPPs)—validated by the Joint Requirements Oversight Council (JROC)—shall be included in the appropriate Acquisition Program Baseline (APB). A KPP is that capability or characteristic so significant that failure to meet the threshold can be cause for the concept or system selection to be reevaluated or the program to be reassessed or even terminated. KPPs are extracted from the CDD and included in the APB. User or user representative participation in each acquisition phase is essential.

.12 ***The Cost Analysis Requirements Description (CARD).*** For ACAT I programs, the DoD Component sponsoring the acquisition shall establish a CARD. The PM shall prepare, and an authority no lower than the DoD Component Program Executive Officer shall approve the CARD. For ACAT IA programs, the PM shall establish the CARD in coordination with appropriate Integrated Product Team (IPT) members. The CARD shall describe the salient features of both the acquisition program and the system itself, and provide the basis for the LCCEs. The CARD shall be flexible, tailored, and refer to information available in other documents available to cost estimators. For joint programs, the CARD shall cover the common program as agreed to by all participating DoD Components, as well as any unique Component requirements. The teams preparing the program office LCCE, the component cost analysis, if applicable, and the independent LCCE shall receive the CARD 180 days prior to a planned Overarching Integrated Product Team (OIPT) or Component review, unless the OIPT leader agrees to another due date.

7.3.2 Tools and Techniques for Cost Estimating

.1 *Analogous estimating.* See same in *PMBOK® Guide.*

.2 *Parametric modeling.* See same in *PMBOK® Guide.*

.3 *Bottom-up modeling.* See same in *PMBOK® Guide*; also referred to as “Engineering” in DoD.

.4 *Computerized tools.* See same in *PMBOK® Guide.*

.5 *Other cost estimating methods.* See same in *PMBOK® Guide*; DoD uses other cost estimating methods, such as the Extrapolation Method—where actual costs for a system are applied to subsequent production contracts for the same system. In all the methods discussed, subject-matter experts (SMEs) are used to obtain cost information.

.6 ***Regulations****.* There is a series of DoD directives and regulations pertaining to defense acquisition which prescribe policies and procedures for cost estimating. These directives address the cost estimates and cost reports prepared by the Program Office, the DoD Component, and if applicable, those preparing the Independent Cost Estimate. For ACAT I and IA programs, DoD has a very structured process for preparation and review of cost estimates as a program moves through the various milestone. See DoDD 5000.4; and DoDD 5000.4-M.

.7 ***Life-Cycle Cost Estimate (LCCE).*** Based on all known requirements associated with materiel solution to a validated mission need intended to satisfy a deficiency, the cost analyst(s) prepares the LCCE (constant year dollar cost estimates) of the proposed materiel solution (i.e., acquisition program). As that acquisition program passes through the various phases and milestones of the acquisition management process, the LCCE is updated and adjusted. Thus, the LCCE is a critical document and often serves as a basis for important decisions impacting the acquisition program. See the *PMBOK® Guide*, section 7.2.2 for cost estimating techniques applicable to both industry and DoD.

.8 ***Integrated Product Teams.*** Within DoD, responsible organizations and individuals make use of the Integrated Product and Process Development (IPPD) concept and Integrated IPTs in the development and review of LCCEs of an acquisition program. These concepts apply to both weapons systems and automated information systems.

7.3.3 Outputs from Cost Estimating

.1 *Cost estimates.* See same in *PMBOK® Guide.*

.2 *Supporting detail.* See same in *PMBOK® Guide.*

.3 *Cost management plan.* See same in *PMBOK® Guide.*

.4 ***Formats for DoD cost estimates.*** Within DoD, the total life-cycle cost of an acquisition program will be provided by the cost analyst within the various costing organizations in at least five different structures or formats: funding by appropriation, WBS, life-cycle, cost document, and time-phasing cost categories (see format types below). Required reports will add variations to these formats. In addition, cost will be presented in a sixth format that displays the relationships between some of the costs in the first three formats. As appropriate, numbers of units of hardware and manpower numbers are also provided and costs assigned to those items.

- ***By funding appropriation.*** These are cost as allocated to one or more of the 13 appropriations employed by Congress in its annual appropriation bills that provide budget authority for the Federal Government. Appropriations applicable to DoD are Research, Development, Test and Evaluation (RDT&E); Procurement; O&M; MILCON; and MILPERS. These breakouts are necessary to develop internal budgets, meet internal DoD program planning needs, and to structure budget requests to Congress via the President's Budget. These categories are sometimes referred to as “colors of money.”

- ***By work breakdown structure.*** These costs are allocated to WBS levels. The WBS, specified in MIL-HDBK-881, is an equipment/product and task-oriented listing of products and activities that must be accomplished to bring a system through R&D and Production. The WBS is organized in levels of indenture. The first level describes the category of system to be developed in the most general of terms, e.g., aircraft, electronics, missiles, ordnance, ships, space, and surface vehicles. MIL-HDBK-881 specifies Levels Two and Three of the WBS for each system category. Level Two lists what must be accomplished to a greater degree of detail, and Level Three presents even more detail. Two types of WBSs are prepared: the Program WBS and the Contract WBS (CWBS). The Program WBS describes the whole program and goes to three levels. The CWBS defines the WBS covered by a particular contract. CWBSs must go to at least Level Three and are gener-

ally extended to lower levels by the contractor. At the lowest level, WBS subsets closely match accounts used by the contractor in its cost accounting systems. This allows accumulation of costs pertinent to higher WBS elements directly from the contractor's cost accounting system with a minimum of disruption.

- ***By life-cycle cost categories.*** These costs are allocated to R&D, Investment, Operations and Support (O&S), and Disposal. Although names of these categories are similar to the funding appropriations, they are not the same and have different meanings. These categories relate to the acquisition phases as shown in Figure 7-5 and are described in the following paragraphs. The percentages shown in this figure are "typical" of major acquisition programs, but should be considered notional.

    - R&D: Cost of all R&D phases (i.e., Concept and Technology Development, System Development and Demonstration, and part of Production and Deployment).

    - Investment: Cost of the investment phase (i.e., part of Production and Deployment and part of O&S) including the total cost of procuring the prime equipment, its related support equipment and facilities.

    - O&S: Cost of the O&S phase including all direct and indirect costs incurred in using the system (i.e., personnel, maintenance (unit and depot), sustaining investment (replenishment spares), and indirect O&S).

    - Disposal: Cost to dispose of the system after its useful life. The PM addresses this issue in the AS demilitarization and disposal requirements section and ensures that sufficient information exists so that disposal can be carried out in a way that is in accordance with all legal and regulatory requirements relating to safety, security, and the environment. The Defense Reutilization and Marketing Office (DRMO) executes the PM's strategy and demilitarizes and disposes of items assigned to the DRMO. All such costs must be estimated and included in the total life-cycle cost of the system under consideration.

- ***By interrelated budget and cost document terms.*** There is a relationship between the different cost breakouts. For weapon acquisition programs, specific budget/cost terms are used to provide a basic structure for understanding DoD acquisition program costs. These terms are used in presentations to the Cost Analysis Improvement Group (CAIG); and in the Selected Acquisition Report (SAR), Fiscal Guidance, Combined Program/Budget, Program Decision Memorandums (PDMs), and various congressional information sheets. The terms provide uniform and consistent definitions identifying relationships between the WBS elements, funding appropriations, and cost categories. There are seven of these terms. For example, one term is "flyaway cost (rollaway, sailaway, etc.)." This term refers to the cost of developing, testing and procuring prime mission equipment. It is funded from the Procurement appropriations and Investment cost categories. The WBS elements of Prime Mission Equipment costs are included in this category. Another is "Program Acquisition Cost," which is a multi-appropriation cost. It consists of all costs (and terms) associated with developing, procuring, and housing a weapon system. Because it consolidates development, weapon system and MILCON costs, appropriations that are designated as RDT&E, Procurement, and MILCON are included. Again, this is the complete cost of acquiring a weapon system-ready to operate. However, it is

not what is termed "Life-Cycle Cost" because it lacks O&M Cost, MILPERS and disposal cost. (See Figure 7-6.)

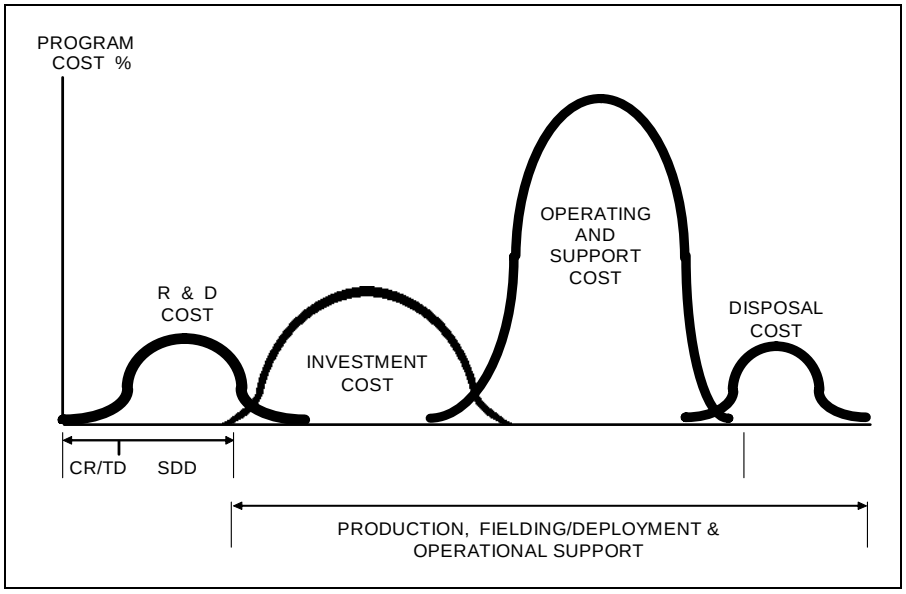


Figure 7-5. Life-Cycle Cost Categories

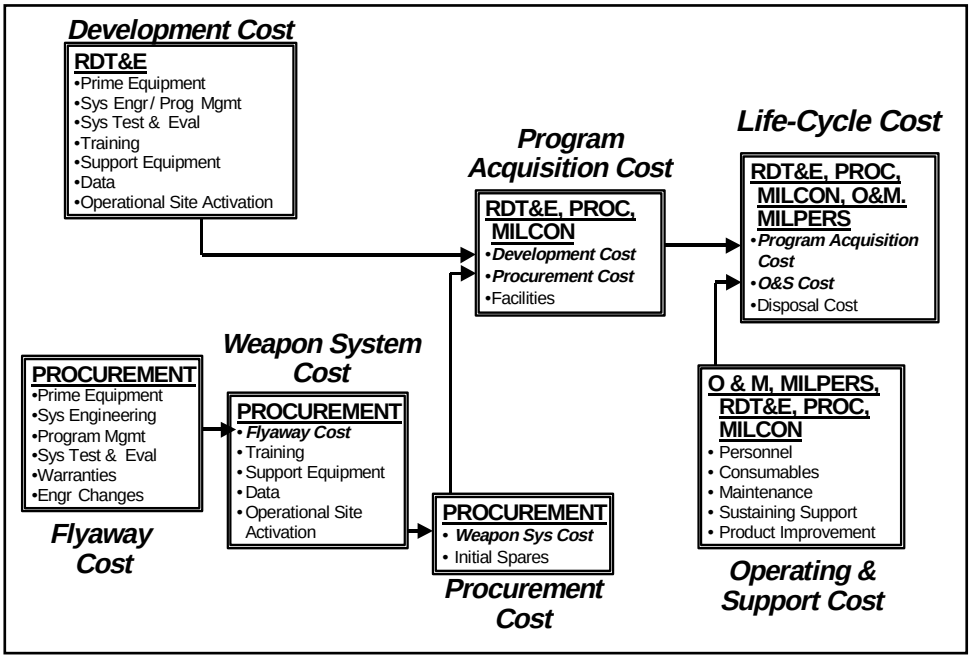


Figure 7-6. Interrelated Budget and Cost Document Terms

- ***By time phasing.*** In addition to the four parameters (see bullet above) by which the life-cycle cost of an acquisition program can be examined, it is appropriate to consider that cost against a time line. Obviously, all costs of a program are not incurred during one fiscal year and, because DoD must request and receive its required funding through an annual Appropriations Act, it is necessary to divide the total life-cycle cost of the

acquisition program among the fiscal years those funds are required. This is further demonstrated through the PPBES process.

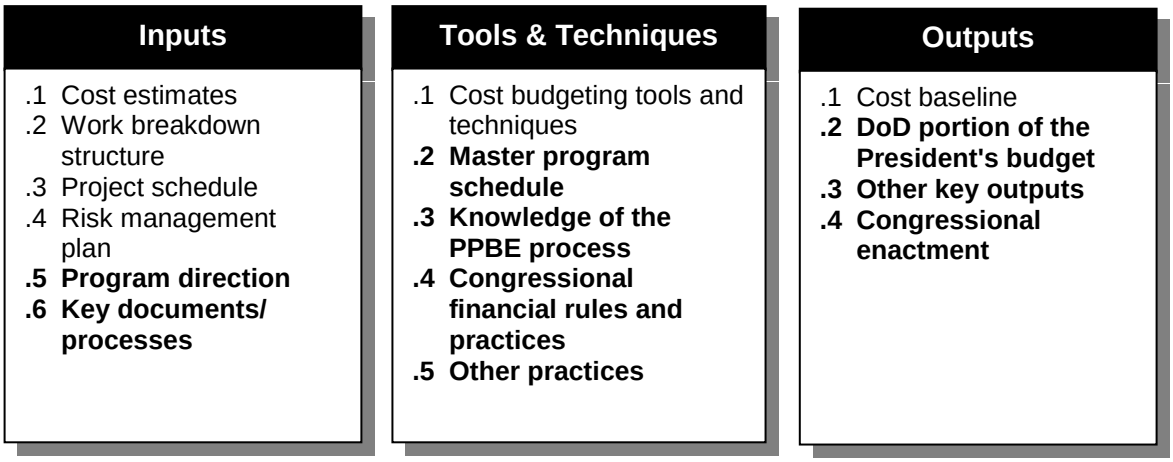
7.4 Cost Budgeting

The DoD PM, relative to budgeting and funds management, must work within three systems. These are: 1) the Defense Acquisition System (the acquisition management framework for R&D and production/fielding to gain program approval to proceed — reference the 5000 Series directives); 2) the PPBES (to gain funding) as outlined in Section 7.2, and 3) the Requirements Generation System (reference the 5000 Series directives and CJCSI 3170.01_). In addition, the PM must be aware of congressional activities impacting his/her program. This section addresses PM functions operating within the Defense Acquisition System, PPBES, and congressional actions.

Although a program may be approved or be in the process of gaining approval within the Defense Acquisition System, the program must be included in the PPBES, as noted in 7.2, as a first step to gain and sustain funding — that is, to gain authority to incur obligations and cause payments to be made from the U.S. Treasury for specified purposes, e.g., RDT&E on a designated acquisition (materiel, weapon, or information system or service) program. Obviously, one of the starting points for budgeting are the same cost estimates addressed in Paragraph 7.3.3 above that were used to support program approval. Thus, the PM will continue to use cost estimating techniques, but attention must also be given to the previously noted appropriations structure (Paragraph 7.3.3.5).

In the process of programming and budgeting as described in 7.2, a DoD acquisition program is dissected for funding purposes into a manageable cost breakdown structure. That is, an estimate is phased by the PM into a program/budget consistent with program’s schedule, documentation requirements, applicable appropriations, and appropriate fiscal years. A major challenge of budgeting is attempting to capture the pervasive increase in price over time. DoD publishes escalation factors that are used to anticipate how much cash (outlay) will be paid from the U.S. Treasury in a given time frame. There are two factors that establish outlays over time: 1) Inflation which compounds year over year, and 2) outlay patterns. Each appropriation has a “spend out” profile depending on its nature. This historical data is used to predict when budget requirements will demand cash from the U.S. Treasury. Acquisition managers are expected to use the published escalation factors unless the manager can justify why their program is different.

These PM appropriation estimates will be reviewed within the applicable Service, adjusted as noted above, and used as part of the Service's Combined Program/Budget provided to OSD (see 7.2). As noted in the PPBES section, the Services revise their budgets to support the decisions resulting from the OSD budget review process for inclusion in the DoD portion of the President's Budget. A PM's original submission to a Service Budget (quantities, dollars, and schedule) may be unchanged, modified, or have portions deleted in the final DoD budget despite prior approval of the acquisition program in the system acquisition process.



7.4.1 Inputs to Cost Budgeting

.1 *Cost estimates.* See same in *PMBOK® Guide.*

.2 *Work breakdown structure.* See same in *PMBOK® Guide.*

.3 *Project schedule.* See same in *PMBOK® Guide.*

.4 *Risk management plan.* See same in *PMBOK® Guide.*

.5 ***Program direction.*** This is a snapshot of the program established by the PM based on the actual and planned progress of the program, direction from superiors, and coordination with Service/OSD/congressional staffers. A budget is prepared based on program direction. If a program is approved or is in the process of gaining approval within the system acquisition process, it will have a number of draft decisions or approved documents that will guide the PM's Combined Program/Budget and later budget preparation efforts. These include an approved or soon-to-be-approved APB. Each baseline contains objectives for key cost, schedule, and performance parameters. The baseline is coordinated among all major acquisition decision makers. This document, other approved or pending program documents, updated versions of coordinated cost estimates noted in Paragraph 7.3.3, the AS, and direction from the MDA will be employed in formulating the PM's submission to the Service Combined Program/Budget. The PM will likely be directed to make quantitative adjustments as driven by Service and OSD program analyst and comptroller staff formal reviews before a program financial profile is made part of the DoD final budget.

.6 ***Key documents/processes.*** Key inputs for program/budget preparation are program direction, schedule, and AS. Program direction in turn comes from such sources as the CDD that supports and justifies a new acquisition program, or an ADM from higher authority. These documents are directive in nature and lead to the development or modification of the AS, which in turn encompasses a program schedule. While these items are key elements in the process of justifying a program budget, they in turn may require adjustment to reflect the realities of program funding. Thus, there is a circular relationship between the program requirements documentation that justifies the program budget request, and the realities of the program funds available following congressional enactment. In this regard, the following points merit emphasis:

- In summary, funding should be addressed as follows:
  - The work in Concept Refinement normally is funded only for completion of concept studies contracts. The work is guided by the ICD.
  - The work in Technology Development is funded only for the advanced development work. The work effort is guided by the validated ICD, but during this activity, a CDD is developed to support program initiation.
  - Each DoD Component should maintain a transition fund in the out-years of the FYDP to allow rapid transition of military or commercial projects from technology opportunity and user needs activities to System Development and Demonstration or Commitment to Low-Rate Production.
  - Entrance into System Development and Demonstration is dependent on three things: technology (including software) maturity, validated requirements, and funding.
  - Regardless of the entry point, approval at Milestone C is dependent on (among other things) a demonstration that the system is affordable throughout the life cycle, optimally funded, and properly phased for rapid acquisition.
  - LRIP may be funded by either RDT&E or by procurement appropriations, depending on the intended usage of the LRIP assets.

- The affordability determination is made in the process of addressing cost as a military requirement in the requirements process and included in the ICD and CDD, beginning with the acquisition cost using LCC or TOC.

- Acquisition Programs are directed, funded efforts, designed to provide a new, improved, or continuing materiel, weapon, or information system or service capability in response to a validated operational or business need. Technology projects are directed, incrementally funded efforts, and are not acquisition programs.

7.4.2 Tools and Techniques for Cost Budgeting

.1 *Cost budgeting tools and techniques.* See same in *PMBOK® Guide.*

.2 ***Master program schedule.*** The "Program Direction" noted above, when combined with a sound Program Work Breakdown Structure, can lead to a Master Program Schedule (MPS) (also called an Integrated Master Schedule (IMS)), which will be an essential part of building a financial profile for the Combined Program/Budget and budget. Functional engineers and other experts must provide a reliable estimate of the total time it will take to accomplish *each* task and the sequence in which the tasks must be executed. The PM—with support from functional managers—must determine if there are tasks that must be completed or partially completed before other tasks can begin. These interrelationships are provided by a critical path type schedule (which includes both critical and non-critical path tasks). The cost of each task is estimated using cost estimating methodologies. For some of the tasks, particularly the longer ones, the PM must know the phasing of costs within the task — front or back loaded, labor rates, etc. A key date that generally governs the master schedule is Initial Operational Capability (IOC). Task schedules evolve by balancing the analysis of the work to be done, and the time frame required to perform the work to achieve IOC. Obviously the Service's Combined Program/Budget must be submitted with sufficient lead-time to accomplish the work scheduled.

.3 ***Knowledge of the PPBE process.*** There are two building blocks within the PPBES (PPBE process) that will aid the PM in preparing his/her program and budget documents. These are "Major Force Programs" and "Program Elements." Both were addressed in 7.2.

.4 ***Congressional financial rules and practices.*** There are a number of ground rules that must be understood concerning the budgeting of funds in specific fiscal years for different appropriations. Two congressional rules are of primary interest in weapons systems acquisition. One applies to the RDT&E appropriation and is called incremental funding; and the other applies to the procurement and MILCON appropriations and is called full funding. These two very different rules have implications for forecasting financial requirements.

- Incremental funding. The congressional intent behind this rule is that a development program should budget annually only for what is needed to pay for R&D work to be performed during each fiscal year. It is necessary to know when the costs will be incurred. In practice, this can be tricky, particularly when looking forward to competitive development without knowledge of who the contractor will be, much less how the costs will be incurred.

- Full funding. Each year's (procurement) appropriation request must contain the funds estimated to be required to cover the total cost to be incurred in completing delivery of a given quantity of usable end items such as aircraft, missiles, ships, vehicles, and ammunition that can be delivered in a future 12 month period.

  — Advance procurement. An exception to the full funding policy is advance procurement. In accordance with DoD Regulation 7000.14-R, procurement of end items shall be fully funded, i.e., the cost of the end items to be bought in any fiscal year shall be completely included in that year’s budget request. However, there are occasions when it is appropriate that some components, parts, material, or effort be procured in advance of the end item buy, as authorized, to preclude serious and costly fluctuation in program continuity or when items have significantly longer lead times than other components, parts, and material of the same end item. In these instances, the long lead-time material or effort may be procured with advance procurement funds, but only in sufficient quantity to support the next fiscal year quantity end-item buy (except for economic order quantity procurement of material to support a multi-year procurement), and only to buy those long-lead items necessary to maintain critical skills and proficiencies that would otherwise have to be reconstituted at significantly greater net cost to the Government. When advance procurement is part of a program, the cost of components, material, parts, and effort budgeted for advance procurement shall be relatively low compared to the remaining portion of the cost of the end item. Because such use of advance procurement limits the MDA’s flexibility, this acquisition technique shall be used only when the cost benefits are significant and only with approval of the MDA.

  — Multiyear procurement. This is another exception to the full funding policy. It is a method for acquiring up to five years of requirements for systems or subsystems with a single contract. The purpose is to reduce the program cost growth and introduce stability into the acquisition process. In theory it does so by making a commitment to the contractor to procure a specific quantity of some weapon system over several years to be funded on a year-by-year basis. The sav-

ings/stability is realized through economic order quantities, earlier deliveries, additional contractor investment in facilities and training, and inflation avoidance.

.5 Other practices.

- Funded delivery schedule. One of the internal DoD criteria used to determine if a program is being executed efficiently is the funded delivery rule. The rule is "from the time of the first delivered item, all items associated with a given fiscal year procurement quantity or lot buy, must be delivered within a 12-month window."

- Other DoD practices deal with product improvement, the concept of management reserve, and inflation indices.

7.4.3 Outputs from Cost Budgeting

.1 Cost baseline. See same in *PMBOK® Guide*.

.2 DoD portion of the President's Budget. After the decisions resulting from the PDM and OSD/OMB budget review have been finalized, the DoD portion of the President's Budget is completed. This annual request reflects his recommendations for existing and proposed spending priorities for the coming fiscal year. In addition, it includes the total expected outlays and receipt levels consistent with the economic assumptions used in the preparation of the budget.

The DoD portion of the President's Budget, which is the end product of the PPBE process, is the basis for the DoD congressional enactment process. In the following nine months, this budget will be closely scrutinized, serving as guidance for several major pieces of defense-related legislation: the National Defense Authorization Bill and the Defense and MILCON Appropriations Bills. Of all the legislative matters before Congress, none is more important or more political than the review of the President's Budget. Each year, 535 members of Congress and hundreds of congressional staffers, all of whom possess their own perspectives and priorities, will examine the budget. One thing is certain, however: the end product of the enactment process (i.e., the Authorization and Appropriations Bills) will differ to some extent from the requests contained in the President's Budget, not to mention the PM's submission to his or her Service Combined Program/Budget months earlier.

.3 Other key outputs. To support the program/budget submissions the Services submit budget exhibits to the USD(C) and to the DoD oversight committees of the Congress immediately following the transmittal of the President's Budget. These budget exhibits describe the overall status of a weapon system program and include: a mission description and justification; an eight-year funding and quantity profile, including initial spares and unit procurement cost; total and unit cost detail by WBS elements; contracting data to include method, type, award date, and first item delivery; and production schedule information showing production rates and lead time, and monthly deliveries for each contract award. Thus, they keep OSD and the Congress informed of the progress and problems in program execution, schedule, and cost projections. The DoD 7000.14-R, *Financial Management Regulation*, Volume 2, provides the basic guidance for these exhibits.

.4 Congressional enactment. Congressional enactment is the legislative review of the President’s Budget. It involves a three-step process: budget resolution, authorization, and appropriation.

- *Budget Resolution.* Resolution is a type of legislation binding on the Congress. It is the product of the Budget Committees and it sets a legislative ceiling on major Government functions. The purpose of resolution is to impose a ceiling, almost in checkbook fashion, to ensure linkage between revenues and expenditures.

- *Authorization.* The DoD Authorization Bill becomes a law (i.e., an Act) when signed by the President. It is the product of the House Armed Services Committee (HASC) and Senate Armed Services Committee (SASC) and is described as a law that provides permission for a Federal program to exist. It specifies spending ceilings and quantities for a program. It often contains end strength numbers and policy issues.

- *Appropriation.* The Defense Appropriations Bill becomes a law (i.e., an Act) when signed by the President. It provides a specific amount of budget authority for an intended purpose, for a given time frame. The Appropriations Bill is the product of the appropriations committees. It is analogous to giving a program a line of credit with a specified limit. Two committees are of interest in appropriations, the Subcommittee on Defense and the Subcommittee on MILCON. DoD programs must receive both an authorization and an appropriation.

- *Other enactment considerations.*

    - *Committees.* President Wilson once said, “Congress in committee is Congress at work.” Much of the legislative work is done in committee, including inquiries, hearings, legislative drafts, etc. The authorizations and appropriations committees primarily influence DoD policies, funding, and operations, although many other committees have an interest in Defense. Legislative liaison is the PM's conduit to congressional staff and committee activity.

    - *Appeals.* In the enactment process the committees have the opportunity to reshape the budget through a “mark.” The appeals process is the result of agreements between DoD leadership and the four committees. The rules of appeals impose constraints not only on when a PM may request restoration of funds, but also how much, and to whom. Generally speaking, the rules are that DoD may appeal to the amount closest in dollar value to the President’s Budget request, or appeal to the next committee that is considering the legislation (usually the Senate or Conference Committees.)

7.5 Cost Control

Within DoD, an AoA addresses the proposed system’s operational effectiveness related to its life-cycle costs compared to various other alternatives to meet the mission area need. This is a cost/benefit analysis that answers the question, “Are we getting the greatest value for the resources expended?” Stated another way, “Is the proposed system the best approach to meet this threat?” The analysis is intended to:

- Analyze alternatives as part of the CAIV process. Alternatives analysis broadly examines multiple elements of project or program alternatives including technical risk and maturity, price, and costs.

- Explicitly analyze continued O&S costs of the baseline. For each alternative, it shall consider requirements for a new or modified Information Technology (IT), including a National Security System (NSS), or support infrastructure. The analysis shall include sensitivity analyses to possible changes in key assumptions (e.g., threat) or variables (e.g., selected performance capabilities). Where appropriate, the analysis shall address the interoperability and commonality of components or systems that are similar in function to other DoD Component programs or Allied programs.

- Aid decision makers in judging whether any of the proposed alternatives to an existing system offers sufficient military and/or economic benefit to justify the cost. For most systems, the analysis shall consider and baseline against the system(s) that the acquisition program will replace, if they exist. The analysis shall consider the benefits and detriments, if any, of accelerated and delayed introduction of military capabilities, including the effect on life-cycle costs.

- Be employed by Program Analysis and Evaluation (PA&E), who shall assess the AoA, in terms of its comprehensiveness, objectivity, and compliance with the Clinger-Cohen Act. PA&E shall provide the assessment to the Component Head or Principal Staff Assistant (PSA), and to the MDA. The PM and MDA shall consider the analysis, the PA&E assessment, and ensuing documentation at Milestone B (or C, if there is no Milestone B) for ACAT I and IA programs.

The analysis will largely be quantitative, but qualitative aspects must also be considered. It facilitates decision makers and staffs at all levels to engage in discussions of key assumptions and variables, develop better program understanding, and foster joint ownership of the program and program decisions. There shall be a clear linkage between the AoA, system requirements and test and evaluation measures of effectiveness. The analysis shall reveal insights into program knowns and unknowns and highlight relative advantages and disadvantages of the alternatives being considered.

Inputs	Tools & Techniques	Outputs
.1 Cost baseline	.1 Cost change control system	.1 Revised cost estimates
.2 Performance reports	.2 Performance measurement	.2 Budget updates
.3 Change requests	.3 Earned value management (EVM)	.3 Corrective action
.4 Cost management plan	.4 Additional planning	.4 Estimate at completion
.5 Key areas	.5 Computerized tools	.5 Project closeout
.6 AoA responsibility	**.6 Preparation**	.6 Lessons learned
.7 Range of concepts		**.7 Program decision points**

7.5.1 Inputs to Cost Controls

.1 *Cost baseline.* See same in *PMBOK® Guide.*

.2 *Performance reports.* See same in *PMBOK® Guide.*

.3 *Change requests.* See same in *PMBOK® Guide.*

.4 *Cost management plan.* See same in *PMBOK® Guide.*

.5 Key areas. The preparation of the AoA will normally include the following:

- Mission Need, Deficiencies and Opportunities;
- Threats;
- Operational Environments;
- Operational Concept;
- Alternatives;
- Measures of Effectiveness;
- Life-Cycle Costs of each alternative;
- Assumptions, Risks, Benefits.

.6 AoA responsibility. The DoD 5000 Series requires that the DoD Component, or for ACAT IA programs the office of the PSA responsible for the mission area associated with the mission deficiency or technical opportunity, normally prepares the AoA. The DoD Component Head (or PSA for ACAT IA programs), or as delegated, but not the PM, shall determine the independent activity to conduct the analysis. If an AoA IPT forms, the PM or designated representative may be a team member, but shall not be the IPT leader. An AoA is intended to be an objective analysis of feasible competing alternative approaches to address a mission's deficiency. A PM as lead may influence the process too much. Joint programs are led by the designated "lead" DoD Component and will ensure a comprehensive analysis. If DoD Components supplement the lead Component's analysis, the lead Component shall ensure consistent assumptions and methodologies between the analyses.

.7 Range of concepts. Each identified mission need has many possible but feasible concepts that will satisfy that need. Not all possible concepts can be explored in Concept Refinement. The analysis of multiple concepts is a process of looking at possible concepts and identifying those concepts that could not realistically satisfy the need at a cost and on a schedule that are acceptable to the user. The analysis of multiple concepts will aid decision makers in placing appropriate boundaries on the type of concepts to explore.

The analysis shall broadly examine each possible concept and describe the rationale for continuing interest in the concept or eliminating the concept from further consideration. The intent of the analysis shall be to define any limitations on the type of alternatives DoD will consider, while leaving the range of remaining alternatives as broad as possible, so as not to constrain innovation or creativity on the part of industry.

The Component(s) responding to a mission need likely to result in an ACAT I program shall prepare the analysis of multiple concepts. The OIPT Leader shall review the analysis, in coordination with the Director, Program Analysis and Evaluation (DPA&E) and other interested staff offices, and provide an assessment to the MDA.

7.5.2 Tools and Techniques for Cost Controls

.1 *Cost change control system.* See same in *PMBOK® Guide.*

.2 *Performance measurement.* See same in *PMBOK® Guide.*

.3 *Earned value management (EVM).* See same in *PMBOK® Guide.*

.4 *Additional planning.* See same in *PMBOK® Guide.*

.5 *Computerized tools.* See same in *PMBOK® Guide.*

.6 ***Preparation.*** For ACAT ID and ACAT IAM programs, the DoD Component Head or PSA or delegated official shall coordinate with the following offices early in the development of alternatives:

- Under Secretary of Defense (Acquisition, Technology and Logistics (USD(AT&L)) or Assistant Secretary of Defense (Command, Control, Communications and Intelligence) (ASD(C3I));
- Joint Staff or PSA office;
- Director, Operational Test and Evaluation (DOT&E);
- Director, Program Analysis & Evaluation (DPA&E).

Coordination shall ensure consideration of the full range of alternatives; the development of organizational and operational plans, with inputs from the Combatant Commanders of the Unified Commands, that are consistent with U.S. military strategy; and the consideration of joint-Service issues, such as interoperability, security, and common use. The USD(AT&L) shall issue guidance for ACAT ID programs. The USD(AT&L) or ASD(C3I) shall issue guidance for other programs. The DPA&E, shall prepare the guidance in coordination with the offices listed above.

7.5.3 Outputs for Cost Controls

.1 *Revised cost estimates.* See same in *PMBOK® Guide.*

.2 *Budget updates.* See same in *PMBOK® Guide.*

.3 *Corrective action.* See same in *PMBOK® Guide.*

.4 *Estimate at completion.* See same in *PMBOK® Guide.*

.5 *Project closeout.* See same in *PMBOK® Guide.*

.6 *Lessons learned.* See same in *PMBOK® Guide.*

.7 ***Program decision points***. Normally, the DoD Component completes the analysis and documents its findings in preparation for a program initiation decision. The MDA may direct

updates to the analysis for subsequent decision points, if conditions warrant. For example, an AoA may be useful in examining cost performance trades at the system demonstration interim progress review. An AoA is unlikely to be required for Milestone C, unless there were no Milestones A or B; unless the program or circumstances (e.g., threat, alliances, operating areas, technology) changed significantly; or unless there are competing procurement strategies for the same system. For ACAT IA programs, the PM shall incorporate the AoA into the cost/benefit element structure and process.

7.6 Setting Objectives

The “execution” or “E” part of the PPBE is for measuring output. This is different than the normal, “how much did you obligate and expend.” Rather, what did DoD actually get for the money provided by Congress.

In establishing realistic objectives, the user shall treat cost as a military requirement. The acquisition community, and the requirements community, shall use the CAIV process to develop TOC/LCC, schedule, and performance thresholds and objectives. CAIV philosophy means that cost should be treated as an independent variable among the three variables traditionally associated with a defense acquisition program: cost, schedule and performance. Simply put, an independent variable is one that is “fixed” and other variables react to (or are dependent upon) the stability imposed by that independent (fixed) variable. Previously, in practice, performance tended to remain relatively stable (i.e., it was treated as the independent variable) while cost increased (i.e., it became the dependent variable). While the total life-cycle cost of a given acquisition program will not necessarily be absolutely fixed and never changed during the life of the program, under the CAIV philosophy, much stronger consideration must be given to stabilizing the costs of acquisition programs. Guidance on implementing CAIV policy is provided in the DoD 5000 Series. Thus, CAIV can also be considered an acquisition philosophy intended to integrate proven successful business-related practices with promising new DoD initiatives to obtain superior, yet reasonably priced systems.

They shall address cost in the CDD, and balance mission needs with projected out-year resources, taking into account anticipated process improvements in both DoD and defense industries. CAIV trades shall consider the cost of delay and the potential for early operational capability.

Under CAIV, the best time to reduce life-cycle costs is early in the acquisition process (e.g., it makes sense for the PM to spend development funds in order to save a greater amount of production costs and/or O&S costs when the program transitions to later phases). Actions taken to contain or reduce projected future life-cycle costs are considered as important as actions taken to meet the schedule and performance thresholds.

7.6.1 Inputs to Setting Objectives

.1 ***CAIV compliance.*** The AoA is an input to the CAIV process (see 7.5). The DoD 5000 Series requires that all ACAT I and ACAT IA programs use the approach specified for compliance with the CAIV requirements; the same principles may be applied to other programs at the discretion of the responsible Component Acquisition Executive (CAE).

.2 ***Team responsibilities.*** Upon CDD approval the PM shall formulate a CAIV plan as part of the AS, to achieve program objectives. Upon program initiation, each ACAT I and ACAT IA PM shall document TOC objectives as part of the APB. Early in the life of the program, the PM is to establish a Cost/Performance Integrated Process Team (CPIPT). The team includes representatives of the user, costing, analysis, and budgeting communities, at a minimum; it may also include other members as and when appropriate, including industry or contractors, consistent with statute and the policy stated in the DoD 5000 Series, and addressed below in this chapter under Industry Participation. Normally, the PM or the PM's representative shall lead the CPIPT.

.3 ***Industry participation and input.*** Industry representatives may be invited to a Working-level IPT (WIPT) or Integrating IPT (IIPT) meeting to provide information, advice, and recommendations to the IPT; however, the following policy shall govern their participation.

- Industry representatives shall not be formal members of the IPT.
- Industry participation shall be consistent with the *Federal Advisory Committee Act.*[3]
- Industry representatives may not be present during IPT deliberations on AS or competition sensitive matters, nor during any other discussions that would give them a marketing or competitive advantage.

At the beginning of each meeting, the IPT chair shall introduce each industry representative, including his/her affiliation and purpose for attending.

- The chair shall inform the IPT members of the need to restrict discussions while industry representatives are in the room, and/or the chair shall request the industry representatives to leave before matters are discussed that are inappropriate for them to hear.
- Support contractors may participate in WIPTs and IIPTs, but they may not commit the organization they support to a specific position. The organizations they support are responsible for ensuring the support contractors are employed in ways that do not create the potential for an organizational conflict of interest.

Given the sensitive nature of OIPT discussions, neither industry representatives nor support contractors shall participate in OIPTs.

7.6.2 Tools and Techniques for Setting Objectives

.1 ***Tradeoffs.*** The CPIPT, in applying CAIV philosophies, is involved in recommending cost objectives for each of the acquisition phases, in the evaluation of the progress being made

toward achieving those cost objectives and, when appropriate, in developing recommendations for the trade-offs between performance parameters and costs in order to stay within the cost objectives. The user community is a primary CPIPT member and is intimately involved in the various stages of the CAIV process, to include developing recommendations for trade-offs. Basically, the PM has authority to make CPIPT recommended performance, engineering, and design changes that would not adversely impact the program's ability to satisfy the threshold performance capability set forth in the CDD/APB. If a CPIPT recommendation would result in the program's failing to satisfy the CDD/APB threshold performance capability, the PM would pass the recommendation to the appropriate CDD/APB approval authority for decision.

.2 ***Other tools.*** The PM also has available several acquisition excellence initiatives that may assist in his efforts to lower program costs. Many of these initiatives are well established now, although a few may require waivers. Such initiatives include using commercial standards and processes, commercial components, commercial best practices, performance capability specifications, and contracting strategy techniques that will allow sharing of cost savings with contractors who bring in the program at or below previously established aggressive cost objectives. One example of such a contracting strategy would be to include a request for proposal (RFP) requirement for the contractor to address how he/she will achieve cost objectives associated with CAIV philosophy, and then include specific incentives for the winning contractor to achieve those objectives (with appropriate "extra" fees given the contractor when he/she actually meets or exceeds objectives stated in the contract). Another example of a contracting strategy to reduce costs associated with acquisition programs is the Single Process Initiative (SPI), a coordinated action that allows the contractor to use a single process within his own facilities to manage and report on all defense contracts (rather than having multiple different processes and reports called for in each separate contract). Competition is a very effective means of achieving CAIV goals through development. When competition is no longer appropriate, another contracting strategy is the use of multi-year procurement contracts.

.3 ***Tactics.*** Government PMs of programs in the development phase will find it to their advantage to trade off detailed performance parameters of their system (if parameters exist rather than the preferred overall system performance capability) because of limited alternatives available to the MDA. The MDA's only choices are, in general terms: (a) provide more funding to pay for desired performance parameters (difficult in an environment of limited funding and competing alternatives; (b) cancel the program (undesirable assuming the military requirement remains valid); or (c) restructure the program through the trade-off process (most likely option). Contractors of programs in the development phase will also be impacted by these same limited alternatives as well as the continued profit motivation.

7.6.3 Outputs for Setting Objectives

.1 ***Objectives for milestone approval.*** CPIPT prepared CAIV-based objectives at Milestone B; and as an input to the Acquisition Strategy.

.2 ***Quality expectations.*** *One* of the primary expectations of acquisition programs implementing CAIV is to achieve substantial reductions in the cost of DoD products without degradation of the quality and ability of those products to fully meet the true needs of operational commanders. Other expectations include the desire to achieve clearer and more innovative approaches to designing, manufacturing and providing support to those products and to the

contracting for those products. In other words, CAIV is a continuation of the basic principles of acquisition excellence.

7.7 DoD Program Budget Execution/Funds Management

Obligation plans and ***expenditure plans*** (also called ***"Spend Plans"***) are written forecasts of the planned execution of program funds, i.e., when during the fiscal year funds are expected to be ***obligated*** (e.g., by signing a contract) or ***expended*** (e.g., by sending the contractor a check). The Business Financial Manager (BFM) is usually responsible for building and submitting these plans to the Service Headquarters.

Obligation and expenditure plans are prepared for each appropriation for each year that is available for obligation. They are presented at the line item level in Procurement appropriations, the program element for RDT&E appropriations, and for the sub-activity group for O&M appropriations. For example, Procurement appropriation spending plans would be prepared for the current fiscal year and the two prior fiscal years assuming that some funds from those years remained un-obligated. Similarly, spending plans for RDT&E appropriations are developed for the current fiscal year and the year prior. In addition, expenditure plans are required for each fiscal year of an appropriation that is not yet *liquidated* (i.e., fully expended), even if its period of availability has expired.

Obligation and expenditure plans are used for many purposes. One major purpose is to allow rational decision making regarding the redistribution of funds among programs. Spending that is behind plan presents a "flag" to the Program Executive Officer (PEO) and local comptroller that may indicate that a program will not be able to use its funds effectively during the period of obligation availability. The PEO and local comptroller will investigate causes and may determine that other programs under their cognizance can spend funds in a more timely manner. Service Headquarters and USD(C) personnel analyze the programs' actual obligation and expenditure data for trends to determine if those programs' budget requests are likely to be executed efficiently.

Preliminary spending plans may be aggregated at the DoD level to support the President's Budget request and congressional enactment of that budget by identifying the timing and use of the budget authority requested. These data also provide the U.S. Treasury with information regarding projected outlays.

The acquisition community uses the obligation and expenditure plans and actuals as a "report card" for PMs. Spending plans and actuals are part of the quarterly reviews or briefings to the PEO. Using this information, the PEO can make decisions regarding sources of funding for emergent requirements and provide direction to local comptrollers to reprogram funds as appropriate among acquisition programs under the PEO's cognizance.

Other budget execution/funds management topics beyond the scope of this *U.S. DoD Extension* to the *PMBOK® Guide* are:

- Award fee payments;
- Acceptance and payment for delivered items;
- Progress payments;
- Defense Contract Audit Agency (DCAA) functions;

- Defense Finance and Accounting Service (DFAS) functions;
- Defense Contract Management Agency (DCMA) functions;
- Use of Contract Funds Status Report and related actions;
- USD(C) expenditure performance report;
- Misappropriation Act;
- Anti-deficiency Act;
- Reprogramming;
- Expiration of funds.

7.7.1 Inputs to Program Budget Execution/Funds Management

.1 ***Annual authorization and appropriation laws.*** These are acts of Congress. The Authorization law permits a program to begin or continue and sets limits on funds that can be appropriated; and the Appropriation law permits Federal agencies to incur obligations and make payments from the Treasury. See section 7.4.3.4.

7.7.2 Tools and Techniques for Program Budget Execution/Funds Management

.1 ***Apportionment process.*** After Congress has granted budget authority via an appropriations act, the budget authority is released for execution via the ***apportionment*** process. The intent of apportionment is to achieve the most effective and economical use of the funds made available. Funds are apportioned by the OMB to Federal Government agencies and departments on a quarterly, annual, or other periodic basis. Investment appropriations (e.g., procurement and MILCON) are usually apportioned on an annual basis, while expense appropriations (e.g., O&M, and MILPERS) are usually apportioned on a quarterly basis.

.2 ***Reprogramming****.* Reprogramming is the use of funds for purposes other than those contemplated by the Congress at the time originally appropriated. These actions do not

represent requests for additional funds from the Congress. Rather, they normally involve the reapplication of resources within the budget authority already appropriated from one ***source*** to another. Reprogramming guidance is contained in the *DoD Financial Management Regulation* (DoD 7000.14-R), Volume 3, Chapter 6.

.3 ***Misappropriation Act, Antideficiency Act, and Bona Fide Need.*** See appropriate Federal laws.

.4 ***Various official forms and reports.*** Used for funds allocation, withholding, request for payment, delivery documentation, funds status, reprogramming, etc.

7.7.3 Outputs from Program Budget Execution/Funds Management

.1 ***Initial allocations.*** The apportionment decisions having been made, USD(C) analysts then prepare a form that releases the initial ***allocation*** of funds. These forms reflect the funds that are on withhold and the funds that can be obligated. These forms are signed by the Comptroller and countersigned by USD(AT&L). Figure 7-7 displays the apportionment process plus related processes.

.2 ***Release of funds.*** With the release of funds at the local level, the following sequence of events normally takes place. A ***commitment***, an "administrative reservation" of funds by the comptroller. A commitment will respond to some form of request (purchase request/order, etc.) for a spending action, such as a contract. When reviewing the funds for a commitment, the comptroller will ***certify*** that the funds requested are available in the amount requested, in the correct fiscal year, and are in the correct appropriation for the work to be done. An ***obligation*** is the "legal reservation" of funds tying the Government to a liability, e.g., a contract for goods or services. The ***cost incurred*** is the cost of the actual work being done that will be paid for. An ***expenditure*** is payment of the obligation and is generally considered to be defined as the issuing of a check. An ***outlay,*** (see 7.4), is a payment by the Treasury when the check is cashed. Allocations, commitments, obligations, and expenditures are carefully controlled to avoid over-spending and to track actual fiscal progress against plans.

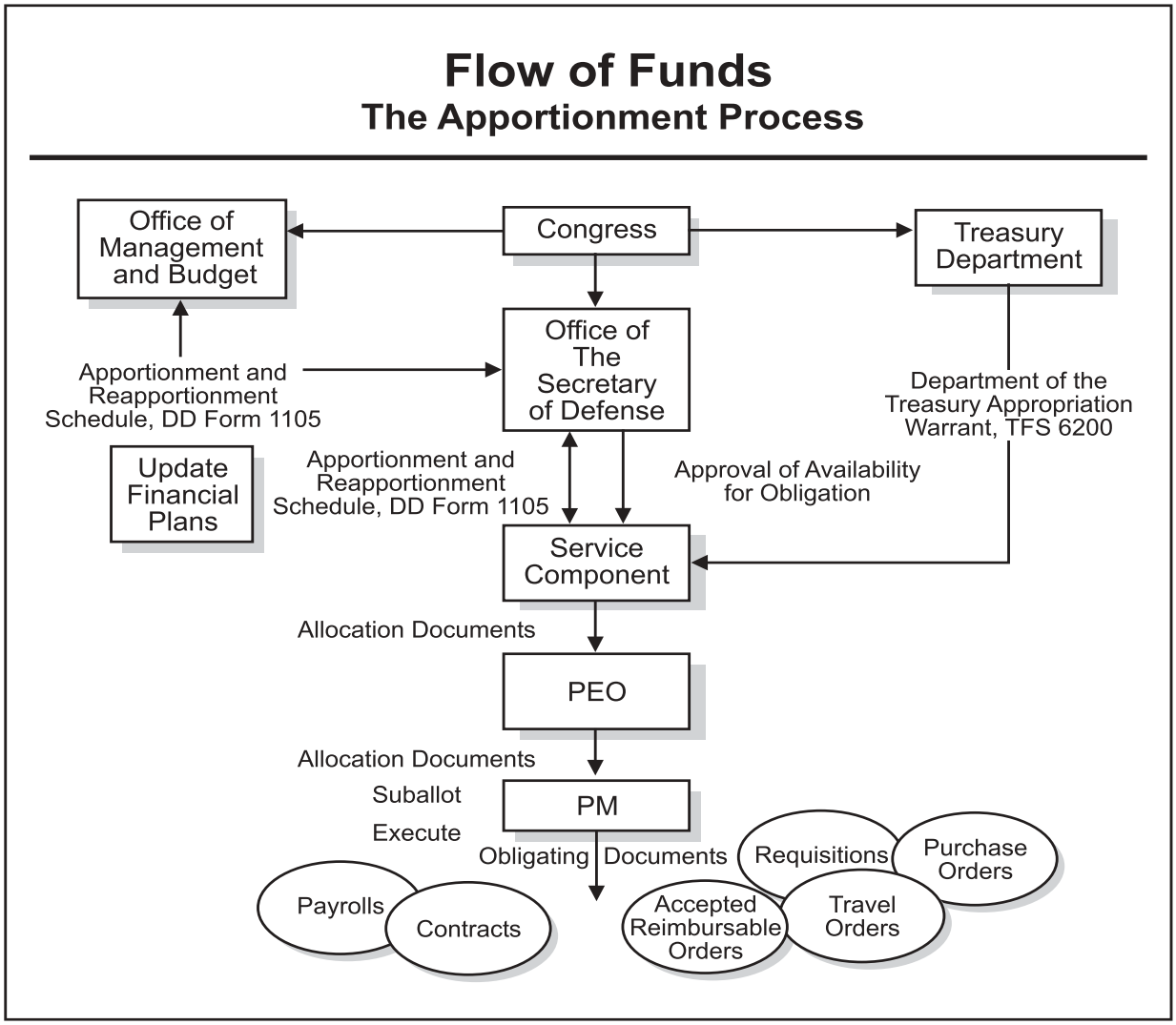


Figure 7-7. The Apportionment Process

Endnotes

1. Much of the text in Chapter 7 was adapted from teaching notes originated by Mr. G. Land, Ms. S. Tack, Ms. S. Richardson, Ms. E. Dunn, Ms. E. Rosenthal, Mr. J. Roberts, Ms. R. Tomasini, Ms. M. Spurlock, and Ms. L. Williams, all of the Defense Acquisition University.
2. Small variations in these titles occur between DoD 7000.14-R; DoD 7045.7-H; and Service programming and budget guidance.
3. Public Law 92-463, *Federal Advisory Committee Act*, October 6, 1972.

Chapter 8

Project Quality Management

Program quality management incorporates the processes, practices, and actions that lead to the desired results for a program. Quality is the result of specific goals and the actions taken to achieve those goals. In both the program development environment and the manufacturing environment, quality requires dedicated efforts that consistently drive toward identifying, defining, designing, and building quality into products and services. This chapter supplements Chapter 8 of the *PMBOK® Guide,* and provides a DoD overview of the following elements of program quality management:

8.1 Quality Planning – identifying which quality standards are relevant to the program and determining how to satisfy them.

8.2 Quality Assurance – evaluating overall program performance on a regular basis to provide confidence that the program will satisfy the relevant quality standards.

8.3 Quality Control – monitoring specific program results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

As in previous chapters of this Extension, the text outline follows the *PMBOK® Guide* outline, with all supplemental subtopics indicated in bold type. Most of the chapter is devoted to listing additional subtopics that complement those in the basic guide. In essence the subtopics become a checklist of the inputs, tools and techniques, and outputs associated with the practice of project quality management within DoD.

Customer identification and related requirements determination are key to the quality program. The International Organization for Standardization (ISO) document ISO 9004 identifies customers as "ultimate consumer, user, client, beneficiary, or second party." For the DoD PM, that is the “warfighter.” However, the PM has an additional set of customers. They are the Congress, the taxpayers, public interest groups, and program overseers within the DoD organization. Each program has a different mix of customers with different requirements.

On the other side of the customer equation is the provider. There is at least one provider for every customer and that provider is responsible for meeting the customer's legitimate needs. Providers are typically not identified or defined in programs, but are assumed to be the person(s) who deliver satisfaction to the customer. Each program should identify the providers and their respective customers.

Quality programs within Government or industry attempt to change the organizational culture (when it needs changing) to ensure that all participants are sensitive to quality issues such as customer awareness, continuous improvement of products and processes, and total

teamwork. Various quality-related programs undertaken in industry and Government have been labeled Total Quality Management (TQM), Total Quality Organization (TQO), Total Quality Leadership (TQL), and Total Customer Satisfaction (TCS).

In most organizations, the pursuit of quality entails the formulation of teams to plan, build, and deliver products. Teams are also being used to manage programs and their various elements. For example, multi-functional Integrated Product Teams (IPTs) are successfully used to manage major elements of DoD acquisition programs. Each member of the IPT represents his or her functional area, and is challenged to oversee the proper integration of all functional areas into the acquisition program, as well as to optimize the development effort.

In summary, quality is the cumulative result of actions throughout the program management process. This process must continually address the requirements of quality as defined by the customers and other program stakeholders, and work toward meeting those needs. In addition, managers must always strive to improve the work processes and eliminate waste within a quality system. Waste is defined as any effort expended that either detracts from the resultant product or service or requires additional expenditures of resources to correct errors.

Quality practices, procedures, and policies must continue to evolve to ensure they are supportive of:

- the customer's requirements;
- the workers' capabilities to produce the end product; and
- the appropriate corrective action when defects are identified.

Continuous improvement of the products and processes is an inherent element of a quality program.

8.1 Quality Planning

Quality planning entails predicting the outcomes of anticipated program actions relative to the prescribed quality goals for the program. This projection is undertaken to ensure the attainment of the DoD user's requirements. Quality planning also examines such areas as the development and production processes that will be used, and any potential improvements to those processes. Quality standards are invoked and quality measures are established.

In this regard, a streamlined process and consistent DoD approach has been authorized for contractors who elect to transition from the 1994 edition of ANSI/ISO/ASQ 9001, 9002, or 9003 to the 9001:2000 Quality Management System — Requirements.[1]

Program quality is the result of disciplined planning, designing, developing, production, and delivery of products. This disciplined process starts with the establishment of goals, and evolves through a series of sub-processes into the final product. Each program takes on its own unique character as to the precise plan, implementation process, and delivery mechanism.

Inputs	Tools & Techniques	Outputs
.1 Quality policy .2 Scope statement .3 Product description .4 Standards and regulations .5 Other process outputs **.6 Program goals (cost, time, quality, other)** **.7 Statement of work and performance specification** **.8 Cost/benefit analysis** **.9 Feasibility studies**	.1 Benefit/cost analysis .2 Benchmarking .3 Flowcharting .4 Design of experiments .5 Cost of quality **.6 Templates** **.7 Work breakdown structure** **.8 Scheduling programs** **.9 Estimating software** **.10 CAD/CAM software**	.1 Quality management plan .2 Operational definitions .3 Checklists .4 Inputs to other processes **.5 Program master plan (or update)** **.6 Time schedule** **.7 Budget** **.8 Designs/drawings** **.9 Work processes**

8.1.1 Inputs to Quality Planning

.1 *Quality policy.* See same in *PMBOK® Guide*.

.2 *Scope statement.* See same in *PMBOK® Guide*.

.3 *Product description.* See same in *PMBOK® Guide*.

.4 *Standards and regulations.* See same in *PMBOK® Guide*.

.5 *Other process outputs.* See same in *PMBOK® Guide*.

.6 ***Program goals (cost, time, quality, other).*** Program goals typically focus on cost, time, and quality (or technical performance). These goals establish the basis for the balance among technical performance, urgency of need, and price of the product.

.7 ***Statement of work and performance specifications.*** The statement of work (SOW) and specifications provide the technical details of the program's product. These inputs to the quality planning provide the basis for planning the product's functionality, characteristics, and attributes.

.8 ***Cost/benefit analysis.*** A cost/benefit analysis, if previously performed, provides the expected benefits to customers for the anticipated cost. This balance between cost and future benefits is important in determining the economic feasibility of producing the program's product when compared to competing solutions.

.9 ***Feasibility studies.*** Feasibility studies, if previously performed, provide the basis for anticipated capability to produce the desired product. Feasibility studies may encompass a wide range of areas, such as availability of technology to meet the requirements, size or weight limitations on a host vehicle, or operating environment.

8.1.2 Tools and Techniques for Quality Planning

.1 *Benefit/cost analysis.* See same in *PMBOK® Guide*.

.2 *Benchmarking.* See same in *PMBOK® Guide*.

.3 *Flowcharting.* Within DoD, flowcharts are a critical element in establishing agreement as to the sequence and definition of work nodes in designing, developing, producing, and fielding defense systems.

.4 *Design of experiments.* See same in *PMBOK® Guide*.

.5 *Cost of quality.* See same in *PMBOK® Guide*.

.6 ***Templates.*** Templates are developed and used to place information into a standard format. Templates serve to provide a checklist approach to including information as well as providing the major headings for consideration in planning.

.7 ***Work breakdown structure.*** The Work Breakdown Structure (WBS) is the fundamental tool for scoping the program, both the product(s) and the functions associated with the program. The top part of the structure is more equipment oriented, whereas the lower parts are more work/task oriented.

.8 ***Scheduling programs.*** Scheduling tools (often misnamed program/project management software) support the definition of the program over time. A key scheduling program function is to lay out the tasks over time in order to integrate such activities as inspections during the process.

.9 ***Estimating software.*** Estimating software provides a uniform basis for determining costs of tasks, which includes the quality functions of a program. This software aids in developing costs of a program and costs for the quality testing, for example.

.10 ***CAD/CAM software.*** Computer-aided design/manufacturing (CAD/CAM) software provides the ability to graphically model products and processes for evaluation and control. This software may also be used in design work to provide a better means of describing the product for communication to others.

8.1.3 Outputs from Quality Planning

.1 *Quality management plan.* See same in *PMBOK® Guide*.

.2 *Operational definitions.* See same in *PMBOK® Guide*.

.3 *Checklists.* See same in *PMBOK® Guide*.

.4 *Inputs to other processes.* See same in *PMBOK® Guide*.

.5 ***Program master plan (or update).*** The program plan (also called an Integrated Master Plan (IMP) provides the narrative description of the work to be accomplished and how it will be

accomplished. This document may include processes that affect product grade and practices that ensure quality of the product. See 6.1.1.2.

.6 ***Time schedule.*** A schedule, or time line, is used to plan the future quality related activities. This should include all activities that are required for building a product that meets the customer(s)' requirements.

.7 ***Budget.*** The budget must include activities that affect the validation or verification of product quality. This would include such activities as product testing at any of several stages of assembly, product demonstration, and system testing.

.8 ***Designs/drawings.*** Designs and drawings provide the ability to graphically communicate product requirements. This may range from simple product design drawings to drawings that show the product in its operating environment with all the interfaces.

.9 ***Work processes.*** Work processes are required to ensure products conform to the requirements. Proven work processes must be described and documented to ensure critical items are neither missed nor changed.

8.2 Quality Assurance

Quality Assurance (QA) is the totality of actions taken to ensure products and services meet the requirements of the program's customer(s). This is the implementation of quality plans for the system and the implementation of quality controls (QCs) to validate product and process conformance to requirements. QA actions encompass all internal and external program activities. QA builds confidence with the customer(s) that the product and/or service will meet their requirements.

Inputs	Tools & Techniques	Outputs
.1 Quality management (QM) plan .2 Results of quality control measurements .3 Operational definitions **.4 Standing quality procedures** **.5 Training of personnel in quality practices** **.6 Quality operating and functional definitions**	.1 Quality planning tools and techniques .2 Quality audits **.3 Quality reviews** **.4 Quality improvement activities** **.5 Tools of modern quality**	.1 Quality improvement **.2 Reports (as defined in QM plan)** **.3 Improved practices and procedures.** **.4 Quality products and services** **.5 Quality-sensitive personnel**

8.2.1 Inputs to Quality Assurance

.1 *Quality management (QM) plan.* See same in *PMBOK® Guide*.

.2 *Results of quality control measurements.* See same in *PMBOK® Guide*.

.3 *Operational definitions.* See same in *PMBOK® Guide*.

.4 ***Standing quality procedures.*** Standing quality procedures within the organization will be used to establish quality practices and assure uniform workmanship in building products. Consistent, repeatable procedures are needed to maintain quality standards.

.5 ***Training of personnel in quality practices.*** Training and indoctrination of personnel in quality practices raises awareness of the need to follow proven methods to assure quality. Awareness of the correct practices to be used and the reason for following these practices gives assurance that the product will meet the requirements.

.6 ***Quality operating and functional definitions.*** Operating and functional definitions of the product provide goals to be achieved by the product. High visibility and under-standing of these goals provide the opportunity for converge of customer requirements.

8.2.2 Tools and Techniques for Quality Assurance

.1 *Quality planning tools and techniques.* See same in *PMBOK® Guide*.

.2 *Quality audits.* See same in *PMBOK® Guide*.

.3 ***Quality reviews.*** The DoD PM shall allow contractors to define and use a preferred quality management (QM) process that meets required program support capabilities. The PM shall not require third-party certification or registration of a supplier's quality system.

.4 ***Quality improvement activities.*** Continuous quality improvement is the goal of all organizations. Activities that identify areas for improvement assure better quality products. Improvements in processes and practices will typically benefit an organization.

.5 ***Tools of modern quality.*** The tools of modern QM are Pareto diagrams, cause and effect diagrams, scatter diagrams, control charts, histograms, and others. These are tools support-ing data collection, formatting the data into understandable form, and giving trends or identi-fying defects. There are typically seven identified tools; however the total number used is generally left to the person's needs in continuous improvement of quality.

8.2.3 Outputs from Quality Assurance

.1 *Quality improvement.* See same in *PMBOK® Guide*.

.2 ***Reports (as defined in QM plan).*** Reports for quality functions will be confirmations of meeting the requirements or defects in the product or process. These reports document the efficacy of the product and processes.

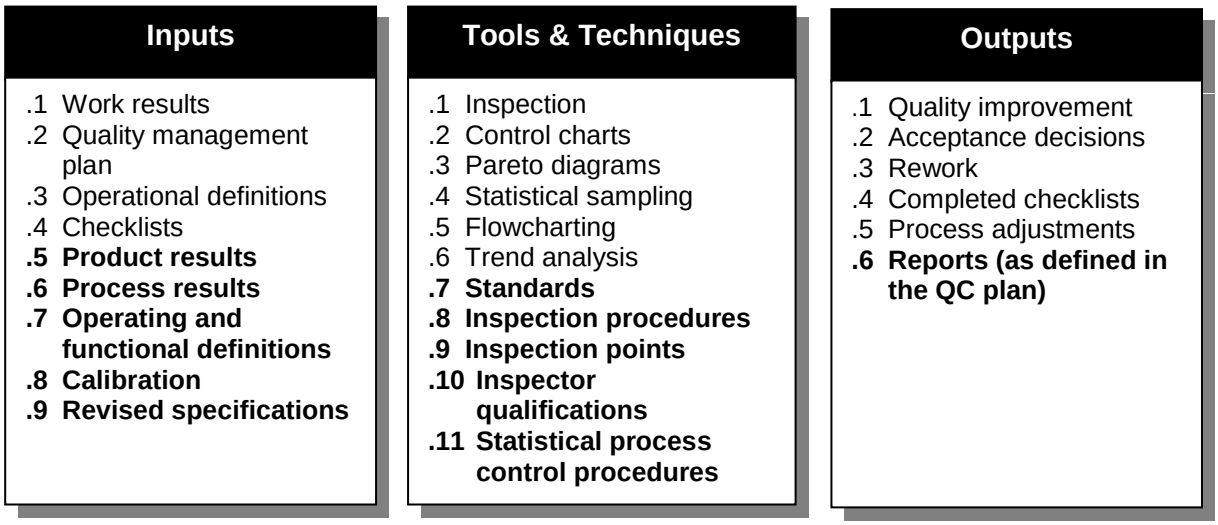
.3 ***Improved practices and procedures.*** Practices and procedures are documented for subsequent use in follow-on work or other programs. These practices and procedures may be called "Best Practices" and provide the basis for planning future work.

.4 ***Quality products and services.*** Products and services must be documented as to whether they meet the customers' needs and whether they have been developed or delivered using approved processes. The products and services delivered are indicative of future capability to provide similar products and services.

.5 ***Quality-sensitive personnel.*** Personnel must be aware of quality processes, procedures, and practices. Their understanding of the quality processes and requirements give assurance that they can meet the requirements.

8.3 Quality Control

Quality Control (QC) is the measurement of products and processes to ensure these comply with established parameters. QC is the validation that the product or process meets the specifications. Variances from the specifications are cause for remedial action.



8.3.1 Inputs to QC

.1 *Work results.* See same in *PMBOK® Guide*.

.2 *Quality management plan.* See same in *PMBOK® Guide*.

.3 *Operational definitions.* See same in *PMBOK® Guide*.

.4 *Checklists.* See same in *PMBOK® Guide*.

.5 ***Product results.*** (Related to 8.3.1.1) Product results are the final measure of whether the product meets the needs of the customer. This is first achieved through proven processes and finally through a validation process. The validation process may be inspection, testing, exercising the functions, or a demonstration.

.6 ***Process results.*** (Related to 8.3.1.1) Process result gives a proven capability or shows the flaws in the process. The results may be determined through an exercising of the process or through examination by experts to validate the process.

.7 ***Operating and functional definitions.*** (Related to 8.3.1.3) Operating and functional definitions are detailed descriptions of the operating or functional characteristics of the

product. These definitions provide the guidance for design of the product and set the expectations for functionality of the product.

.8 ***Calibration.*** Calibration is a function of ensuring the measuring devices are within the tolerances and are capable of meeting measurement specifications.

.9 ***Revised specifications.*** Revised specifications reset the baseline for a product. This reset occurs when new features are added or features are discarded. Revising the specification provides a means to measure the completion of the product through comparison, either by functional or physical audit.

8.3.2 Tools and Techniques for QC

.1 *Inspection.* See same in *PMBOK® Guide*.

.2 *Control charts.* See same in *PMBOK® Guide*.

.3 *Pareto diagrams.* See same in *PMBOK® Guide*.

.4 *Statistical sampling.* See same in *PMBOK® Guide*.

.5 *Flowcharting.* See same in *PMBOK® Guide*.

.6 *Trend analysis.* See same in *PMBOK® Guide*.

.7 ***Standards.*** (Related to 8.3.2.1) Manufacturing standards for materials and workmanship are used to simplify the selection process for materials in the product or work processes. Standards are called out during the design.

.8 ***Inspection procedures.*** (Related to 8.3.2.1) Inspection procedures and practices provide standard ways to conduct inspections and record the results of those inspections. They also prescribe the method for documenting defects identified during inspections.

.9 ***Inspection points.*** (Related to 8.3.2.1) Inspection points are identified and used to conduct different types of inspections. These documented areas give assurances that the products are meeting the requirements.

.10 ***Inspector qualifications.*** (Related to 8.3.2.1) Quality inspectors must be trained in the discipline of conducting inspections on all areas of the product. These qualifications must be documented to ensure that inspectors possess the qualifications needed for a given product.

.11 ***Statistical process control procedures.*** (Related to 8.3.2.4) Statistical process control procedures are used on repetitive processes to ensure the processes are in control and capable of providing assurance that processes are within limits. Statistical process control is also a means of achieving continuous improvement through reduction of the range of the control zone.

8.3.3 Outputs from QC

.1 *Quality improvement.* See same in *PMBOK® Guide*.

.2 *Acceptance decisions.* See same in *PMBOK® Guide*.

.3 *Rework.* See same in *PMBOK® Guide*.

.4 *Completed checklists.* See same in *PMBOK® Guide*.

.5 *Process adjustments.* See same in *PMBOK® Guide*.

.6 Reports (as defined in the QC plan). Reports for QC focus on the product and process variations. Reports typically cover defects in materials, workmanship, and procedures. These reports must be determined prior to initiating the program.

Endnotes

1. Principal Deputy Under Secretary of Defense (AT&L) memo of 19 March 2001, Subj: ISO 9001:2000 Quality Management System — Requirements, Transition.

Chapter 9

Project Human Resource Management

Project Human Resources Management[1] includes the processes required to make the most effective use of the people involved with the program. This Extension provides the DoD aspects to supplement the *PMBOK® Guide*, and follows the chapter outline therein:

9.1 Organizational Planning – identifying, documenting, and assigning program[1] roles, responsibilities, and reporting relationships.

9.2 Staff Acquisition – getting the human resources needed assigned to and working on the program.

9.3 Team Development – developing individual and group skills to enhance program performance.

9.1 Organizational Planning

Inputs	Tools & Techniques	Outputs
.1 Program interfaces .2 Staffing requirements .3 Constraints	.1 Templates .2 Human resource practices .3 Organizational theory .4 Stakeholder analysis	.1 Role and responsibility assignments .2 Staffing management plan .3 Organization chart .4 Supporting detail **.5 Personnel budgets**

9.1.1 Inputs to Organizational Planning

.1 Program Interfaces.

- Organizational interfaces —
  - First, a unique concern to DoD PMs is the strong hierarchical, vertical nature of military acquisition. Issues relating to lines and limits of authority, and

responsibilities for communication and status briefings, are often stipulated for the PM, dependent upon the acquisition category (ACAT) of the program.

- Second, multi-Service and multi-national programs represent particularly difficult efforts from the standpoint of constructing effective horizontal communication channels across extremely different organizational entities. The different perspectives brought by these often conflicting entities must be counterbalanced to ensure that broader DoD and national objectives are met. Memoranda of Agreement or Understanding (MOAs or MOUs) are often used to define the expectations about roles, responsibilities, and outline procedures for organizational conflict resolution.
- Third, within DoD's Integrated Product and Process Development (IPPD) approach to systems engineering, a fundamental reporting concern is the effective integration of multiple Program Integrated Product Teams (IPTs) to ensure "seamless" product development and effective interaction among IPTs.

- Technical interfaces — technical relationships deal with the nature of the work being accomplished, whereas organizational relationships primarily concern balancing power and control between groups. The manner in which technical disciplines share data and/or products can seriously impede or accelerate overall program progress. The use of IPTs is specifically designed to improve the flow of information across technical disciplines. Mechanisms should be designed to allow data and information to flow smoothly, in an uninterrupted fashion across technical disciplines within a program office. Historically, it is at the boundaries between technical functions that work progress difficulties have been encountered and it is at those points that clarity in exit and entry conditions for products/processes is needed to avoid difficulties. All reengineering efforts, in practice, address this as the crucial issue.

- Interpersonal interfaces — interpersonal relationships frequently overarch both organizational and technical reporting. PMs and their staff personally network with other individuals throughout program offices to accomplish their responsibilities. Astute PMs recognize this hierarchy, and devote attention, time, and energy to networking among superiors, colleagues, and subordinates. Formal and informal interpersonal mechanisms may be employed to facilitate this networking, ranging from highly structured teambuilding experiences to unstructured "Management by Walking Around" (MBWA).

- Customer interfaces — customers are critical to DoD program office success. Hence they are singled out as a separate requirement. PMs must establish multiple communication channels with personnel representing the designated operational users (hereafter referred to as the users) and other customers to ensure they are well apprised of the direction and progress of program efforts. Organizational points of contact in user communities should be identified early and consistently exercised. Multiple individuals within those organizations should be utilized to provide redundancy for expected personnel assignment turbulence. A constant flow of information is critical for users to be able to advocate their program within the budgeting process.

.2 Staffing Requirements.

- Skills — the skills area deals with identifying the qualitative competencies and professional experiences necessary for accomplishing program work. Those skills are

then "purchased" from the supply of people who are available. One issue unique to the DoD is a system for delineating acquisition-"critical" positions or billets. Originating with the congressionally-mandated Defense Acquisition Workforce Improvement Act (DAWIA), these critical billets are carefully managed by the Services with special personnel rules applying. Because of these special rules, PMs have less flexibility in managing these positions and these constraints frequently result in requests for waivers.

- Individuals — because of a duality of human resource practices in the DoD, i.e., civilian and military systems, dealing with personnel issues is much more regimented and time-consuming than in the private sector. Occupational specialties, job series, grade levels, position, and duty descriptions must be given much attention and importance. In recent years, much effort has been placed upon an acquisition competency certification process: identifying and cataloging each individual's acquisition education, training, and job experiences. The goal has been the building of an Acquisition Corps personnel database to better match individuals with job requirements. While each Service is unique in its approach, all attempt the same objective.

- Times — sequencing individuals to maximize their time on program tasks, minimize waiting periods, and subsequently optimize schedules is critical. DoD military and civilian work assignment policies and practices directly influence when and where individuals can be made available for program work. Unique Defense rules about temporary duty, the detailing of personnel, and the nature and scope of work assignments must be followed.

.3 Constraints.

- Organizational structure — prevailing organizational structures constrain the range of program office designs available to the PM. For example, Service end strengths and organizational manpower authorizations establish ceilings at every level of command and extend to the program office. Paradigms relating to organizational characteristics such as acceptable spans of control and average grade levels also constrain what PMs might be able to construct. The construction of IPTs and Team networks has not been immune to paradigmatic effects and has been influenced by pre-existing notions of appropriate grade structures and reporting relationships.

- Collective bargaining — much as in the private sector, Defense PMs must also contend with trade and professional labor unions, and commanders often attend to bargaining agreements and labor contracts.

- Preferences — PMs rely heavily on their own experiences and those of others in similar situations; consequently individual preferences tend to strongly influence organizational planning.

- Expectations — both individuals and groups have strong expectations about correct, adequate, and appropriate organizational structures for programmatic activities. Clear differences in expectations exist, for example, in terms of the numbers and mixes of people required to accomplish program work between the unclassified or minimum classified programs and the world of heavily classified programs.

- Process lead times — another constraint frequently encountered deals with required human resource and funding lead times. Significant time delays may be encountered and should be anticipated for such activities as advertising positions to find qualified applicants, accomplishing changes in duty stations, having civilian payroll budgets approved among many others.

- Organizational policies — within DoD, as in other work environments, management policies often drive organizational planning by emphasizing certain approaches to aligning activities. Functionally aligned groups, matrix alignments, and cross-functional, self-managing work teams all represent organizational structures recommended by different management philosophies. Embedded within these alignments are different concepts of types and levels of duties, authorities and responsibilities, human resource utilization, and even preferred organizational climates.

- Organizational mission — the system life-cycle phase of the program will necessarily impact the structure of the program. If an effort or concept is in early development, such as an Advanced Technology Demonstration (ATD) or Advanced Concept Technology Demonstration (ACTD), the organizational structure will need to support free-wheeling and creative activity. In subsequent development phases, the structure must support more conservative and structured activity. The mixes of functional specialties and disciplines will vary accordingly.

9.1.2 Tools and Techniques for Organizational Planning

.1 *Templates.* PMs are often provided "model" program office staffing guidance and staffing management plans from their respective Services or Program Executive Officer (PEO). Predecessor program offices for previously fielded systems, can also be used to suggest structures and alignments. With the use of IPTs, the work breakdown structure (WBS) is increasingly important for assigning tasks and responsibilities to groups of people.

.2 *Human resource practices.* Many analytic and empirical approaches may be employed to estimate the amount and kind of work to be performed and consequently the number and mixes of personnel required. Among these approaches include manpower workload simulations, human resource forecast modeling, personnel skill inventories (like the acquisition competencies and the acquisition corps mentioned above). Other relevant practices and procedures that should be considered include affirmative action goals and timetables and risk analysis.

.3 *Organizational theory.* Organizational design best practices have been enumerated in many organizational behavior textbooks. PMs in the DoD frequently utilize design principles of, among others, grouping by similar activities, unity of command, levels of organization, span of control, decentralization, involvement of customers, and empowerment.

.4 *Stakeholder analysis.* See same in *PMBOK® Guide*.

9.1.3 Outputs from Organizational Planning

.1 *Role and responsibility assignments.* Planning organizational processes includes allocating work to individuals and groups to be responsible and accountable for specified tasking. Summary workload allocations across individuals, across groups and across the organization

can be aggregated, monitored and controlled. In addition, if the potential of conflict has been attended to, appropriate resolution mechanisms will be in place to ensure competing perspectives will be fairly and logically handled.

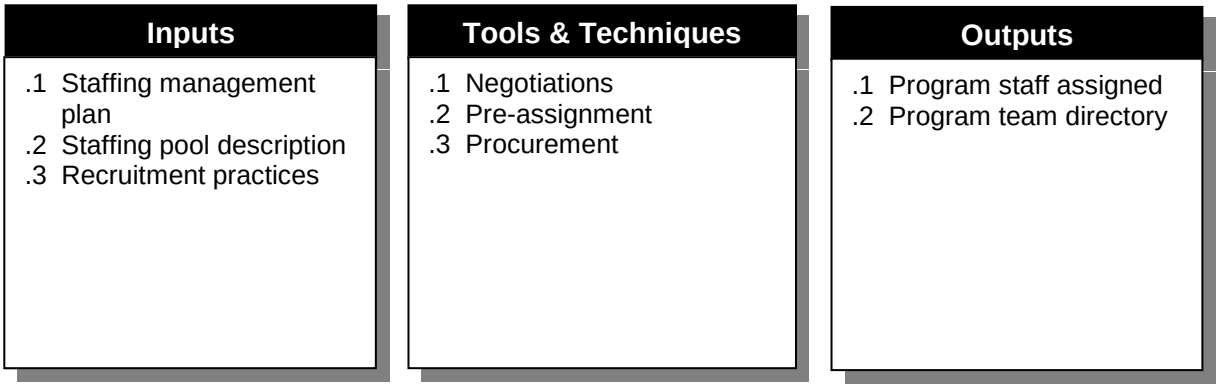
.2 *Staffing management plan.* The unit manpower authorization document lists the numbers and kinds of personnel the program office possesses and reflects a balance between the constraints identified by higher headquarters and the requirements derived by a bottom-up PM analysis. Additional personnel requests to appropriate staffing agencies result once new position and duty descriptions are defined to include requisite knowledge, skills and abilities, education, and experience. For larger, more mature program offices, a succession chart can also be an invaluable tool for managing the turbulence of personnel rotations. So called "depth charts" can be used to establish developmental needs for personnel and facilitate orderly succession of individuals into key billets.

.3 *Organizational charts.* Traditional organizational charts are used to pictorially display lines of authority, responsibility, and coordination within hierarchical organizations. These charts function as a communication device to promote understanding of how offices work together to achieve a program's objectives. However, in matrix and team-based organizations the complexity of the interactions at the individual level is often too great to be clearly portrayed with two dimensional lines and boxes. Consequently, DoD PMs, while being normally expected to construct such charts, are cognizant that rarely do these charts illustrate "reality" within their or other's programs.

.4 *Supporting detail.* By completing the analytic process of first translating the work to be accomplished into skills and experiences necessary for job incumbents, and second into actual position descriptions, any deficiencies between the skills required and the skills available will be identified. These deltas represent training and development needs. Deciding what tasks will be performed through in-house sources versus delegating tasks through contracted personnel is also a by-product of this analysis.

.5 Personnel budgets. Once manpower authorizations and position descriptions are clearly defined, civilian and military personnel budgets can be constructed to account for salaries, travel, moving expenses, performance awards, cash bonuses and so on. These budgets represent important objectives in resourcing the program office staff and its incentive systems especially within the downsizing DoD environment.

9.2 Staff Acquisition



9.2.1. Inputs to Staff Acquisition

.1 *Staffing management plan.* Armed with a staffing plan detailing the human requirements for competencies and experiences, the PM can begin the recruitment process for acquiring these assets. Owing to the parallel military and civilian personnel systems, multiple formal supply channels must be tapped to acquire staff. Formal channels tend to emphasize external sources for new incumbents and invoke a series of actions with specific requirements. For instance, civilian position vacancies must be announced or advertised for a defined period of time, and applications and resumes are accepted only during that "window"; then qualified candidate listings are prepared, interviews with qualified candidates are conducted, leading ultimately to the selection of the best qualified candidate.

.2 *Staffing pool description.* Informal candidate search methods also exist. Informal channels tend to favor an internal approach because they allow managers to search for and access personnel who have favorable reputations within their immediate community. Historically, professional networks are the source of the majority of "fills" for vacancies. Consequently, transfers and reassignments within the same command organization housing the program office are routine procedure.

.3 *Recruitment practices.* Organizational practices also influence how individuals are sought to fill staff vacancies. For example existing grade/rank structures impact how jobs are graded. Assignment and reassignment policies influence the availability of personnel for filling openings. Promotion and retirement policies impact whether individuals may aspire to or remain in positions. Hiring freezes, reduction-in-force mandates, and other personnel policies constrain how and when personnel requirements are filled.

9.2.2 Tools and techniques for Staff Acquisition

.1 *Negotiations.* Even when PMs are armed with clear manning authorizations, they must still negotiate for the specific assets they desire. To be as persuasive as possible, astute PMs bolster their rationale for specific personnel with as much logic and data as they can muster. Manpower modeling efforts, expert impartial technical advice, the desires of the affected stakeholders, and other pertinent information can be used to build strong negotiating positions with individuals and agencies controlling personnel assets.

.2 *Pre-assignment.* Each Service and each installation possesses military and civilian personnel centers with supporting staff and management. These centers are to provide support and staff assistance to PMs on personnel issues. However, it is incumbent upon all DoD PMs to be conversant with the policies and practices of both military and civilian personnel systems, including the full range of tasks from defining and filling positions, to performance appraisals, awards and incentives, to terminations and retirements.

.3 *Procurement.* See same in *PMBOK® Guide*.

9.2.3 Outputs from Staff Acquisition

.1 *Program staff assigned.* Given that the human requirement generation process has been accomplished and that the relevant personnel sources have been tapped, the PM will be provided incumbents for his/her full-time and part-time positions, and complementary tasks will be determined for contractor support to the acquisition program. Authorized position descriptions are defined and approved, and future requirements anticipating staff rotations are documented.

.2 *Program team directory.* See same in *PMBOK® Guide*.

9.3 Team Development

9.3.1 Inputs to Team Development

.1 *Program staff.* Defense programs are different from industry programs in the dual personnel systems for uniformed military and civilian employees. The military members of a program staff are normally expected to be reassigned at three to four years of tenure and consequently a 25-30 percent turnover rate is to be expected per year. By design civilian tenure is much longer. Consequently team development requirements are on a nearly continuous basis. Past organizational promotion statistics and success in garnering desirable assignments and training opportunities will have a profound impact upon the organization's future ability to attract, retain, and motivate top quality staff members.

.2 *Program plan.* Team development efforts must be planned for and budgeted within program offices. Unfortunately, training and travel budgets are not often protected and consequently

are lost in budget reductions. Personnel losses due to promotions, non-promotions, retirements, voluntary separations, career management plans, and so on must be expected and team development planned accordingly. Replacement and incoming personnel should be acculturated into existing teams to minimize disruptive impacts. Activities specifically including contractors in teambuilding should be addressed, especially within IPTs.

.3 *Staffing management plan.* While each of the Services calls it by different names, this document reflects guidance from PEOs, support provided by major acquisition commands, and constraints identified by personnel agencies. Ultimately, the PM must negotiate with a variety of personnel "owners" for acquiring and maintaining his/her human assets. Redefining the knowledge, skills, and abilities necessary to accomplish program objectives at various points in the life cycle is a particularly subjective endeavor, made harder because of dealing with incumbents.

.4 *Performance reports.* Several types of personnel data are available which an astute PM can access to evaluate the "health" of his/her staffing efforts. Turnover rates are indicative of the stability of the staff, either for good or ill. Grievances and complaints are suggestive of management's attention, or lack of attention, to workplace concerns. As indicated above, promotion and selection rates are highly indicative of the attractiveness of the organization to incumbents and potential incumbents.

.5 *External feedback.* A constant flow of organizational performance feedback comes to the PM regarding the effectiveness and efficiency of his/her people. Products and services are delivered to customers, communications take place and organizational coordination occurs. Status of contracting activities, financial management indices, and evaluations of technical and management plans are continuously tracked. These performance data are essential to diagnosing needs for communication, problem solving, integration and/or teambuilding activities.

.6 ***Organizational philosophy.*** Within cross-functional teams, such as IPTs, groups of heterogeneous individuals are chartered with producing an identifiable product or improving a process. Consequently the need for team development is greatly increased over organizational philosophies relying on more homogeneous workgroups. Similarly, the management philosophy of Total Quality Management (TQM) (or Leadership (TQL)) emphasizes the participation of many people in an organization in correcting problems and improving processes. Process Action Teams (PATs) must have teambuilding investments to be effective.

.7 ***Environmental influences.*** Downsizing is a reality within DoD and it has impacted all of the organizational structures and functions within the acquisition community. Declining military Service end strengths, past Base Realignment and Closure (BRAC) Commissions and the discontinuation of weapon systems have all impacted the organizational climate within the acquisition corps. These impacts place a premium upon maintaining esprit de corps within acquisition professionals.

9.3.2 Tools and Techniques for Team Development

.1 *Teambuilding activities.* A variety of sources exist within and outside of DoD to facilitate teambuilding activities. Quality management, organizational development, and organizational effectiveness disciplines within the Services and outside academic institutions can provide many experts and facilitators to support such efforts. Process consultant contractors can

generally tailor development efforts from half-day through week-long off-sites. These team-building interventions generally involve vision, communication, leadership, decision making, and insights regarding roles and norms.

.2 *General management skills.* DoD PMs are expected to implement the full range of goal setting, time management, conflict management, quality management, career advising and delegation skills within their staff organizations, honing them for successful program accomplishment. Because of inherent DoD funding and policy instabilities, PMs often must emphasize creative problem solving, astute conflict management, and persuasive communications to resolve seemingly insoluble conflicts.

.3 *Rewards and recognition systems.* The potential use of power, rewards, and penalties is qualitatively different within the DoD. For military personnel (MILPERS) falling under the domain of the Uniform Code of Military Justice (UCMJ), the level of influence a PM can exert on the behavior of subordinates is substantially greater than within civilian communities. In the civilian domain, all rewards and penalties must be directly related to the job and the individual's position description, and a clear linkage must be established. For example, step increases, performance bonuses, performance appraisals, selection for assignments, or training or educational opportunities must be clearly performance-related.

.4 *Collocation.* Physically locating staff members in common facilities can provide an opportunity for the development of a group identity above that normally expected when individuals are brought together for only short periods of time. Having representatives from a variety of stakeholders (i.e., users, maintainers, suppliers, and so on) available on a long-term basis can significantly improve buy-in from those communities, as well as highlight the practical importance of the program's activities to acquisition program staff. Care must be exercised to integrate these perspectives so as not to cause internal functional differences.

.5 *Training.* While many individual-oriented training and education opportunities exist, group teambuilding interventions are also available. Off-site retreats can be orchestrated to enhance the ability of program staff to communicate clearly and honestly and build positive regard for one another. Either contracted or in-house facilitator support can be obtained for such efforts, but much thought and care should be exercised, as off-sites, if done poorly with poor facilitator support, can yield the opposite effects from those intended. Workshops to facilitate vision, mission, or values can be beneficial if done properly. Outdoor experiential activities such as confidence courses can facilitate group self-confidence and communication. It should be noted that the positive effects of such teambuilding have a half-life, and should be reinvigorated periodically.

.6 ***Management development.*** Inherent in each program is the need to develop every individual's capacity for increased responsibility. Utilizing individual development plans, coupled with mentoring and coaching techniques, can yield substantial performance and motivational payoffs if accomplished sincerely and not superficially. Of particular difficulty is identifying potential mentors and matching mentors with subordinates. Interpersonal dynamics and chemistry overarch the administration of such development programs.

.7 ***Communication devices.*** As organizations increase in size, the requirements for communication increase exponentially. Staff members desire knowledge not only about what is going on from a work perspective, but they also desire information about each other. The existence and strength of rumor mills often indicates a weakness in formal communication channels on items of mutual concern. Consequently, many devices must be used by a PM to improve not

only job performance, but also team cohesion. Examples of such devices are newsletters, magazines, manuals, handbooks, e-mail bulletin boards, town hall or all-hands meetings, television productions, fireside chats, and so on.

9.3.3 Outputs from Team Development

.1 *Performance improvements:*

- Individual — because of the “up-or-out” DoD promotion system within the uniformed Services, a premium should be placed upon individual development and readiness for increased responsibility. All teambuilding efforts start with recognition of an individual's strengths and contributive potential. All of the Services require that performance feedback be periodically given to subordinates with this development in mind. If supervisors have constructed performance plans carefully, individual performance improvements can be readily observed, measured, and charted.

- Team — as groups of individuals coalesce into performing teams, there can be a synergistic performance effect. Work is accomplished faster, with less need for coordination, explanation, approval, and discussion. More creative solutions are forthcoming. All members can support and defend team decisions.

- Processes — if teambuilding efforts are successful, outdated, anachronistic approaches to accomplishing technical, contracting, and management tasks become apparent. Then they can be targeted for reengineering or other process-improvement efforts. Many of the suggestions for acquisition excellence (reform) have been proffered through the involvement of teams of contributors.

- Organization — another set of benefits from teambuilding occurs at the organizational level. The program objectives are met efficiently and economically, the program office provides a cadre of seasoned staff for future development efforts, and the accomplishments of the program serve as role models and benchmarks for succeeding efforts. Stakeholders are satisfied and have confidence in possible future interactions.

.2 *Input to performance appraisals.* See same in *PMBOK® Guide*.

Endnotes

1. For consistency with DoD terminology and with other chapters of this Extension, the word “program” is used instead of “project” when referring to an overall DoD acquisition program. However, the chapter title remains "Project Human Resource Management."

Chapter 10

Project Communications Management

Clear and effective communications are fundamental to the management of any program or project. The DoD 5000 Series directives make the point that the Department and industry shall "collaborate" (communicate) "…to produce integration and interoperability capabilities spanning all acquisition functions and phases. Expected results include improved acquisition program execution and superior acquired systems." For internal DoD activities, these same directives state "Direct communication between the program office and all levels in the acquisition oversight and review process is expected as a means of exchanging information and building trust." This also applies to PM communications among the requirements, acquisition, intelligence, logistics, and budget communities.

10.1 **Communications Planning** – determining the information and communications needs of the stakeholders: who needs what information, when they will need it, and how it will be given to them.

10.2 **Information Distribution** – making needed information available to project stakeholders in a timely manner.

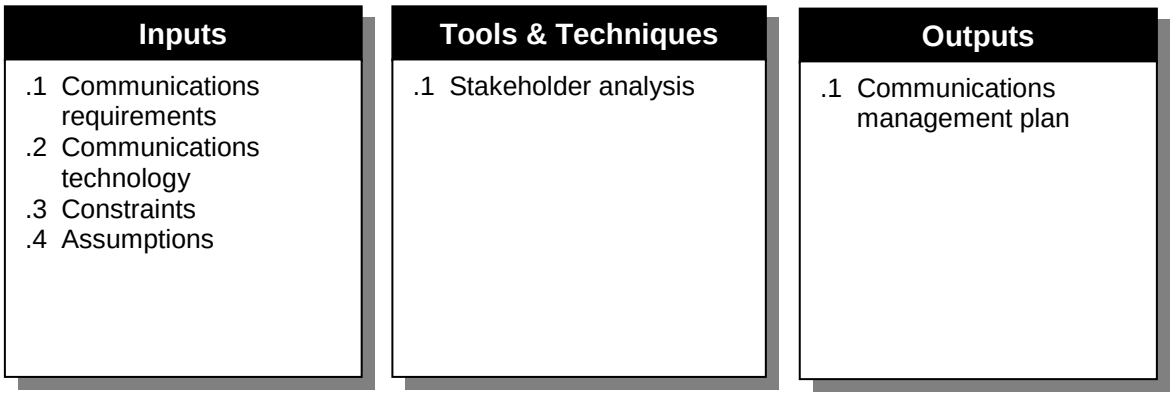
10.3 **Performance Reporting** – collecting and disseminating performance information. This includes status reporting, progress measurement, and forecasting.

10.4 **Administrative Closure** – generating, gathering, and disseminating information to formalize a phase or project completion.

Part 2 of the *Interim Defense Acquisition Guidebook* addresses the DoD Program PM's Program Acquisition Strategy. The Integrated Digital Environment (IDE) is a major topic and method of communication to be addressed in the strategy. The IDE is so important to a program because of the numerous levels of oversight and review within the DoD, and the significant number of Government-contractor reviews involved in the acquisition process. In this regard, DoD policy requires the maximum use of digital operations throughout acquisition and the entire system life cycle. The acquisition strategy is required to summarize how the PM will establish a cost-effective data management system and appropriate digital environment that will allow every activity involved with the program, throughout its total life-cycle, to digitally exchange data. Further, the IDE is required to keep pace with evolving automation technologies, and will use existing infrastructure (e.g., Internet) to the maximum extent practicable.

10.1 Communications Planning

In addressing the role of communications, particularly as applies to exchanges between the DoD PM and industry, few if any, activities are of greater importance. In this regard, the reader is referred to the same section in the *PMBOK® Guide.*



10.1.1 Inputs to Communications Planning

.1 *Communications requirements.* See same in *PMBOK® Guide.*

.2 *Communications technology.* See same in *PMBOK® Guide.*

.3 *Constraints.* See same in *PMBOK® Guide.*

.4 *Assumptions.* See same in *PMBOK® Guide.*

10.1.2 Tools and Techniques for Communications Planning

.1 *Stakeholders analysis.* See same in *PMBOK® Guide.*

10.1.3 Outputs from Communications Planning

.1 *Communications management plan.* See same in *PMBOK® Guide.*

10.2 Information Distribution

The envisioned IDE for a given acquisition program will be a cross-functional digital information infrastructure tailored to support that program. It should be readily accessible by those who need it, used at various organizational levels within Government and industry, and capable of supporting a range of acquisition management purposes. The IDE will be composed of various tools and processes that allow for the physical exchange of data, electronic delivery of data, use of shared databases, and offer support to both local and integrated workflow.

IDE is justified by conclusions that it will offer:

- A potential for reduced Total Ownership Cost (TOC);
- Increased process and product coordination;
- Reduced redundancy in workload; and
- Reduced manpower associated with status reporting.

10.2.1 Inputs to Information Distribution

.1 *Work results.* See same in *PMBOK® Guide.*

.2 *Communications management plan.* See same in *PMBOK® Guide.*

.3 *Program plan.* See same in *PMBOK® Guide.*

.4 IDE framework. PMs shall establish a data management system and appropriate digital environment to allow every activity involved with the program to cost-effectively create, store, access, manipulate, and/or exchange data digitally. In particular, using interoperability standards for data exchange is critical to other programs. The IDE shall, at a minimum, meet the data management needs of the support strategy, system engineering process, modeling and simulation activities, T&E strategy, and periodic reporting requirements. The design shall allow ready access to anyone with a need-to-know (as determined by the PM), a technologically "current" personal computer, and Internet access through a Commercial Off-the-Shelf (COTS) browser.

10.2.2 Tools and Techniques for Information Distribution

.1 *Communications skills.* See same in *PMBOK® Guide.*

.2 *Information retrieval systems.* See same in *PMBOK® Guide.*

.3 *Information distribution methods.* Further information is available on DoD e-Business from the Defense Logistics Agency (DLA), Joint Electronic Commerce Program Office, and IDE Project Office.

.4 IDE technologies. Each IDE tool can be organized into the following structure:

- Introduction;
- Functionality;
- Benefits;
- Standards;
- Repository;
- Security;
- Emerging trends;
- Learning applications (references only);
- Summary.

.5 IDE tools. Some or all of the following primary IDE tools can be focused on specific functional areas:

- Imaging;
- Workflow;
- Document management;
- Records management;
- Enterprise resource planning;
- Product data management;
- Collaborative tools;
- Project management;
- Databases;
- Stand-alone applications;
- Office applications;
- Modeling, simulation, and computer-aided design/manufacturing (CAD/CAM);
- Video teleconferencing;

- Action item tracker;
- Other.

.6 ***Solicitations.*** *Solicitations* shall require specific proposals for an IDE solution to support acquisition and operational support activities. Unless analysis verifies prohibitive cost or time delays or a potential compromise of national security, new contracts shall require the contractor to provide on-line access to programmatic and technical data. Contracts shall give preference to on-line access (versus data exchange) through a contractor information service or an existing information technology (IT) infrastructure. Contracts shall specify the required functionality and data standards. The data formats of independent standards-setting organizations shall take precedence over all other formats. The issue of data formats and transaction sets shall be independent of the method of access or delivery.

10.2.3 Outputs from Information Distribution

.1 *Program records.* See same in *PMBOK® Guide.*

.2 *Program reports.* See same in *PMBOK® Guide.*

.3 *Program presentation.* See same in *PMBOK® Guide.*

.4 ***Industry IDE solutions.*** Industry partners have been strongly encouraged to develop and implement IDE solutions that best meet their preferred business models. Consequently, program office IDE shall take maximum advantage of and have minimum impact on industry solutions.

At milestones and other appropriate decision points and program reviews, the PM will address the status and effectiveness of the IDE.

10.3 Performance Reporting

See Earned Value Management topics in Chapter 4 of this Extension and 10.3 of the *PMBOK® Guide.*

10.3.1 Inputs to Communications Planning

.1 *Project plan.* See same in *PMBOK® Guide.*

.2 *Work results.* See same in *PMBOK® Guide.*

.3 *Other project records.* See same in *PMBOK® Guide.*

10.3.2 Tools and Techniques for Communications Planning

.1 *Performance reviews.* See same in *PMBOK® Guide.*

.2 *Variance analysis.* See Chapter 4 of this Extension and 10.3.2 in *PMBOK® Guide.*

.3 *Trend Analysis.* See Chapter 4 of this Extension and 10.3.2 in *PMBOK® Guide.*

.4 *Earned value analysis.* See Chapter 4 of this Extension and 10.3.2 in *PMBOK® Guide.*

.5 *Information distribution tools and techniques.* See same in *PMBOK® Guide*.

10.3.3 Outputs from Communications Planning

.1 *Performance reports.* See same in *PMBOK® Guide.*

.2 *Change requests.* See same in *PMBOK® Guide.*

10.4 Administrative Closure

See Chapter 4 of this Extension and 10.4 of the *PMBOK® Guide*.

Inputs	Tools & Techniques	Outputs
.1 Performance measurement documentation .2 Product documentation .3 Other project records	.1 Performance reporting tools and techniques .2 Project reports .3 Project presentations	.1 Project archives .2 Project closure .3 Lessons learned

10.4.1 Inputs to Communications Planning

.1 *Performance measurement documentation.* See Chapter 4 of this Extension and 10.4.1 in *PMBOK® Guide.*

.2 *Product documentation.* See same in *PMBOK® Guide.*

.3 *Other project records.* See same in *PMBOK® Guide.*

10.4.2 Tools and Techniques for Communications Planning

.1 *Performance reporting tools and techniques.* See Chapter 4 of this Extension and 10.4.2 in *PMBOK® Guide.*

.2 *Project reports.* See same in *PMBOK® Guide.*

.3 *Project presentations.* See same in *PMBOK® Guide.*

10.4.3 Outputs from Communications Planning

.1 *Project archives.* See same in *PMBOK® Guide.*

.2 *Project closure.* See same in *PMBOK® Guide.*

.3 *Lessons learned.* See same in *PMBOK® Guide.*

Chapter 11

Project Risk Management

The processes presented in the *PMBOK® Guide*, Chapter 11, Project Risk Management, are generally applicable to DoD acquisition programs. However, this *U.S. DoD Extension* offers additional supplemental information required for risk management of defense systems including:

- DoD risk management policy;
- A summary of DoD risk management principles and lessons learned;
- DoD risk management structure;
- DoD risk management definitions and the Risk Management Process Model;
- Organizational and behavioral considerations for implementing risk management;
- The performance dimension of consequence of occurrence;
- The performance dimension of Monte Carlo simulation modeling;
- A structured approach for developing a risk handling strategy.

Except for up-front information on the DoD processes, DoD enhancements and supplements to the *PMBOK® Guide,* risk management processes will generally be addressed in this *U.S. DoD Extension* Chapter in the same order as the paragraph structuring in the *PMBOK® Guide* (Figure 11-1 and Sections 11.1-11.6 below):

11.1 Risk Management Planning – deciding how to approach and plan the risk management activities for a project.
11.2 Risk Identification – determining which risks might affect the project and documenting their characteristics.
11.3 Qualitative Risk Analysis – performing a qualitative analysis of risks and conditions to prioritize their effects on project objectives.
11.4 Quantitative Risk Analysis – measuring the probability and consequences of risks and estimating their implications for project objectives.
11.5 Risk Response Planning – developing procedures and techniques to enhance opportunities and to reduce threats to the project's objectives.
11.6 Risk Monitoring and Control – monitoring residual risks, identifying new risks, executing risk reduction plans and evaluating their effectiveness throughout the project life cycle.

The following material outlines DoD risk management policy, principles, structure, and a process model, and is based on DoD 5000 Series policy.

DoD Risk Management guidance in DoD 5000 Series policy reads:

> "The establishment of a risk management process (including planning, assessment (identification and analysis), handling, and monitoring) to be integrated and continuously applied throughout the program, including, but not limited to, the design process. The risk management effort shall address risk planning, the identification and analysis of potential sources of risks including, but not limited to cost, performance, and schedule risks based on the technology being used and its related design, manufacturing capabilities, potential industry sources, test and support processes, risk handling strategies, and risk monitoring approaches. The overall risk management effort shall interface with technology transition planning, including the establishment of transition criteria for such technologies."

In this regard, the following principles summarize some of the major lessons learned in DoD risk management:[1]

- The primary goals of program risk management are to support the development of an acquisition strategy to meet the user's need with the best balance of cost, schedule, and performance, and to reduce the likelihood of failure by identifying risk events and dealing with them explicitly.

- Poor program planning will exacerbate a program's risk management efforts by establishing unrealistic objectives that do not recognize and account for program risk.

- Risk events must be dealt with in terms of the probability of their occurrence and their effects (consequences) on cost, performance, and schedule. This should be considered for critical processes, product (work breakdown structure (WBS)), and integrated product/process approaches.

- Risk can be assessed within the context of an acquisition strategy. Change the acquisition strategy and you change the risk. Conversely, change how risk is handled and the acquisition strategy changes.

- Unless the original plan was sub-optimal, risk reduction will almost always involve trading off cost, performance, and schedule.

- Risk is defined in terms of cost, performance, and schedule risk. Under the "Cost as an Independent Variable" (CAIV) concept, as cost-performance tradeoffs (including risk) are made on an iterative basis, aggressive cost goals are established that become more of a constraint, and less of a variable. Therefore, the PM may be required to trade performance/technical and schedule — and their risks — to meet CAIV cost constraints and reduce cost risk.

- Risk can almost never be fully eliminated or completely transferred. We are not able to buy down all program risk; therefore, risk must be prioritized for handling

based upon the level of individual risks, the anticipated level of residual risk, and the resources needed to reduce the risk to an acceptable level.

- The principal purpose of research and development (R&D) is to reduce the uncertainty, and thereby the risk, associated with acquiring a new system. In this regard, some managers consider risk "good" in that acceptance of some risk opens up "opportunities" for technological breakthroughs. DoD considers "risk" and "opportunities" separate, but related. While risk is considered potentially detrimental to a program, taking greater risks may open up more opportunities.

- There are products throughout the risk management process that need to be developed and captured as documentation (digital preferred) for monitoring and reporting of process activities. (See Figure 11-1.)

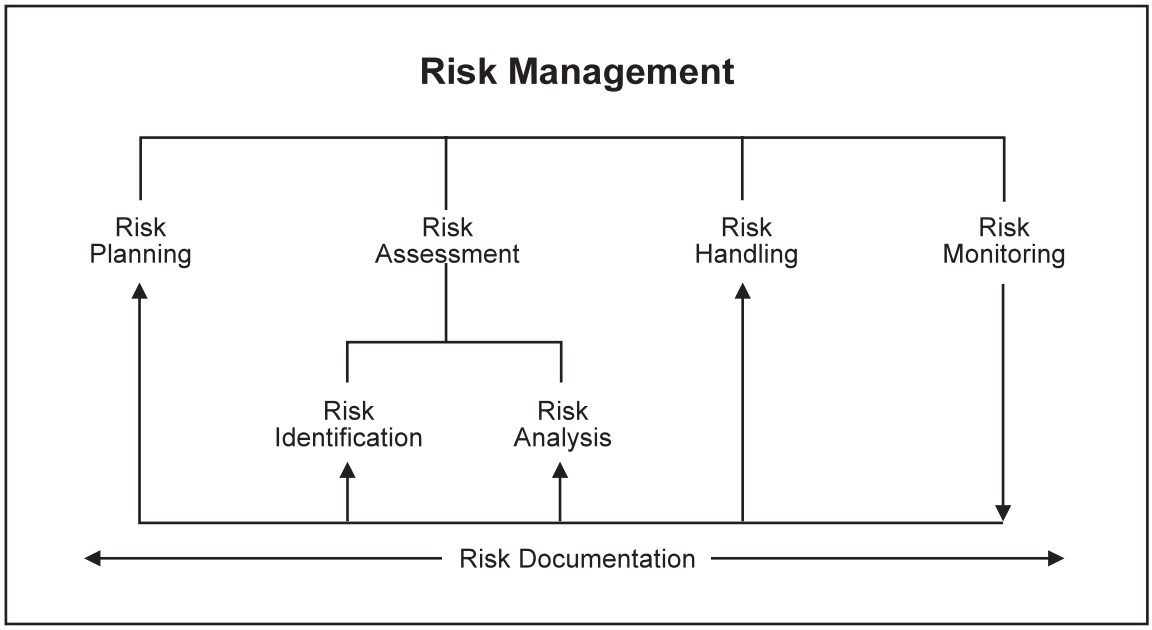


Figure 11-1. DoD Risk Management Structure

- Commercial and Government computer software models have been developed to help us better plan and perform risk management.

DoD has chosen to provide a structure and definition for risk management. This is based on the thought that although a risk management strategy depends upon the nature of the system being developed, research and experience reveal that good strategies contain the same basic processes and structure as shown in Figure 11-1, the DoD risk management structure.[2] The application of the displayed processes varies with acquisition phases and the degree of system definition; however, all the processes should be integrated into the program management function.

Some basic definitions for the elements of risk management include:

- **Risk** is a measure of the potential inability to achieve overall program objectives within defined cost, schedule, and technical constraints and has two components: 1) the probability (or likelihood) of failing to achieve a particular outcome, and 2) the consequences (or impact) of failing to achieve that outcome. To avoid obscuring the results of an assessment, the risk associated with an issue should be characterized in terms of these two components. Other factors that may significantly contribute to the importance of risk issues, such as the frequency of occurrence, time sensitivity, and interdependence with other risk issues can also be noted and used either directly or indirectly in the risk rating methodology.

- **Risk management** is the act or practice of dealing with risk. It includes planning for risk, assessing (identifying and analyzing) risk issues, developing risk-handling options, monitoring risks to determine how risks have changed, and documenting the overall risk management program.

- **Risk planning** is the process of developing and documenting (including the draft risk management plan (RMP)) an organized, comprehensive, and interactive strategy, process, and methods for identifying and tracking risk issues, developing risk-handling plans, performing continuous risk assessments to determine how risks have changed, and assigning adequate resources.

- **Risk assessment** is the process of identifying and analyzing program areas and critical technical process risks to increase the likelihood of meeting cost, performance, and schedule objectives. *Risk identification* is the process of examining the program areas and each critical technical process to identify and document the associated risk. *Risk analysis* is the process of examining each identified risk issue or process to refine the description of the risk, isolating the cause, and determining the effects.

- **Risk handling** is the process that identifies, evaluates, selects, and implements options in order to set risk at acceptable levels given program constraints and objectives. This includes the specifics on what should be done, when it should be accomplished, who is responsible, and associated cost and schedule. Risk-handling options include assumption, avoidance, control (also known as mitigation), and transfer. The most desirable handling option is selected, and a specific approach is then developed for this option. The chosen option coupled with the implementation approach is known as the risk handling strategy.

- **Risk monitoring** is the process that systematically tracks and evaluates the performance of risk-handling actions against established metrics throughout the acquisition process and provides inputs to updating risk-handling strategies, risk analysis results, and risk identification information, as appropriate.

- **Risk documentation** is recording, maintaining, and reporting assessments, handling analysis and plans, and monitoring results. It includes all plans, reports for the PM and decision authorities, and reporting forms that may be internal to the program.

A flow diagram version of the DoD risk management process model is given in Figure 11-2.

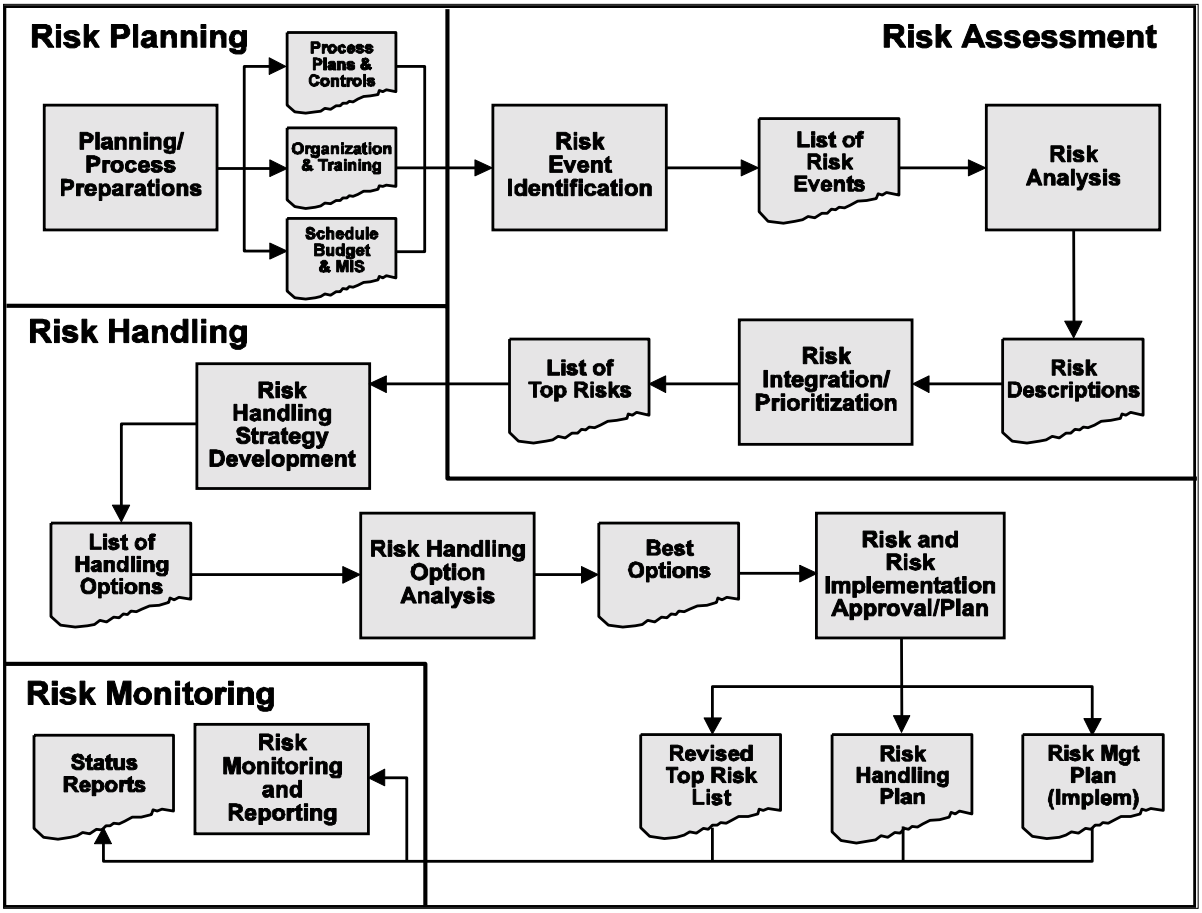


Figure 11-2. Risk Management Process Model

A multitude of possible risk management actions can arise in any one of these process model areas. In this regard, and to aid in understanding DoD's approach to risk management, the Department has published numerous risk management documents and maintains a Website that offers insight and considerations related to risk management within the Department of Defense.[3]

Some organizational and behavioral implementation considerations follow:[4]

Although a comprehensive, structured risk management process is important for effective risk management, it is equally important that suitable organizational and behavioral considerations exist to achieve proper implementation. While organizational and behavioral considerations will vary on a program-to-program basis, it is important that risk management roles and responsibilities be defined in the RMP and carried out throughout the duration of the program. Some of the roles and responsibilities that must be determined and implemented include, but are not limited to:

- Which group of managers have responsibility for risk management decision making (e.g., Level I Integrated Product Team (IPT), Risk Management Board (RMB), etc.)? Note that the Risk Management Board (RMB) is composed of

senior program leaders who have responsibility to rationalize and balance risk over an entire program.

- Which group "owns" and maintains the risk management process (e.g., PM, RMB, Systems Engineering (SE) IPT, etc.)?
- Which group or individual is responsible for risk management training and assisting others in risk management implementation (e.g., SE IPT, risk manager, etc.)?
- Who identifies candidate risk event? (Everyone should.)
- How are focal points assigned for a particular approved risk issue (e.g., Level I IPT or RMB, relevant IPT, etc.)?
- How are risk analyses and risk-handling plans (RHPs) developed and approved?
- How are risk monitoring metrics collected and evaluated?

The answers to these questions will vary depending upon the size of the project, organizational culture, degree that effective risk management is already practiced within the organization, contractual requirements, Government and contractor relationship, etc. Behavioral considerations for effective risk management will also vary on a case-by-case basis, but a few important characteristics apply to all projects.

Risk management should be implemented in both a “top-down” and “bottom-up” manner within the project. The PM and other decision makers should use risk management principles in decision making, and support all others within the project to perform risk management. The PM should generally not be the risk manager, but he/she and other key program personnel (e.g., deputy PM, IPT Leads...) must actively participate in risk management activities and use risk management principles in decision making. Without this type of leadership by example, other personnel within the program may view risk management as unimportant, and effective risk management will often be illusive. Similarly, while it is important for key program personnel not to “shoot the messenger” for reporting risk issues, etc., eliminating this behavior does not in and of itself create a positive environment for performing effective risk management.

Working-level personnel will "see through" a risk management implementation that is performed out of contractual, stakeholder, or other necessity rather than being done to manage program risks. If working-level personnel perceive the implementation as lip service, ineffective risk management will result. The goal here is to encourage working-level personnel to assimilate risk management principles as part of their daily job function while leaving the more detailed aspects of the risk management process (such as knowledge of a variety of tools and techniques) and implementation methods to other program personnel who are assigned such roles and responsibilities.

11.1 Risk Management Planning

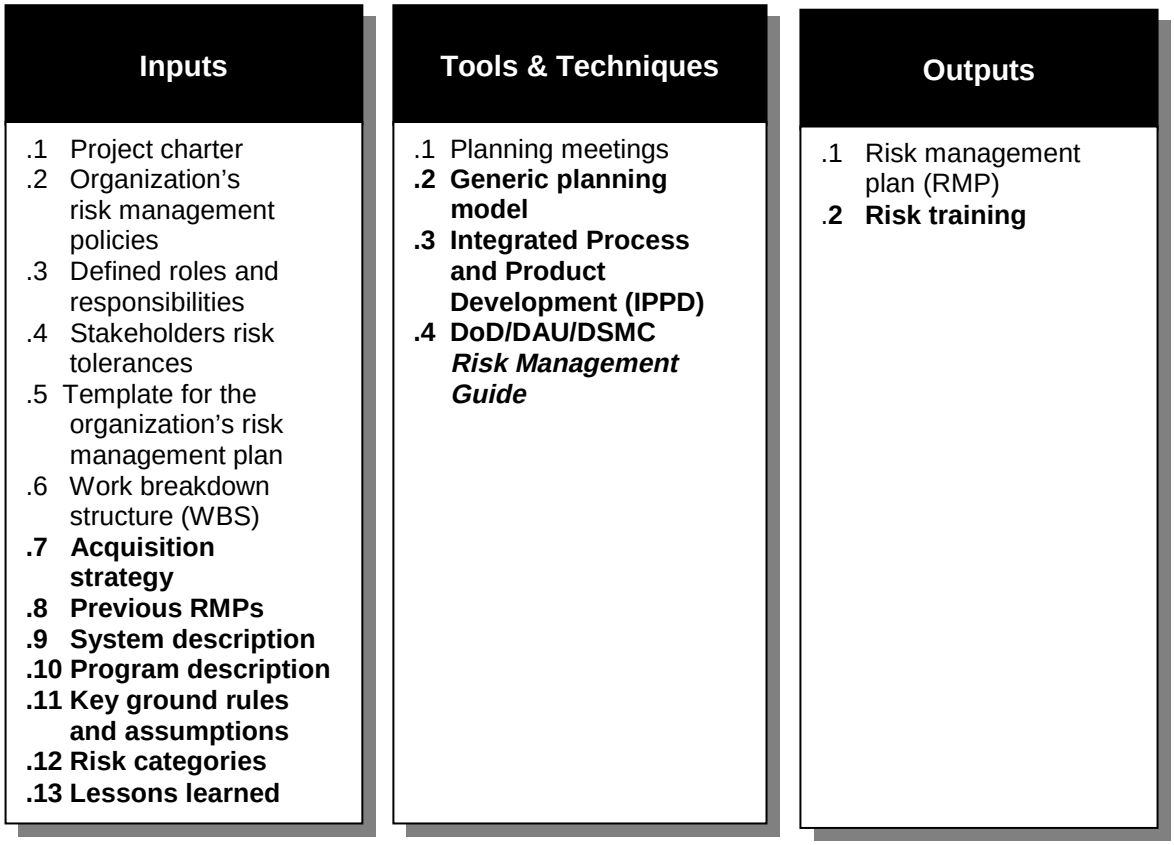
Risk planning is the first phase in DoD Risk Management. Risk planning is the detailed formulation of a program of action for the management of risk. It is the process to:

- Develop and document an organized, comprehensive, and interactive risk management strategy and processes (usually in a draft RMP);

- Determine the methods to be used to execute a program's risk management strategy;
- Plan for adequate resources for a risk management process; and
- Train program personnel and IPTs in risk management.

The planning process is iterative and includes the entire risk management process, with activities to assess (identify and analyze), handle, monitor, and document the risk associated with a program. The primary result of the initial risk planning process is the draft RMP which should then be approved by the Program Level IPT, RMB, or PM.

Planning begins by developing and documenting a risk management strategy. Early efforts establish the purpose and objective, assign responsibilities for specific areas, identify additional technical expertise needed, describe the assessment process and areas to consider, define a risk rating approach, delineate procedures for consideration of handling options, establish monitoring metrics (where possible), and define the reporting, documentation, and communication needs.



11.1.1 Inputs to Risk Management Planning

.1 *Project charter.* See same in *PMBOK® Guide*.

.2 *Organization's risk management policies.* See same in *PMBOK® Guide*.

.3 *Defined roles and responsibilities.* See same in *PMBOK® Guide*.

.4 *Stakeholders risk tolerances.* See same in *PMBOK® Guide*.

.5 *Template for the organization's risk management plan.* See same in *PMBOK® Guide*.

.6 *Work breakdown structure (WBS).* See same in *PMBOK® Guide*.

.7 ***Acquisition strategy.*** The top-level plan for an acquisition program designed to achieve program objectives within resource constraints; it identifies the overall plan to address program risk.

.8 ***Previous (or current draft) RMPs (if one exists).*** Provides a program's risk management goals, objectives, and processes.

.9 ***System description.*** Includes system WBS, system specification, requirements documentation, and concept of operations.

.10 ***Program description.*** A short historical summary, detailed Government objectives for both the current program phase and succeeding phases.

.11 ***Key ground rules and assumptions.*** Contractor and Government risk management responsibilities and guidelines for interaction.

.12 ***Risk categories.*** Includes, but is not limited, to, cost, design/engineering, integration, logistics/support, manufacturing, schedule, technology, and threat.

.13 ***Lessons learned.*** Historical data on similar projects that can be used by way of analogy.

11.1.2 Tools and Techniques for Risk Management Planning

.1 *Planning meetings.* See same in *PMBOK® Guide*.

.2 ***Generic planning model.*** Takes key inputs, evaluates alternatives against input criteria, and develops recommended outputs.

.3 ***Integrated Process and Product Development (IPPD).*** A management technique that simultaneously integrates all essential acquisition activities through the use of multi-disciplinary teams to optimize design, manufacturing, and supportability processes.

.4 ***DoD/DAU/DSMC Risk Management Guide.*** (See reference at endnote 5). This is the definitive source of DoD risk management guidance.

11.1.3 Outputs from Risk Management Planning

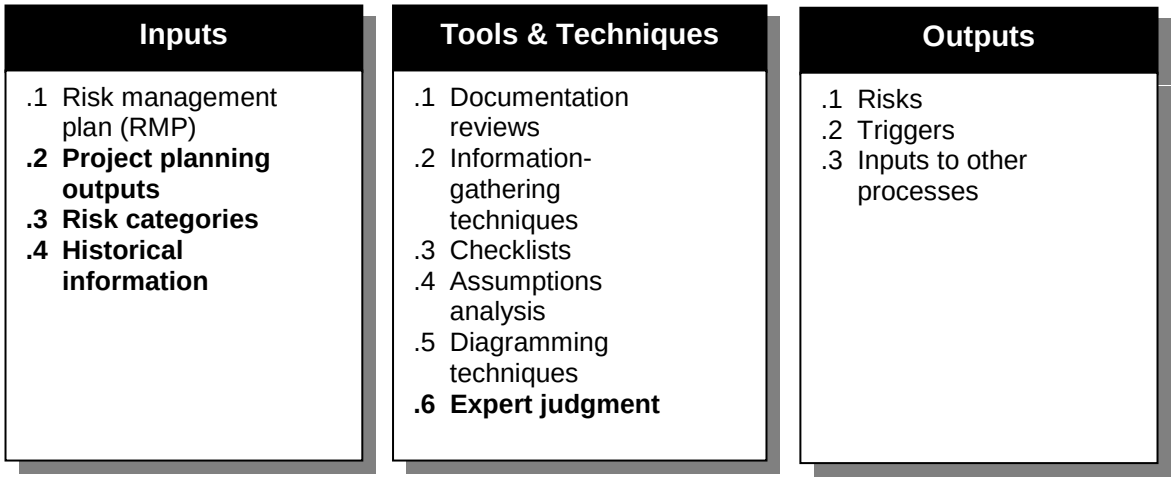
.1 *Risk management plan (RMP).* The RMP is the roadmap that tells the Government and/or team how to get from where the program is today to where the program wants it to be in the future. It lays out a process for risk management tailored to a specific program. The key to writing a good RMP is to provide the necessary information so the program team knows the objectives, goals, and the risk management process. Since it is a roadmap, it may be specific in some areas, such as the assignment of responsibilities for Government and contractor participants and definitions, and general in other areas to allow users to choose the most efficient way to proceed. For example, a description of techniques that suggests several methods for evaluators to assess risk is appropriate, since every technique has advantages and disadvantages depending on the situation. For a recommended outline and generic RMP, see *DoD/DAU/DSMC Risk Management Guide*, Appendix B. This outline and generic RMP should be used as a starting point and tailored to *your program*. (For DoD programs, use this outline in lieu of the outline given in the *PMBOK® Guide*, 11.1.3.)

.2 ***Risk training.*** A plan for training program personnel in risk management processes — planning, assessment, handling, and monitoring. Training may be addressed in the RMP.

11.2 Risk Identification

Within the DoD Risk Management Process, risk identification, along with risk analysis, are considered sub-sets of the risk assessment phase. A construct for risk identification often used in defense acquisition involves establishment of WBS elements associated with products. This involves screening each element against risk categories — such as design, technology, logistics, test and evaluation, requirements, cost/funding, etc. — and then identifying risk events that reside within each WBS element, i.e., what things could go wrong.

All program personnel and IPTs should be encouraged to participate in risk identification. While risk identification can also be performed by a group of program personnel, it is generally better, when possible, to have a single session rather than multiple sessions involving subsets of personnel. After candidate risks have been approved by the program RMB (or equivalent), they should then be evaluated via risk analysis, rather than directly passing to risk handling. This is because risk analysis provides ranking of risks and some risks will have a low enough level that risk handling may not be warranted (e.g., the item is placed on a watch list or closed).



11.2.1 Inputs to Risk Identification

.1 *Risk management plan (RMP).* See same in *PMBOK® Guide*.

.2 ***Project planning outputs***. Include performance requirements as part of sub-set; assumption and constraint lists is part of key ground rules and assumptions and should be documented as part of the RMP.

.3 ***Risk categories***. This item should be documented as part of the RMP. Also, the risk categories described in the *PMBOK® Guide* are not all-inclusive (e.g., omission of manufacturing, support, threat, and other risk categories).

.4 ***Historical information***. See same in *PMBOK® Guide*.

11.2.2 Tools and Techniques for Risk Identification

.1 *Documentation reviews.* See same in *PMBOK® Guide*.

.2 *Information gathering techniques.* See same in *PMBOK® Guide*.

.3 *Checklists.* Checklists should ideally be at a similar WBS level as the risks being identified, or else they may not be accurate. Also, checklists are almost always not all-inclusive and should be used in conjunction with other risk identification tools and techniques.

.4 *Assumptions analysis.* This should be performed as part of risk planning and included in the RMP — an input to risk identification. Constraints should also be included in this analysis. See 11.1.1.11.

.5 *Diagramming techniques.* See same in *PMBOK® Guide*.

.6 ***Expert judgment.***[5] This technique relates to item ".2 Information gathering techniques." However, quantifying expert qualitative judgment involves several additional mathematical methods which are discussed in the end-noted reference. Also see *PMBOK® Guide* Section 11.4.1.6 for additional information.

11.2.3 Outputs from Risk Identification

.1 *Risks.* Risks emerging from risk identification are candidate risks. They should only become approved after evaluation by the program RMB (or equivalent). Furthermore, in DoD risk management, a "risk event" is viewed as having a negative, and not a positive effect on the program if it occurs. Positive events, or opportunities, are balanced against the negative, or risk events, as part of the risk management process.

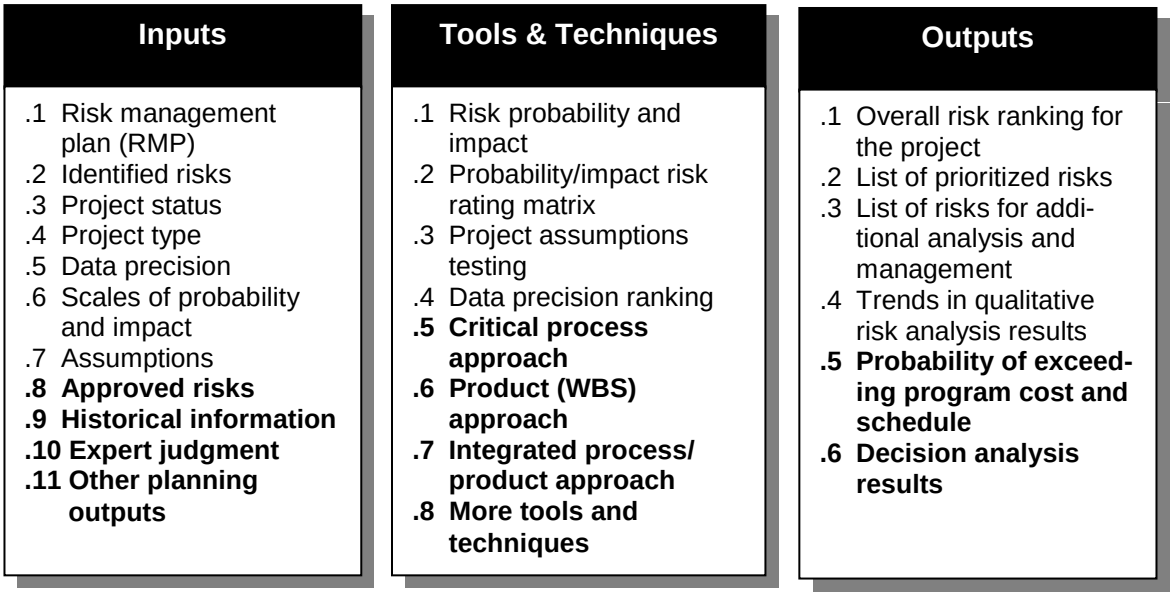
.2 *Triggers.* In DoD risk management, this is a risk identification tool and technique, not a risk identification output. Triggers, i.e., symptoms or warning signs, are also an important tool and technique in risk monitoring.

.3 *Inputs to other processes.* In DoD risk management, this is performed as an output from risk planning, risk identification, risk analysis, risk handling, and risk monitoring.

11.3 Qualitative Risk Analysis

The *PMBOK® Guide* has chosen to split risk analysis into qualitative (*PMBOK® Guide* Section 11.3) and quantitative (*PMBOK® Guide* Section 11.4) risk analysis sections. The DoD perspective is that such a split is not required, since many of the same inputs, tools and techniques, outputs, and associated resources are needed for each category. Nevertheless, the *PMBOK® Guide* numbering convention in the remaining sections has been preserved.

As discussed in the Section 11.2 of this Extension, risk identification, along with risk analysis, are considered sub-sets of the risk assessment phase within the DoD Risk Management Process; see Figure 11-2. Risk Analysis is the process of examining identified risks or risk events, isolating causes, determining the relationship to other risks, expressing the impact in terms of probability and consequence of occurrence or deviation from best process practices, and assigning a risk rating such as low, medium, or high. It can also include prioritization of risk events, which is important for program management personnel in the follow-on risk response-planning (DoD risk handling) phase.



11.3.1 Inputs to Qualitative Risk Analysis

.1 *Risk management plan (RMP).* See same in *PMBOK® Guide*; DoD Risk Management Planning stresses the four major parts of risk management, and the processes within those parts.

.2 *Identified risks.* See same in *PMBOK® Guide.*

.3 *Project status*. See same in *PMBOK® Guide.*

.4 *Project type*. See same in *PMBOK® Guide.*

.5 *Data precision*. See same in *PMBOK® Guide.*

.6 *Scales of probability and impact*. See same in *PMBOK® Guide.*

.7 *Assumptions.* See same in *PMBOK® Guide.*

.8 ***Approved risks.*** Only those risks approved by the RMB (or equivalent) should be evaluated via risk analysis.

.9 ***Historical information.*** See *PMBOK® Guide* Section 11.4.1.5.

.10 ***Expert judgment.*** See paragraph 11.2.2.6 above.

.11 ***Other planning outputs.*** See *PMBOK® Guide* Section 11.4.1.7.

11.3.2 Tools and Techniques for Qualitative Risk Analysis

.1 *Risk probability and impact.* See same in *PMBOK® Guide.*

.2 *Probability/impact risk rating matrix.* Construction of risk rating matrices is also a technique used in defense/aerospace program management. In many cases ordinal probability/likelihood and consequence/impact of occurrence scales are used; these are normally un-calibrated ordinal scales (e.g., the values assigned to them are placeholders and do not have cardinal meaning). Care should be taken to avoid performing mathematical operations on results from un-calibrated ordinal scales, or a combination of un-calibrated ordinal and cardinal scales, because these operations can provide information that will at best be misleading, if not completely meaningless, and could result in erroneous risk ratings. (For example, it can be easily shown that errors of up to several hundred percent can exist for results obtained this way. Such large and uncertain errors will swamp the accuracy of virtually any risk analysis and may render the results meaningless.) One way to avoid this situation is to show each risk event's probability/likelihood and consequences/impacts levels separately, then combine them using a risk neutral (symmetrical) risk rating (mapping) matrix with no attempt to perform mathematical operations on the results (e.g., multiply them). Another way is to use calibrated ordinal probability/likelihood and consequence/impact scales whose coefficients have been estimated by an additive utility function or a similar approach. In such cases numerical computations have at least some valid meaning and the results can be used directly (e.g., a value of 0.4 is twice as important to the program as 0.2).[6]

.3 *Project assumptions testing.* See same in *PMBOK® Guide.*

.4 *Data precision ranking.* See same in *PMBOK® Guide.*

A number of different techniques may be used in DoD to evaluate risk events, which can be grouped into a small number of approaches. Three approaches commonly used in DoD programs to assist in identifying and assessing risk include:

- Critical Process
- Product (WBS)
- Integrated process/product.

A discussion of each follows.

.5 Critical process approach. This approach is used to identify program technical risk by assessing the amount of variance between the contractor's design, test, and production processes (i.e., those not related to individual WBS elements) and industry Best Practices. Success of any risk reduction efforts associated with this technique will depend on the contractor's ability and willingness to make a concerted effort to replace any deficient engineering practices and procedures with industry Best Practices. Chapter 5 NAVSO P-3686 (the reference for this approach) contains a list of several fundamental engineering design, test, and production critical industrial processes.

The Best Practices and "Watch-Out-Fors" associated with critical industrial technical processes should be used as a starting point in developing a baseline of program-specific contractor processes. The Best Practices associated with these critical processes can also serve as benchmarks against which to compare your program's baseline processes and results achieved versus desired goals (in a risk management context). The following examples (Figure 11-3) of critical processes for Design, Test, and Production phases of a product's development are presented in detail in Chapter 5 of NAVSO P-3686.[7]

One of the primary benefits of this approach is that it addresses pervasive and subtle sources of process risk in most DoD acquisition programs and uses fundamental engineering principles and proven procedures to reduce technical risks.

Design	Test	Production
• Design Reference Mission Profile • Trade-Studies • Design Analysis • Parts & Materials Selection • Design for Testability • Built-In-Test • Design Reviews • Thermal Analysis • Design Release • Computer-Aided Design/Computer-Aided Manufacturing	• Design Limit Qualification Testing • Test, Analyze, and Fix	• Manufacturing Plan • Rapid Prototyping • Manufacturing Process Proofing/Qualification • Conformal Coating for Printed Wiring/Circuit Assemblies • Subcontractor Control • Tool Planning • Special Test Equipment • Manufacturing Screening • Failure Report Analysis and Corrective Action

Figure 11-3. Critical Industrial Processes

Process metrics, Best Practices, and "Watch-Out-Fors" are used in conjunction with contract requirements and performance specifications to identify those technical processes that are critical to the program, and to establish a program baseline of contractor processes. This baseline should be developed using fundamental engineering Critical Processes noted in the above reference as a starting point and by reviewing and compiling additional Critical Processes in use by companies in both the defense and non-defense sectors.

The program baseline being used by the contractor should be determined by evaluating actual contractor performance, as opposed to stated policy. This program baseline should then be compared to a baseline of those industry-wide processes and practices that are critical to the program. The variances between the two baselines are indications of the technical process risk present in the program. These results should be documented in standard format, such as a program-specific risk assessment form, to facilitate the development of a RHP.

In summary, the critical process approach has many benefits; however, the critical processes normally are not directly related to the individual WBS product elements comprising the weapon system being develop and produced.

.6 ***Product (WBS) approach.*** (See *PMBOK® Guide* Section 5.3.2.1 for a discussion of the WBS.) This approach has strong historical precedence and is widely used within DoD. It is based on WBS elements/products. Risk assessment and handling activities are conducted primarily on the individual WBS elements/products, with an emphasis on typical risk areas or sources of risk — technology, design, funding, etc. In this approach the focus is on system elements or products and the specific processes related to those elements. Since most DoD programs are established around the WBS approach, technical risks are identified and assessed based on their probability of occurrence and impact on program cost, schedule, and performance. The associated costs and schedule for each element/product can be readily base-lined.[8]

As stated in the DoD 5000 Series, the WBS provides a framework for program and technical planning, cost estimating, resource allocations, performance measurements, and status reporting. It is important to recognize that the WBS is a product of the system engineering process, which emphasizes both product and process solutions required for completion of objectives.

.7 ***Integrated process/product approach.*** The integrated process/product approach to technical risk management is derived primarily from the critical process approach and incorporates some facets of the product/WBS approach. The systems engineering function takes the lead in system development throughout any system's life cycle. The purpose of systems engineering is to define and design process and product solutions in terms of design, test and manufacturing requirements. The WBS provides a framework for specifying technical objectives for a program by first defining the program in terms of hierarchically-related, product-oriented elements and work processes required for their completion.

This emphasis on systems engineering, including processes and technical risk along with process and product solutions, validates and supports the importance of focusing on controlling critical generic processes, especially the prime contractor's and subcontractor's critical processes. Such a focus is necessary to encourage a proactive risk management program, one that acknowledges the importance of understanding and controlling the critical generic processes — especially during the initial phases of product design and manufacture. The key difference between this approach and the WBS approach is that "process variance" replaces "probability" in the risk analysis prioritization matrix.

In summary, the Critical Process Approach provides technical "drivers" and associated technical risks as measured by process variance. See Figure 11-4 for an overview of some of the advantages and disadvantages of the three approaches.

.8 ***More tools and techniques.*** Other tools and techniques used in DoD qualitative risk analysis include:

- Comparisons with similar systems to estimate potential risk rating levels.
- Experience from similar programs to estimate potential risk levels.[9]
- Data from engineering or other models in order to provide estimates of maturity and variances.

Approach	Advantages	Disadvantages
Process 11.3.2.1 (of *U.S. DoD Ext*)	• Proactive focus on critical generic processes. • Encourages market search for best practices/benchmarks. • Reliance on fundamental design, test and manufacturing principles. • Address pervasive and subtle sources of risk. • Technical discipline will pay dividends in cost and schedule benefits.	• Less emphasis on the product-oriented elements of a program, i.e., does not relate to WBS. • Perception that technical issues dilute the importance of cost and schedule. • May be difficult to apply some aspects early in the program life cycle.
Product (WBS) 11.3.2.2 (of *U.S. DoD Ext*)	• Commonly accepted approach using logical, product oriented structure. • Relates the elements of work to be accomplished to each other and to the end product. • Separates a defense materiel item into its component parts. • Allows tracking of product items down to any level of interest including specific processes associated with the product elements.	• Does not typically emphasize critical top level generic design and manufacturing processes, or product cost. • Part of risk is typically expressed as a probability estimate rather than a process variance.
Integrated Process/Product 11.3.2.3 (of *U.S. DoD Ext*)	• Maximizes the advantages of Process and Product Approaches.	• Difficulty in determining variance from best practices.

Figure 11-4. Comparison of the Three Processes

- Results from tests and prototype development that provide estimates of maturity and variances (actual versus planned values).

- Quantifying expert judgment using information-gathering techniques.[10]

- Analysis of plans and related documents in order to provide estimates of variances.

- Un-calibrated and calibrated ordinal probability of occurrence and consequence of occurrence scales. No mathematical operations can be performed on un-calibrated (raw) ordinal scales as the scale coefficients are only rank ordered (e.g., e, d, c, b, and a (where e > d > c > b > a) is just as meaningful as 5, 4, 3, 2, 1) and the true coefficient values are unknown. Limited mathematical operations can be performed on the results of calibrated ordinal scales (e.g., a value of 0.4 is twice as important to the program as a value of 0.2). However, the calibration process is typically both complex to develop and costly to implement, and cannot

be readily transferred from one program to another. As a result, (accurately) calibrated ordinal scales are rarely used in risk analyses.[11]

- Separate cost, performance, and schedule consequence of occurrence scales should be used for technical risk analyses. Quality and scope consequence of occurrence scales are not recommended since quality *is often a cause, not an impact* to the program and scope encompasses cost, performance, and schedule considerations.

- Risk ranking methods to convert risk scores or levels to ranked risk (e.g., a risk mapping matrix to convert estimated "probability" and consequence of occurrence levels to a risk rating level). Note: an asymmetric risk-mapping matrix should not be used unless conclusive evidence supports its existence and the risk level boundaries can be accurately estimated. In addition, some forms of decision analysis (particularly what is known as expected value (probability times impact), which requires a risk neutral assumption, cannot be used on the same program at the same time as an asymmetric risk mapping matrix, which requires either a risk averse or risk taker position.

- Sensitivity analysis to examine the uncertainty associated with estimated probability and/or consequence of occurrence information and to consider the effect of each risk issue on the program outcomes. Sensitivity analysis can include project assumptions testing and data precision ranking (*PMBOK® Guide* Sections 11.3.2.3 and 11.3.2.4, respectively).

While several of the above tools and techniques are similar or identical to ones discussed in *PMBOK® Guide* Sections 11.3.2 and 11.4.2, DoD process descriptions vary from some of the information contained in those *PMBOK® Guide* sections. Specifically, variances occur in content (e.g., *PMBOK® Guide* Sections 11.3.2.1, 11.3.2.2, and Figures 11-2, 11-3, and 11-4, and 11-6) and omissions (e.g., no discussion of performance consequence of occurrence or technical risk).

11.3.3 Outputs from Qualitative Risk Analysis

.1 *Overall risk ranking for the project.* See same in *PMBOK® Guide*. However, care needs to be taken when developing scores from un-calibrated ordinal scales, or a combination of un-calibrated ordinal and cardinal scales; information obtained from mathematical operations on these scales can be either misleading or erroneous.

.2 *List of prioritized risks.* See same in *PMBOK® Guide.* In DoD a risk list is constructed based upon the risk ranking methodology included in the RMP, and should apply to results derived from both qualitative and quantitative tools and techniques. In addition, the risk level associated with each risk issue is provided. At a minimum, all medium or higher risk issues should be included in such a list. Additional considerations, such as the frequency of occurrence, time sensitivity, and interdependence with other risk issues can also be noted and used either directly or indirectly in the risk rating methodology.

.3 *List of risks for additional analysis and management.* See same in *PMBOK® Guide.* Also see comments regarding DoD procedures described in 11.3.3.2 above.

.4 *Trends in qualitative risk analysis results.* See same in *PMBOK® Guide.* Statement applies to both qualitative and quantitative risk analysis results.

.5 ***Probability of exceeding program cost and schedule.*** Estimates of the program cost and schedule at a desired confidence level (e.g., 50th percentile) are determined from a Monte Carlo simulation. This yields an estimate of cost and schedule risk when the results are compared to most likely values. Likewise, the probability of achieving performance characteristics at a desired percentile can also be estimated.

.6 ***Decision analysis results.*** Decision analysis results may be deterministic or stochastic depending upon whether or not the branch probabilities are fixed or given by probability distributions, respectively.

11.4 Quantitative Risk Analysis

Inputs	Tools & Techniques	Outputs
.1 Risk management plan .2 Identified risks .3 List of prioritized risks .4 List of risks for additional analysis and management .5 Historical information .6 Expert judgment .7 Other planning outputs	.1 Interviewing .2 Sensitivity analysis .3 Decision tree analysis .4 Simulation **.5 More tools and techniques**	.1 Prioritizes list of quantified risks .2 Probabilistic analysis of the project .3 Probability of achieving the cost and time objectives .4 Trends in quantitative risk analysis results

11.4.1 Inputs to Quantitative Risk Analysis

.1 *Risk management plan.* See same in *PMBOK® Guide.*

.2 *Identified risks.* See same in *PMBOK® Guide.*

.3 *List of prioritized risks.* See same in *PMBOK® Guide.*

.4 *List of risks for additional analysis and management.* See same in *PMBOK® Guide.*

.5 *Historical information.* See same in *PMBOK® Guide.*

.6 *Expert judgment.* See paragraph 11.2.2.6 above.

.7 *Other planning outputs.* See same in *PMBOK® Guide.*

11.4.2 Tools and Techniques for Quantitative Risk Analysis

.1 *Interviewing.* See same in *PMBOK® Guide.*

.2 *Sensitivity analysis.* See same in *PMBOK® Guide.*

.3 *Decision tree analysis.* See same in *PMBOK® Guide.*

.4 *Simulation.* See same in *PMBOK® Guide.*

.5 More tools and techniques

- Decision tree analysis (with variable branch probabilities) Variable branch probability concept is not covered in *PMBOK® Guide – see 11.4.2.3 above.)*

- Estimative probability tables (e.g., high probability = 0.75 (25th percentile) to 0.85 (75th percentile), medium probability = 0.45 (25th percentile) to 0.55 (75th percentile), and so on).[12] [Note: these tables can also be ordinal, thus qualitative if specific scale levels are assigned to a given definition (e.g., high probability = 0.75 (25th percentile) to 0.85 (75th percentile) = Level 5.]

- Cost, performance, and schedule Monte Carlo simulations. Cost risk analysis simulations usually include cost estimating uncertainty, technical risk, and schedule risk. Schedule risk analysis simulations usually include schedule estimating uncertainty and technical risk, and may include cost risk. WBS elements and/or performance-related parameters, and their probability distributions are included in performance risk analysis simulations that results in a performance probability distribution [e.g., cumulative distribution function (CDF)]. The probability distribution is then analyzed to determine the level of performance risk.[13]

- Probabilistic risk analysis (related to reliability).

- Failure modes and effects analysis (related to reliability).

- Fault tree analysis (related to reliability).

- Payoff Matrices (includes Laplace Criterion, Wald's Maximum, Hurwicz Optimism Criterion, and Savage's Minimax).

11.4.3 Outputs from Quantitative Risk Analysis

.1 *Prioritized list of quantified risks.* See paragraph 11.3.3.2 above.

.2 *Probabilistic analysis of the project.* See same in *PMBOK® Guide.*

.3 *Probability of achieving the cost and time objectives*. See paragraph 11.3.3.5 above.

.4 *Trends in quantitative risk analysis results.* See paragraph 11.3.3.4 above.

11.5 Risk Response Planning

A critical part of DoD risk handling (risk response planning in the *PMBOK® Guide*) involves refining and selecting the most appropriate handling option(s) and specific implementation approach(es) for selected risk issues (often those with medium- or higher-risk levels).

DoD risk-handling options include risk assumption (acceptance in the *PMBOK® Guide* 11.5), avoidance, control (mitigation in the *PMBOK® Guide* 11.5), and transfer (transference in the *PMBOK® Guide* 11.5). Although the control option (often called mitigation) is commonly used in aerospace and high technology programs, it should not automatically be chosen. All four options should be evaluated and the best one chosen for a given risk issue.

The primary risk handling strategy represents the selected handling option and implementation approach.[14] The key here is to use a structured approach to first select the most desirable handling option (among the four possible options), then choose the best specific implementation approach for that option. When backup (or secondary) risk-handling strategies are needed, the selection process used to choose the option and implementation approach should be performed again. The backup risk-handling strategy may have a different option from that used in the primary risk-handling strategy, and will certainly have a different implementation approach.

Inputs	Tools & Techniques	Outputs
.1 Risk management plan .2 List of prioritized risks .3 Risk ranking of the project .4 Prioritized list of quantified risks .5 Probabilistic analysis of the project .6 Probability of achieving the cost and time objectives .7 List of potential responses .8 Risk thresholds .9 Risk owners .10 Common risk causes .11 Trends in qualitative and quantitative risk analysis results	.1 Avoidance .2 Transference .3 Mitigation .4 Acceptance	.1 Risk response plan .2 Residual risks .3 Secondary risks .4 Contractual agreements .5 Contingency reserve amounts needed .6 Inputs to other processes .7 Inputs to a revised project plan **.8 Supporting data**

11.5.1 Inputs to Risk Response Planning

The following items address the *PMBOK® Guide* inputs to risk response planning. DoD risk response procedures differ from the *PMBOK® Guide* in some respects as described below:

.1 *Risk management plan.* See same in *PMBOK® Guide.*

.2 *List of prioritized risks*. See same in *PMBOK® Guide.*

.3 *Risk ranking of the project.* See same in *PMBOK® Guide*. However the level of each risk event should determine whether or not risk response planning is performed, not an overall project risk ranking.

.4 *Prioritized list of quantified risks*. See same in *PMBOK® Guide*. However, both qualitative and quantitative risks should be included in a prioritized list.

.5 *Probabilistic analysis of the project*. See same in *PMBOK® Guide.*

.6 *Probability of achieving the cost and time objectives*. See same in *PMBOK® Guide.*

.7 *List of potential responses.* See same in *PMBOK® Guide*. However, normally risk responses are not identified during the DoD risk identification part of risk assessment.

.8 *Risk thresholds*. See same in *PMBOK® Guide.*

.9 *Risk owners.* See same in *PMBOK® Guide.*

.10 *Common risk causes.* See same in *PMBOK® Guide.*

.11 *Trends in qualitative and quantitative risk analysis results.* See same in *PMBOK® Guide*; within DoD, risk levels rather than trends are the key input to risk response planning.

11.5.2 Tools and Techniques for Risk Response Planning

As noted in the introduction to Section 11.5, Risk Response Tools and Techniques used in DoD vary somewhat from those discussed in the *PMBOK® Guide*. DoD Risk Response (or Handling in DoD terminology) has the following steps: Control, Avoidance, Assumption, and Transfer. An acronym used in DoD to identify these options is “CAAT.” Although the control risk-handling option is commonly used in defense programs, it should not automatically be chosen. All four options should be evaluated and the best one chosen for a given risk issue.

.1 *Avoidance.* See same in *PMBOK® Guide.*

.2 *Transference.* See same in *PMBOK® Guide.*

.3 *Mitigation.* See same in *PMBOK® Guide*. This corresponds to the control option in DoD terminology.

.4 *Acceptance.* See same in PMBOK® Guide. This corresponds to the assumption option in DoD terminology.

11.5.3 Outputs from Risk Response Planning

DoD risk response processes generally agree with *PMBOK® Guide* processes as described below:

.1 *Risk response plan.* See same in *PMBOK® Guide*; described as a Risk Handling Plan (RHP) in DoD risk management terminology.[15]

.2 *Residual risks*. See same in *PMBOK® Guide.*

.3 *Secondary risks*. See same in *PMBOK® Guide.*

.4 *Contractual agreements*. See same in *PMBOK® Guide.*

.5 *Contingency reserve amounts needed*. See same in *PMBOK® Guide.*

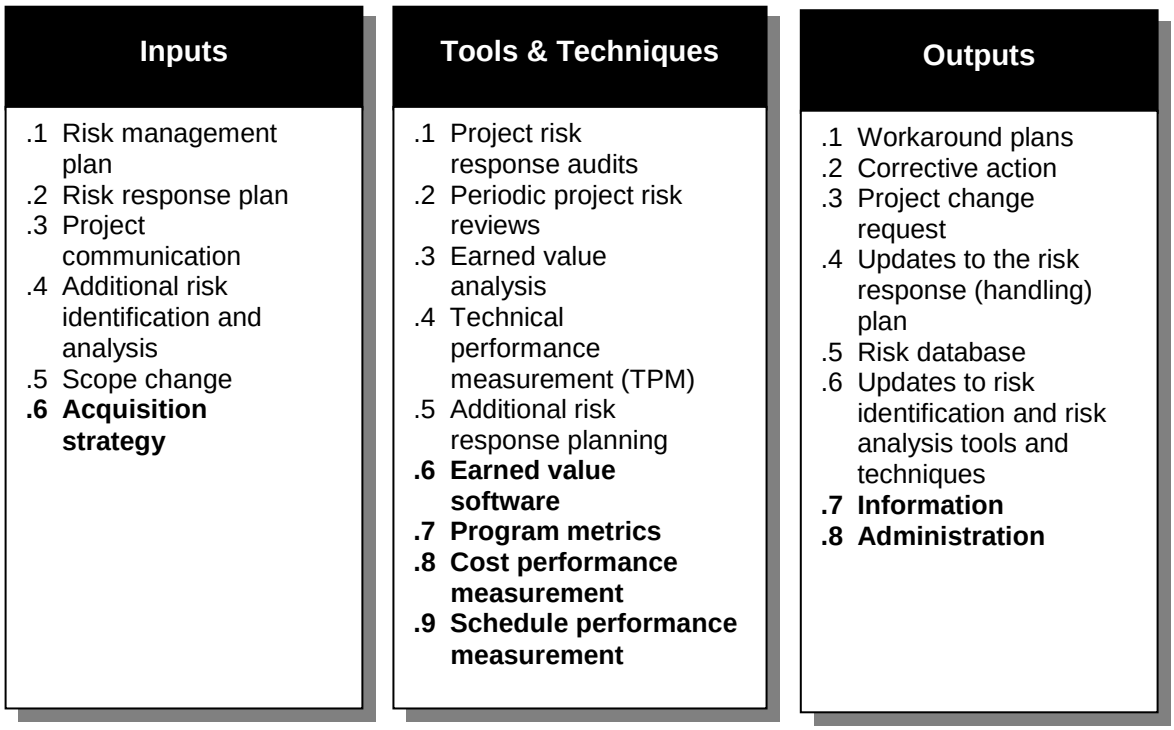
.6 *Inputs to other processes*. See same in *PMBOK® Guide.*

.7 *Inputs to a revised project plan*. See same in *PMBOK® Guide.*

.8 Supporting data. Estimates of the budget, activities, and resources (e.g., personnel and equipment) needed to implement each Risk Response Plan (DoD RHP) should be included in the appropriate documentation. For example, risk handling activities should be included in the integrated master schedule (IMS).

11.6 Risk Monitoring and Control

Risk monitoring in DoD is performed to measure actual versus planned progress associated with implemented risk response plans. The monitoring process systematically tracks and evaluates the effectiveness of risk-handling actions against established cost, schedule and performance metrics. Monitoring results may also provide a basis for developing additional risk response (handling) options and/or approaches, or updating existing risk response (handling) strategies, and/or re-analyzing known risks. In some cases monitoring results may also be used to identify new risks and revise some aspects of risk planning. The key to the risk monitoring process is to establish a cost, schedule and performance management indicator system that the PM and other key personnel use to evaluate the status of the program. The indicator system should be designed to provide early warning of potential problems to allow management actions. Risk monitoring is not a problem-solving technique, but rather, a proactive technique to obtain objective information on the progress to date in reducing risks to acceptable levels.



11.6.1 Inputs to Risk Monitoring and Control

Some additional inputs to risk monitoring and control commonly used in DoD risk management but not included in the *PMBOK® Guide* are described below:

.1 *Risk management plan.* See same in *PMBOK® Guide.*

.2 *Risk response plan.* See same in *PMBOK® Guide.*

.3 *Project communication.* Work results and other project records described in *PMBOK® Guide* Section 10.3.1 provide information about project performance and risks. Within DoD, a variety of reports — such as the Defense Acquisition Executive Summary (DAES) — are commonly used to monitor and control risks, including those associated with the risk level, changes in the risk level, and watch lists.

.4 *Additional risk identification and analysis.* See same in *PMBOK® Guide.*

.5 *Scope changes.* Within DoD scope changes require new risk identification in addition to risk analysis and risk response (handling) planning.

.6 ***Acquisition strategy.*** The overall program plan that lays out events, activities and timing; the strategy is graphically represented in both the IMP and IMS. Key Performance Parameters (KPP) that the strategy is designed to achieve are also inputs and included in the Acquisition Program Baseline (APB).

11.6.2 Tools and Techniques for Risk Monitoring and Control

.1 *Project risk response audits.* See same in *PMBOK® Guide.*

.2 *Periodic project risk reviews.* See same in *PMBOK® Guide*; in DoD, risk ratings and prioritization may change during a project phase. Any changes may require additional risk identification, risk analysis, and risk response (handling) planning.

.3 *Earned value analysis.* See same in *PMBOK® Guide*; earned value (described in *PMBOK® Guide* Section 10.3.2.4) is used for monitoring overall program performance against a baseline plan. An earned value management system (EVMS) uses standard cost/schedule data to evaluate a program's cost performance (and provide an indicator of schedule performance) in an integrated fashion. As such, it provides a basis to determine if implemented risk-handling strategies are achieving their forecasted results. Results from an earned value analysis may indicate potential deviation of the program at completion from cost and schedule targets. When a program deviates significantly from the baseline, risk identification and risk analysis updates should be performed, and updates to the risk response (handling) plan may be considered. Data sources include the Cost Performance Report (CPR), and the Cost/Schedule Status Report (C/SSR).

.4 *Technical performance measurement (TPM)***.** See same in *PMBOK® Guide*; within DoD this is a method for product design assessment which estimates, through engineering analysis and tests, the values of essential performance parameters of the current design affected by risk handling actions.

.5 *Additional risk response planning.* See same as in *PMBOK® Guide*; within DoD, if a risk emerges that was not anticipated in the risk response (handling) plan, or its impact on objectives is different than expected, the planned response may not be suitable. In such cases it will be necessary to update the risk response (handling) plan.

.6 ***Earned value software.*** (Related to 11.6.2.3) The Contract Appraisal System Module (CAPPS 3.0) is available to assist in the analysis of earned value methodology data submitted by contractors. The primary purpose of the tool is cost management. The sponsor is the Defense Acquisition University.

.7 ***Program metrics.*** These are formal, periodic performance assessments of the selected development processes, evaluating how well the development process is achieving its objective. This technique can be used to monitor corrective actions that emerged from an assessment of critical program processes. Other metrics may involve financial controls such as obligations on time and expenditures paid on time.

.8 ***Cost performance measurement.*** Formal cost performance measurement is a part of the accounting considerations involving EVMS at the time of progress payments or actual receipt of materials, and it is a PM's responsibility relative to trade-off analysis when dealing with program alternatives and milestone decisions. Thus, it is a risk monitoring tool.

.9 ***Schedule performance measurement.*** This is the use of program schedule data to evaluate how well the program is progressing to completion.

11.6.3 Outputs from Risk Monitoring and Control

.1 *Workaround plans.* See same in *PMBOK® Guide.*

.2 *Corrective action*. See same in *PMBOK® Guide.*

.3 *Project change requests.* See same as in *PMBOK® Guide.*

.4 *Updates to the risk response (handling) plan.* See same in *PMBOK® Guide*; within DoD an updated risk response (handling) plan should include changes — as warranted — to the risk response (handling) strategy (option and/or implementation approach), resources necessary to implement the strategy, milestones associated with implementation activities, etc.

.5 *Risk database.* See same in *PMBOK® Guide.*

.6 *Updates to risk identification and risk analysis tools and techniques*. See same in *PMBOK® Guide*; within DoD risk management, information obtained from risk monitoring and control may be used to update tools and techniques in risk identification (e.g., checklists) and risk analysis (e.g., ordinal risk scales).

.7 ***Information.*** Knowledge about success (or lack of success) in implementing risk response (handling) plans.

.8 ***Administration.*** Data to facilitate preparation of risk management reports.

Endnotes

1. William Bahnmaier and Paul McMahon, Defense Systems Management College, 1 May 2001. Also see Chapters 1-8 and Appendices A, C, D, G, and J of Edmund H. Conrow, *Effective Risk Management: Some Keys to Success*, American Institute of Aeronautics and Astronautics, 2000, for additional DoD risk management lessons learned.
2. *Risk Management Guide for DoD Acquisition*, pg. 7, Defense Acquisition University, Fifth Edition, June 2002, and Edmund H. Conrow, *Effective Risk Management: Some Keys to Success*, op. cit., pg. 20. At the time of this writing the *Risk Management Guide for DoD Acquisition* can be obtained online at: http://www.dau.mil/pubs/gdbks/risk_management.asp.
3. DoD Risk Management; at the time of this writing the DoD Risk Management Focus Area can be found at the following website/URL: http://www.pmcop.dau.mil/pmcop/.
4. Conrow, Edmund H., *Effective Risk Management: Some Keys to Success*, *op. cit.,* Chapter 3, Sections 6, 7, 12-15, 2000; also see *Risk Management Guide for DoD Acquisition*, Chapter 4, Sections 4.1-4.5, Defense Acquisition University, Fifth Edition, June 2002.
5. *Risk Management Guide for DoD Acquisition*, Defense Acquisition University, Appendix D, Fifth Edition, June 2002.
6. *Risk Management Guide for DoD Acquisition*, Defense Acquisition University, Section 2.6.4.3, Fifth Edition, June 2002, and Edmund H. Conrow, *Effective Risk Management: Some Keys to Success*, op. cit., Chapter 6 and Appendix G, 2000.
7. NAVSO P-3686, *Top Eleven Ways to Manage Technical Risk*, Office of the Assistant Secretary of the Navy (RD&A), October 1998 was used in developing the risk analysis discussions in Defense Draft Extension Sections 11.3.2.5, 11.3.2.6, 11.3.2.7. The original text of NAVSO P-3686 is available at: http://www.abm.rda.hq.navy.mil/p3686.pdf.
8. *Risk Management Guide for DoD Acquisition*, Section 5.4.1, Defense Acquisition University, Fifth Edition, June 2002 and *PMBOK® Guide* Section 11.4.1.6 for additional information.
9. *Risk Management Guide for DoD Acquisition*, Section 5.4.8, Defense Acquisition University, Fifth Edition, June 2002.
10. *Risk Management Guide for DoD Acquisition,* Defense Acquisition University, Appendix D, Fifth Edition, June 2002.
11. Conrow, Edmund H., *Effective Risk Management: Some Keys to Success*, *op. cit.*, Chapter 6 and Appendix G, 2000; *Risk Management Guide for DoD Acquisition*, Section 2.6.4.3, Defense Acquisition University, Fifth Edition, June 2002.
12. *Ibid.*, *Effective Risk Management: Some Keys to Success*, Appendix I.
13. *Ibid., Effective Risk Management: Some Keys to Success*, Chapter 6, and the DoD *Risk Management Guide*, Sections 5.4.5 and 5.4.6 for additional information.
14. *Ibid., Effective Risk Management: Some Keys to Success*, Chapter 7.
15. *Ibid., Effective Risk Management: Some Keys to Success*, Chapter 7, and the DoD *Risk Management Guide*, Section 6.3 and Appendix B.

Chapter 12

Project Procurement Management

This chapter discusses program procurement in the context of Government (DoD) contract management of acquisition programs (R&D, production, etc.) with DoD as the buyer, supplementing the information in the *PMBOK® Guide*. As in the *Guide,* the material is covered in the following sections:

12.1 Procurement Planning – determining what to procure and when.
12.2 Solicitation Planning – documenting product requirements and identifying potential sources.
12.3 Solicitation – obtaining quotations, bids, offers, or proposals as appropriate.
12.4 Source Selection – choosing from among potential sellers.
12.5 Contract Administration – managing the relationship with the seller.
12.6 Contract Close-out – completion and settlement of the contract, including resolution of any open items.

In DoD contract management (Procurement Management), both the PM and the Government Contracting Officer (CO) hold key decision-making positions.

The PM's role is essentially to direct and integrate multifunctional resources in support of objectives that meet cost, schedule and performance standards. Basically, the CO is responsible to prepare and administer contracts, protect the interests of his/her organization, ensure contractors meet contract terms and conditions and ensure laws, regulations, and internal policies are met. It is worth noting that the CO position has burgeoned over recent years to include an expanded knowledge base and increased discretion as many mandatory rules have been eliminated through the Federal Acquisition Streamlining Act (FASA) and related initiatives — thus, enabling the CO to be more involved and more judgmental in developing strategy and tactics, and shaping the deal. The PM and CO roles intersect in that all formal aspects of the business are represented in the contract and the CO's responsibility for successful contract execution is shadowed by the PM's accountability for contract execution and overall program management. In recent years, the CO role has evolved to where working more closely with the PM has become the rule and not the exception.

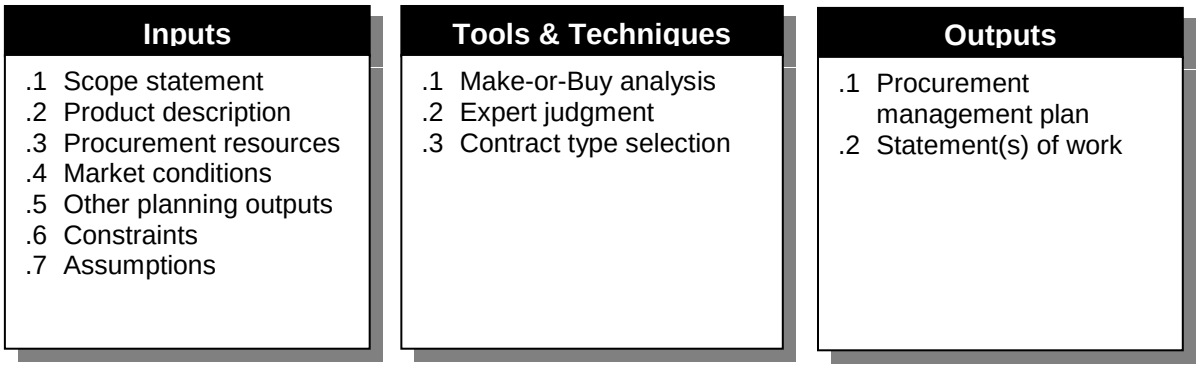
Where the PM and CO roles and responsibilities differ is in the breadth and depth of the PM's responsibility and accountability. The PM is ultimately accountable to the user and to Congress for overall program success or failure. Therefore, PM activities involve extensive coordination with internal/contractor operations as well as being fully involved in political, business, and technical issues important to numerous external stakeholders

such as Congress, the Government user, and industry stockholders. In contrast, the CO is responsible for meeting conditions of the contract and as such, more time is spent relating to business and legal issues and contract administration. This requires interface with Government or industry counterparts and outside stakeholders (different from the PM) such as subcontractors, banks, approving authorities for industry and legal reviewers, committee reviewers, Small and Disadvantaged Business Utilization Specialists, and Competition Advocates for Government. Although the role of the CO impacts the entire program, to include the relationship between Government and industry, it is not as encompassing as the work of the PM. From a PM's perspective, contracting is extremely important but it is only one of many functional departments that the PM must coordinate with and rely upon to achieve program support.

It should be noted that within the Federal Government, contracting professionals have to be "warranted" in order to obligate taxpayer dollars. The warrant is taken very seriously as it distinguishes that individual for taking on a significant amount of responsibility and accountability. Procedurally, as a result of the CO's training and the significance of the warrant, it is his/her inclination to first see how law, policy, regulation, court precedence and the written contract relates to the issue at hand. Second, he/she looks at the needs of the user/customer and works to make the best business deal possible, within the constraints of the law or the requirements of the contract. A CO must not only be well versed in pricing, negotiations, and in Federal Acquisition Regulation and policy, but must also be a good communicator and knowledgeable of the program he or she is supporting. The best COs are creative, flexible people who can work both the overall program strategy as well as the details of the contracts and laws.[1]

12.1 Procurement Planning

Reference should be made to Federal Acquisition Regulation (FAR) – Part 7, and Defense FAR Supplement (DFARS) – Part 207, Acquisition Planning.



12.1.1 Inputs to Procurement Planning

.1 *Scope statement.* See same in *PMBOK® Guide*.

.2 *Product description.* See same in *PMBOK® Guide*. Product and services should be stated in terms of performance.

.3 *Procurement resources.* See same in *PMBOK® Guide*. Within DoD, a CO with a warrant will be part of the process.

.4 *Market conditions.* PMs are required to conduct market research to determine the availability of commercial items or in the alternative non-developmental items that may be available to satisfy the Government's requirement prior to starting a new R&D program.

.5 *Other planning outputs.* See same in *PMBOK® Guide*.

.6 *Constraints*. See same in *PMBOK® Guide*.

.7 *Assumptions.* Any assumption is unobtainable data that bears directly on the procurement or the problem. An assumption should be valid in that it establishes a requirement that must be fulfilled for the procurement to be successful. If the procurement or other action will be unaffected regardless of whether or not an assumption turns out to be factually accurate, then that assumption is not considered valid.

12.1.2 Tools and Techniques for Procurement Planning

.1 *Make-or-buy analysis.* See same in *PMBOK® Guide*.

.2 *Expert judgment.* See same in *PMBOK® Guide*.

.3 *Contract type selection.* Fixed price type contracts are not appropriate for R&D efforts unless the level of program risk permits realistic pricing and an equitable allocation of program risk between the parties.

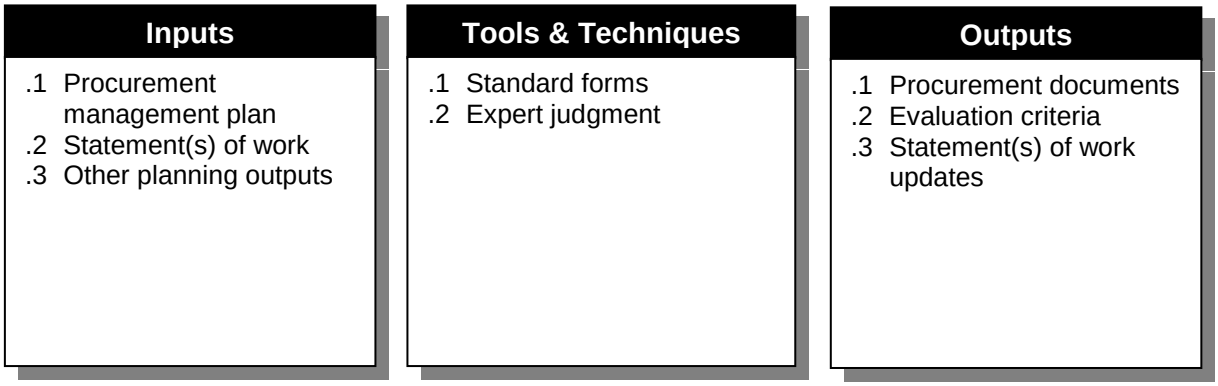
12.1.3 Outputs from Procurement Planning

.1 *Procurement management plan.* The military departments and agencies shall prepare written acquisition plans for development, production, and other programs as specified in FAR Part 7 and DFARS Part 207. The plans are comprehensive and intended to facilitate attainment of the acquisition objectives by addressing milestones and other significant considerations that will control the acquisition. The PM has overall responsibility for acquisition planning. Normally acquisition plans are detailed relative to the immediate phase and less so in subsequent phases. Acquisition plans are updated prior to the beginning of each phase of the program. Written plans are not required in acquisitions for final buy out or one-time buy contracts which cover all current and future requirements.

.2 *Statement(s) of work.* One of the key systems engineering planning documents that will be included in the solicitation is the Statement of Work (SOW). A Statement of Objectives (SOO) can be used to obtain a SOW or equivalent during the selection process. Government task requirements are expressed in the SOW. During the solicitation phase, the tasks can be defined in a very general way by an SOO. The SOO is extremely important to the solicitation because it guides the contractors responses — bid or proposal. The SOW placed on contract serves as baseline to measure contractor progress and to determine contract changes that may occur during performance.

12.2 Solicitation Planning

Reference should be made to FAR – Subpart 15.2, and DFARS – Subpart 215.2, Solicitation and Receipt of Proposals and Information.



12.2.1 Inputs to Solicitation Planning

.1 *Procurement management plan.* See same in *PMBOK® Guide.*

.2 *Statement(s) of work*. See same in *PMBOK® Guide.*

.3 *Other planning outputs.* See same in *PMBOK® Guide.*

12.2.2 Tools and Techniques for Solicitation Planning

.1 *Standard forms.* The DoD prescribes a Uniform Contract Format (UCF), consisting of four parts and thirteen sections, for most purchases. Notable exceptions include architecture-engineering and shipbuilding contracts. This standard format enables readers to focus on content rather than form and facilitates communication between the parties. Standard forms, contract provisions, and contract clauses are also prescribed for use by all activities within the DoD.

.2 *Expert judgment.* See same in *PMBOK® Guide.*

12.2.3 Outputs from Solicitation Planning

.1 *Procurement documents.* See same in *PMBOK® Guide*.

.2 *Evaluation criteria.* An agency can obtain best value in negotiated acquisitions by using any one or a combination of source selection approaches. In different types of acquisitions, the relative importance of cost or price may vary. For example, in acquisitions where the requirement is clearly definable and the risk of unsuccessful contract performance is minimal, cost or price may play a dominant role in source selection. The less definitive the requirement, the more development work required, or the greater the performance risk, the more technical or past performance considerations may play a dominant role in source selection.

Proposal evaluation is an assessment of the proposal and the offeror's ability to perform the prospective contract successfully. An agency shall evaluate competitive proposals and then assess their relative qualities solely on the factors and sub-factors specified in the solicitation. Evaluations may be conducted using any rating method or combination of methods, including color or adjectival ratings, numerical weights, and ordinal rankings. The relative strengths, deficiencies, significant weaknesses, and risks supporting proposal evaluation shall be documented in the contract file. Evaluations must include cost and price criteria and may include past performance, technical, and small business contracting criteria. The source selection authority (SSA) may reject all proposals received in response to a solicitation, if doing so is in the best interest of the Government.

.3 *Statement(s) of work updates.* See same in *PMBOK® Guide*.

12.3 Solicitation

Reference should be made to FAR – Subpart 15.2, and DFARS – Subpart 215.2, Solicitation and Receipt of Proposals and Information.

Inputs	Tools & Techniques	Outputs
.1 Procurement documents .2 Qualified seller lists	.1 Bidder conferences .2 Advertising **.3 Incentive strategies** **.4 Commercial item acquisition** **.5 Intellectual property**	.1 Proposals

12.3.1 Inputs to Solicitation

.1 *Procurement documents.* See same in *PMBOK® Guide*.

.2 *Qualified seller lists.* In general DoD does not restrict the marketplace by using qualified sellers lists. (See FAR 9.2 for restrictions on using these lists.) In order to encourage full and open competition, DoD buyers are required to advertise for sources in the Fed Biz web site (www.fedbizopps.gov) for each contract action expected to exceed $25,000.

12.3.2 Tools and Techniques for Solicitation

.1 *Bidder conferences*. Exchanges of information among all interested parties, from the earliest identification of a requirement through receipt of proposals, are encouraged. Any exchange of information must be consistent with procurement integrity requirements. Interested parties include potential offerors, end users, Government acquisition and supporting personnel, and others involved in the conduct or outcome of the acquisition.

The purpose of exchanging information is to improve the understanding of Government requirements and industry capabilities, thereby allowing potential offerors to judge whether or how they can satisfy the Government's requirements, and enhancing the Government's ability to obtain quality supplies and services, including construction, at reasonable prices, and increase efficiency in proposal preparation, proposal evaluation, negotiation, and contract award.

Agencies are encouraged to promote early exchanges of information about future acquisitions. An early exchange of information among industry and the PM, CO, and other participants in the acquisition process can identify and resolve concerns regarding the acquisition strategy, including proposed contract type, terms and conditions, and acquisition planning schedules; the feasibility of the requirement, including performance requirements, SOWs, and data requirements; the suitability of the proposal instructions and evaluation criteria, including the approach for assessing past performance information; the availability of reference documents; and any other industry concerns or questions. Some techniques to promote early exchanges of information are:

- Industry or small business conferences;
- Public hearings;
- Market research;
- One-on-one meetings with potential offerors;
- Pre-solicitation notices;
- Draft requests for proposals (RFPs);
- Requests for information (RFIs);
- Pre-solicitation or pre-proposal conferences;
- Site visits.

.2 *Advertising.* Effective 1 January 2002, DoD is posting all solicitations together with amendments, over $25,000, in the Government-wide point of entry site known as Fed Biz Opps (www.fedbizopps.gov). COs will post a synopsis and the solicitation package, so that interested suppliers do not have to contact the contracting activity for copies.

.3 ***Incentives strategies.*** The DoD recognizes that a mutual commitment by both industry and Government is required to create a cooperative atmosphere for information exchange. Information exchange feeds the joint development of the acquisition (procurement) business case, through which both Government and industry articulate their motivations, goals, barriers, and enablers. Once the relationship has been established and the business case clearly understood, incentives can be structured to motivate mutually desired behaviors and outcomes. A 40-page guidebook entitled *Incentive Strategies For Defense Acquisitions*, April 2001, is offered by the Office of the Under Secretary of Defense for Acquisition Reform (DUSD(AR)). This office was replaced by the Director, Defense Procurement and Acquisition Policy.

.4 ***Commercial item acquisition.*** Expanding the use of commercial items in DoD systems offers the DoD opportunities for reduced cycle time, faster insertion of new technology, lower life-cycle costs, greater reliability and availability, and support from a more robust industrial base. It is a fact that for many of the technologies that are critical to military systems, the commercial marketplace — and not the DoD — now drives the pace of innovation and development. The increasing priority on the use of commercial items in DoD systems is reflected in the DoD 5000 Series directives, which state that the use of commercial items in DoD systems is the preferred approach for meeting operational requirements.[2] Simply put, if the DoD intends to field state-of-the art systems in a cost-effective manner, then it must incorporate commercial items into these systems. A 25-page guidebook entitled *Commercial Item Acquisition: Considerations And Lessons Learned,* July 2000, is offered by the Office of the DUSD(AR).

.5 ***Intellectual property.*** The DoD acquisition community should consider certain core principles when dealing with industry intellectual property (IP). As used here, the term "IP" means patents, copyrights, trademarks, and trade secrets. The Government has promulgated policies and regulations on copyrights, patents, technical data, and computer software. In the Government's acquisition of IP license rights, it should consider certain principles highlighted below:

- Integrate IP considerations fully into acquisition strategies for advanced technologies in order to protect core DoD interest.
- Respect and protect privately developed IP because it is a valuable form of intangible property that is critical to the financial strength of a business.
- Resolve issues prior to award by clearly identifying and distinguishing the IP *deliverables* from the *license rights* in those deliverables.
- Negotiate specialized IP provisions whenever the customary deliverables or standard license rights do not adequately balance the interest of the contractor and the Government.
- Seek flexible and creative solutions to IP issues, focusing on acquiring only those deliverables and license rights necessary to accomplish the acquisition strategy.

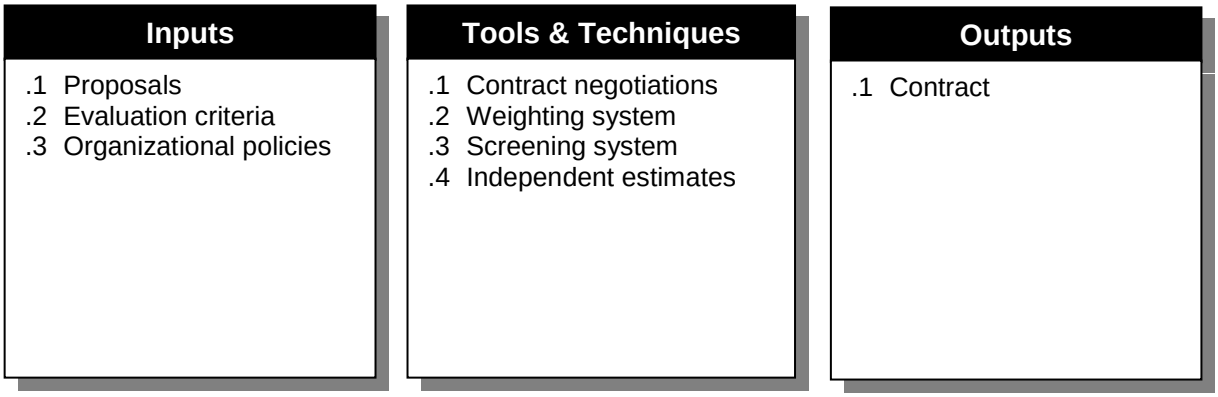
In this regard, a guidebook (about 90 pages) entitled *Intellectual Property: Navigating Through Commercial Waters,* April 2001, is offered by the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)).

12.3.3 Outputs from Solicitation

.1 *Proposals*. See same in *PMBOK® Guide.*

12.4 Source Selection

Reference should be made to FAR – Subpart 15.3, and DFARS – Subpart 215.3, Source Selection.



12.4.1 Inputs to Source Selection

.1 *Proposals.* See same in *PMBOK® Guide*.

.2 *Evaluation criteria.* See same in *PMBOK® Guide*.

.3 *Organizational policies.* Source selection policies are found in the FAR, the DFARS, and Service supplements. Additionally, most buying activities have developed handbooks that describe local procedures.

12.4.2 Tools and Techniques for Source Selection

.1 *Contract negotiations.* In a competitive source selection, the DoD's primary objectives are to award the contract to the offeror that best meets the Government's needs, and to provide an impartial and comprehensive evaluation of all proposals. This latter objective is consistent with the Federal standard of full and open competition.

A typical DoD organization for source selection has a designated Source Selection Authority (SSA), who is responsible for the process and makes the final selection decision. The SSA typically is supported by either one or two tiers of technical and business advisors. For the most complex procurements, the source selection organization includes a Source Selection Advisory Council (SSAC) and a Source Selection Evaluation Board (SSEB). The SSEB evaluates proposals against the requirements of the solicitation and provides a report to the SSAC who compares the proposals and briefs the SSA on its findings.

The source selection process usually involves the following steps:

- Initial evaluation of proposals and generation of issues for discussion;
- Establishment of a competitive range consisting of the most highly rated proposals that will still be considered for award;
- Discussions with all offerors in the competitive range;

- Cut off of discussions and submission of final proposal revisions;
- Final evaluation of proposals as amended;
- Selection of contractor(s) for award.

.2 *Weighting system.* DoD contracting officers are required to advise all prospective offerors of the evaluation factors and significant sub-factors and their relative importance. Offerors must also be informed of any minimum requirements that apply to the factors and sub-factors. All solicitations will use cost and price factors and will evaluate quality as measured by past performance, technical, or management factors, etc. DoD also requires the evaluation of the contractors' ability in past programs to meet small, small disadvantaged, and woman-owned small business subcontracting goals on most contracts over $500,000. Past performance shall be a factor in all competitively negotiated source selections over $1 million.

.3 *Screening system.* See same in *PMBOK® Guide.*

.4 *Independent estimates.* Within the DoD, the term "should cost" is a technique to determine what it should cost the offeror to produce, assuming reasonable economy and efficiency of operation. A should cost team conducts an in-depth cost analysis at the contractor's plant to identify uneconomical or inefficient practices, in order to develop a realistic price objective for negotiation purposes. This technique is generally applied in sole source situations.

12.4.3 Outputs from Source Selection

.1 *Contract.* A check and balance on the public contracting process permits interested parties to a DoD contract to protest solicitation provisions and contract award decisions to an administrative forum, the General Accounting Office (GAO) or to the Federal District Court or the Court of Federal Claims. The parties are also encouraged to use alternative dispute resolution (ADR) techniques as an inexpensive and expeditious means to resolve issues in controversy.

12.5 Contract Administration

Inputs	Tools & Techniques	Outputs
.1 Contract .2 Work results .3 Change requests .4 Seller invoices	.1 Contract change control system .2 Performance reporting .3 Payment system	.1 Correspondence .2 Control changes .3 Payment requests

12.5.1 Inputs to Contract Administration

.1 *Contract.* See same in *PMBOK® Guide*.

.2 *Work results*. See same in *PMBOK® Guide*.

.3 *Change requests.* In U.S. Federal procurement there are three clauses in the contract that provide the sovereign with superior rights generally not found in commercial contracts. These clauses are Changes, Disputes and Terminations. The Changes clause permits the DoD to unilaterally order changes for contractor compliance provided that such changes lie within the scope of the contract. While the contractor is entitled to an equitable adjustment in cost and schedule as a result of the changes, he/she must perform the changes upon receipt of the change order(s). The Disputes clause permits the Government CO to issue a final decision concerning issues in dispute between the parties. While the contractor may appeal the decision to an administrative or judicial forum, he must comply with the decision pending review to avoid breach of contract. The Terminations clause permits the Government to terminate the contract for its convenience, usually because the requirement has changed or the funding for the contract has been eliminated. While the contractor is entitled to payment for performance to date, he has no recourse to the courts to require continued performance of the contract absent arbitrary or capricious action on the part of Governmental agents.

.4 *Seller invoices.* See same in *PMBOK® Guide*.

12.5.2 Tools and Techniques for Contract Administration

.1 *Contract change control system.* See same in *PMBOK® Guide*.

.2 *Performance reporting.* DoD PMs typically use the Cost Performance Report (CPR), a monthly report from the contractor on program costs and schedules, and the quarterly Contract Funds Status Report to forecast funding requirements. These reports are part of the earned value management system used on major programs.

.3 *Payment system.* See same in *PMBOK® Guide*.

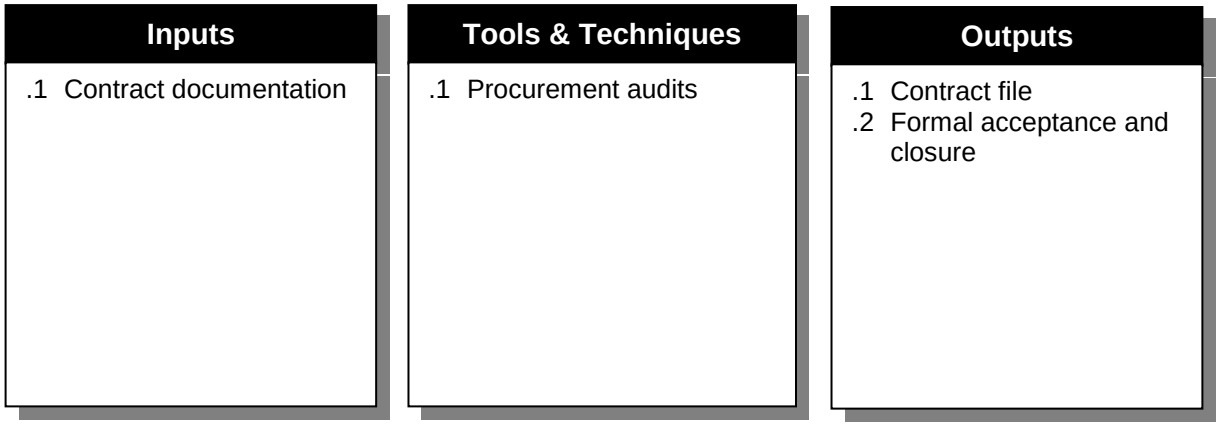
12.5.3 Outputs from Contract Administration

.1 *Correspondence.* See same in *PMBOK® Guide*.

.2 *Control changes.* See same in *PMBOK® Guide*.

.3 *Payment requests.* See same in *PMBOK® Guide*.

12.6 Contract Close-out



12.6.1 Inputs to Contract Close-out

.1 *Contract documentation.* See same in *PMBOK® Guide*.

12.6.2 Tools and Techniques for Contract Close-out

.1 *Procurement audits.* The Defense Contract Audit Agency (DCAA) is the Government agency authorized access to the contractor's financial records. For flexibly priced contracts DCAA provides audit support and advice to the Government CO.

12.6.3 Outputs from Contract Close-out

.1 *Contract file.* See same in *PMBOK® Guide*.

.2 *Formal acceptance and closure.* See same in *PMBOK® Guide*.

Endnotes

1. Deneault, Leslie S., LtCol, USAF (Ret). Defense Acquisition University; and Stambaugh, Bryan, Program Manager, United Defense L.P.
2. See the Preface to this *U.S. DoD Extension* to the *PMBOK® Guide.*

SECTION III

DEFENSE ACQUISITION KNOWLEDGE AREAS

13. Project Systems Engineering Management
14. Project Software Acquisition Management
15. Project Logistics Management
16. Project Test and Evaluation Management
17. Project Manufacturing Management

Chapter 13

Project Systems Engineering Management

Systems Engineering Management is the broad process by which the technical aspects of a program[1] are evaluated, managed, and controlled. By its nature, it embraces and includes all of the functional disciplines required to design, develop, test, produce, and support products in the defense environment. Systems engineering is an iterative, comprehensive technical management process. The process and its tools and techniques are widely recognized and accepted in defense and commercial program management standards and texts. For purposes of description, the topic has been divided into the general areas shown here, and each is discussed in terms of Inputs, Tools and Techniques, and Outputs:

13.1 **Systems Engineering Planning** – developing a roadmap to guide the engineering effort.

13.2 **Systems Engineering Activities** – the fundamental activities common to the system engineering process.

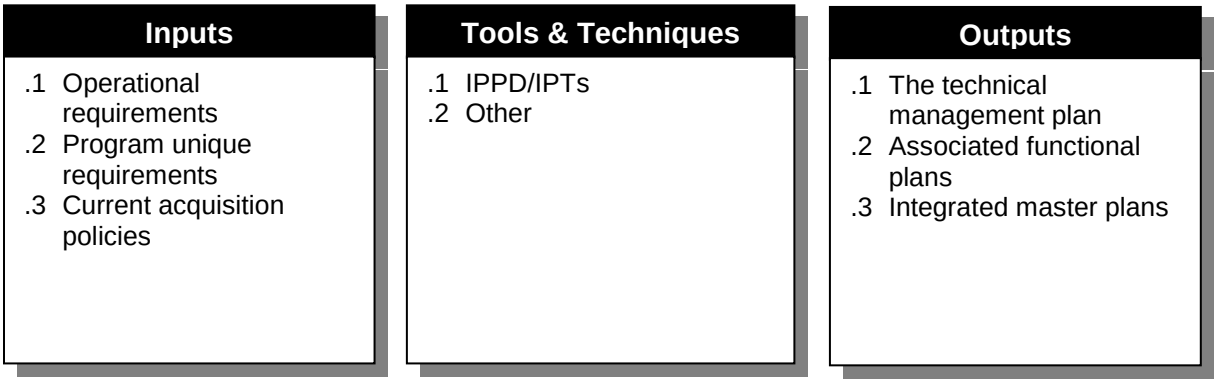
13.3 **Analysis and Control** – the tools and techniques used to control and manage the systems engineering process.

The activities comprised by the systems engineering process are repeated continually through the life cycle of the product. The output of each phase or level of development becomes the input for the next application of the process. While the focus of systems Engineering Activities gradually becomes increasingly detailed and technical in nature, the fundamental activities and the logical flow that starts with requirements analysis and results in synthesized designs, i.e., products, does not change.

13.1 Systems Engineering Planning

The development and distribution of plans is important as a means of assisting the PM to think through the specifics of the technical effort and identify risks. Further, plans are an effective means of communication between the Government program office, supporting Government activities, and contractors. It is important that detailed plans represent a tailored approach to the generalized models normal to systems engineering.

Most programs have unique requirements associated with mission performance, technical management, logistics support, and schedule. Plans for activities such as configuration management, technical reviews, and documentation should reflect these unique needs rather than adhere to generalized process models that tend to be all inclusive and general in nature.



13.1.1 Inputs to Systems Engineering Planning

.1 *Operational requirements.* The primary inputs to the systems engineering effort are the stated requirements of the user. Very early in the program, these may be stated in the form of Initial Capabilities Document (ICD), Concepts of Operation, or Scenarios. Later, as the program moves into development, the operational requirements will normally be stated in the Capability Development Document (CDD), which is updated during each phase of the program. One of the early tasks of systems engineering is to translate the operational requirements into system specifications, transcribing the operational requirements into technical performance, functional, and interface requirements that become the basis for the design of the system, its sub-systems, and the components that make up the sub-systems.

.2 *Program unique requirements.* In addition to the customer (operational) requirements, there may be an array of program unique requirements that are associated with the DoD stakeholders in the program. These include logistics support requirements, test requirements, or even constraints imposed by the political and oversight environment typical of defense programs. Furthermore, the nature of the program itself, its size, technical complexity, and perceived importance will influence program planning and management.

.3 *Current acquisition policies.* DoD system acquisition is regulated by the DoD 5000 Series of regulations. That series of regulations sets forth mandatory procedures and guidance for DoD defense program management. However, consistent with statutory requirements, these regulations provide some latitude to Milestone Decision Authorities (MDAs), allowing them to tailor procedures for specific situations.

13.1.2 Tools and Techniques for Systems Engineering Planning

.1 *IPPD/IPTs.* DoD has established Integrated Product and Process Development (IPPD) and the use of Integrated Product Teams (IPTs) as the preferred management approach for DoD programs. This approach continues a fundamental shift toward an emphasis on

integrated management practices in DoD, and both DoD program offices and DoD contractors continue to adjust to the change. From a planning perspective, an integrated approach brings multiple technical and business skills together early in the program to jointly prepare plans, striving to reflect the concerns of all stakeholders in the program. Thus multiple engineering specialties must be involved in the program planning process together with the user, producers, suppliers, testers, logisticians, and business specialists. The goal of the coordinated team effort is the generation of realistic plans and designs that will permit the achievement of cost, schedule, and performance objectives.

.2 *Other.* There are many other tools and techniques that can be employed in planning for the systems engineering effort. These are adequately described in other chapters of this document and include such diverse topics as scope, cost, human resources, and risk management. The program planning effort must include each of these elements to be complete, and the most efficient way to accomplish this objective is through the use of an integrated team approach.

13.1.3 Outputs from Systems Engineering Planning

.1 *The technical management plan.* A plan should be prepared by the Government that describes the management of the technical aspects of the program contemplated. The Government program office should initiate the planning process by describing the program and management at the top level, integrating the broad areas of concern that must be addressed to successfully manage the program to completion. Contractors should develop plans that describe in more detail the processes and techniques to be employed in order to manage their contractual aspects of the program. The combination of a broad, overarching Government technical management plan and a set of more detailed contractor plans comprises the program technical management plan.

.2 *Associated functional plans.* The technical management plan represents the broad technical management strategy for the program. In most cases, there will be a need for more detailed plans for certain specific functional areas, e.g., test or manufacturing. Where such additional planning detail is required, these should be developed as annexes to the technical management plan and they should be integrated in the sense that there is consistency among and between the multiple technical plans.

.3 *Integrated master plans.* Increasingly, DoD program offices are turning to integrated plans that are not specialized to specific areas, such as engineering, finance, or logistics support. Rather, these offices are developing plans that integrate all of these areas into a single plan that acknowledges the linkage of these diverse specialties. The specialty plans may be developed as annexes to the overarching integrated plan, but there must also be an integrating planning function that is responsible for resolving the conflicts natural to integrated planning.

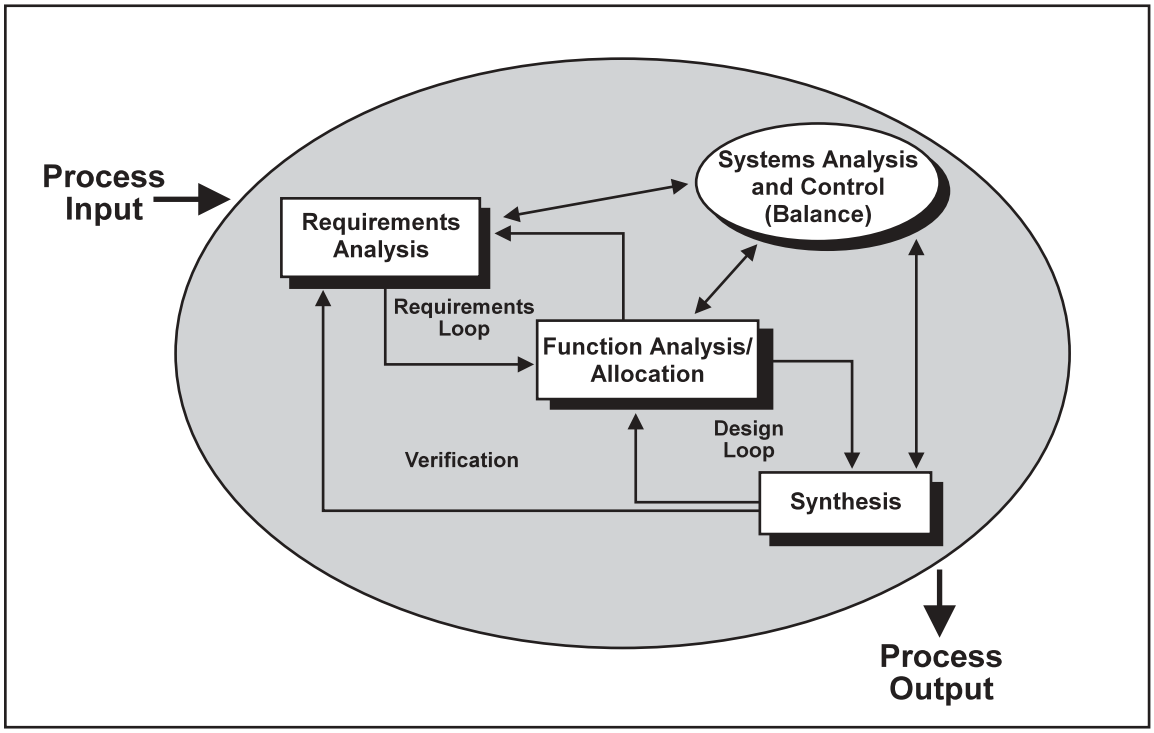


Figure 13-1. The Systems Engineering Process

13.2 Systems Engineering Activities

The systems engineering process model used in DoD, Figure 13-1, is widely recognized and accepted. The process is described in current DoD regulations, and also appears in similar or identical form in numerous texts on the subject. The model consists of two fundamental parts:

- The sequence of Systems Engineering Activities, based on customer needs, which transform requirements into designs and products;
- The associated activities employed to manage and control the transformation process through the evolution of the design from concept to finished product.

This section (13.2) deals with the former, the activities involved in the transformation of requirements into designs and products.

Inputs	Tools & Techniques	Outputs
.1 Requirements .2 Other constraints	.1 Requirements analysis .2 Functional analysis and allocation .3 Synthesis	.1 Functional architecture .2 Physical architecture .3 Documentation

13.2.1 Inputs to Systems Engineering Activities

.1 *Requirements.* DoD requirements may come from the organization representing the eventual operator (in DoD parlance, the “user“ or “warfighter”), or they may come from functional or program-unique sources. The system-level requirements are typically documented in an CDD. DoD policy states that the requirements must detail the required performance, and not specify product or process design requirements. Specifically, requirements should address the following:

- Functions the product must accomplish;
- Required performance associated with the functions;
- Interfaces involved (what environment, in what combinations);
- Physical or other constraints that must be observed.

Requirements written in performance terms will provide the designer an opportunity to employ alternative approaches to meet Government needs. The Government can then choose the approach that appears to provide the best combination of cost, risk, and performance.

.2 *Other constraints.* Additional inputs can be introduced into the development process beyond those specific to the product requirements. These include technology maturity, legislative requirements, and current DoD policies and guidance (such as the requirement to design open systems architectures). Other possible constraints may take the form of compliance with the Joint Technical Architecture (JTA) and the DoD Common Operating Environment (COE). The PM must ensure that these overarching requirements are integrated into the planning and design processes.

13.2.2 Tools and Techniques for Systems Engineering

.1 *Requirements analysis.* Requirements may be stated explicitly or they may be derived from known requirements. The fundamental task during requirements analysis is to identify the functions, performance, interface requirements, and any physical or other design constraints. The objective during this portion of the systems engineering process is to develop as complete and unambiguous an understanding of the user’s needs as possible. Requirements analysis is necessarily conducted in an iterative manner with Functional Analysis, as depicted in Figure 13-1. As the process of defining the system proceeds, typically questions will be raised that demand further requirements definition by the user. The final set of system-level requirements, expressed in technical terms, is documented in the System Specification.

.2 *Functional analysis and allocation.* Functional analysis involves the decomposition of the top-level functions identified during requirements analysis into lower-level functions and the allocation of performance requirements to these lower-level functions, and optimizing the functional architecture. Typically, functional analysis includes time-line analyses and the construction of functional flow block diagrams that describe the logical sequence of functions, interdependencies, and inputs and outputs, e.g., information flows. It is through functional analysis that design specifications are developed for items below

system level. In addition, functional analysis is a key tool for identifying areas of technical risk and making appropriate decisions to control that risk.

.3 *Synthesis.* Synthesis is the process of developing physical design solutions to perform the functions identified during functional analysis. As requirements are allocated to different portions of the system, physical elements are identified that the designer believes will perform the functions required within the performance, interface, and other constraints (e.g., cost) required. As each design decision is made, the functional, performance, and interface requirements are revisited formally to verify that the solution conforms to the required parameters. Synthesis is also an iterative activity. As the functional description evolves, the physical design solution can be extended to lower levels, leading ultimately to a complete top-down design solution.

13.2.3 Outputs from Systems Engineering Activities

.1 *Functional architecture.* The functional architecture is a description of an item or system in functional terms. It is the product of Functional Analysis and Allocation (FAA), described in the previous section. It consists of the complete array of functional flow block diagrams, data flow diagrams, time-line analyses, etc. that describe how the system will function, what performance levels are anticipated, and where functional interfaces must be considered. Through consideration of alternative Functional Architectures, the designer can determine whether or not requirements can be met, where new development is likely to be required, and also where requirements can be met by non-developmental or commercial elements.

.2 *Physical architecture.* The physical architecture refers to the description of the item or system in terms of the physical elements and components that together make up the item. The definition of the physical architecture is a top-down process; lower level elements are successively defined until system design is complete. The validation that design is complete and the system is ready to be fabricated typically takes place at the Critical Design Review (CDR). Fabrication, development, integration, and test of the physical components then follows. This is a bottom-up process, culminating in system level verification and test prior to beginning rate production.

.3 *Documentation.* The eventual products of requirements analysis include both the refined CDD and the final System Specification. In addition to the documents referred to above, the primary documents associated with functional analysis and allocation are the Item Specifications, which describe the design requirements for the items that together define the system under development. The physical architecture is documented in a complex array of documents that include (but are not limited to) product and interface drawings, software code lists, and parts lists. The combination of these documents and others that describe the system, such as the System Specification and the Item Specifications, comprise what is generally referred to as the Technical Data Package (TDP) — the complete functional and physical description of the item developed.

13.3 Analysis and Control

Analysis and control refers to the set of tools and techniques employed to evaluate, manage, and control the Systems Engineering Activities described earlier that transform requirements into designs and products. The systems engineering process is repeated

multiple times during the course of design and development. With each repetition, the design or product matures. Initially a concept is developed. From that point a system design is evolved, and then a detailed design. Following design, components and subassemblies are fabricated. Then they are integrated into sub-systems and finally integrated into a system. Concurrently, the supporting processes, such as training, test and evaluation, manufacturing, and logistics are planned, designed, developed, and initiated as appropriate. A mix of engineering management tools are employed to ensure that alternatives are considered, risk is managed, product definitions are controlled, and technical maturity is appropriate to the stage of development. These tools are an integral part of the systems engineering process and are the subject of this section (13.3) on analysis and control.

13.3.1 Inputs to Analysis and Control

.1 *Systems engineering process activities.* As described in earlier sections, the sequence of Systems Engineering Activities — requirements analysis, functional analysis and allocation, and synthesis — form the engine that transforms operational requirements into designs and systems that meet user needs. These activities are repeated through the development process, but the outputs from this transformation engine change as the design, or the product, matures. As this design evolution progresses, analysis and control tools are employed to manage the process and to ensure that the eventual product satisfies the original requirements upon which it is based. Alternatives are considered through trade studies; product descriptions are documented through configuration management; risk is managed (Risk Management is addressed separately in Chapter 11, Section II of this document), while key technical parameters are tracked using technical performance measures; and evaluations of technical maturity are undertaken through technical reviews.

13.3.2 Tools and Techniques for Analysis and Control

.1 *Trade studies.* Systems engineering is characterized by the establishment of alternative approaches to solve technical problems and the subsequent selection of preferred solutions based on measurement against a set of well-defined criteria. This process of evaluating alternatives is referred to as trade studies (or trades or trade-off studies). The process is a classic problem-solving approach applied to technical situations. Formal trade studies require the selection of decision criteria, analyses of the alternatives against selected criteria, sensitivity analyses to examine underlying influences on

outcomes, definition of risks involved, followed by selection of a preferred approach. Disciplined trade studies permit a variety of investigations that include the evaluation of performance, cost, and system effectiveness as factors that can be traded to achieve optimum system architectures, where the optimum is defined by the decision criteria established.

.2 *Configuration management.* Configuration management refers to the process of documenting the description of the functional, performance, interface, and physical characteristics of a system and then maintaining the descriptive information in current form as changes are made. A disciplined configuration management process will provide accurate information about the product as it is designed, developed, manufactured, and supported through its life cycle. The configuration management process is composed of a number of underlying activities: 1) identifying and documenting the item to be managed, 2) managing changes of configuration, 3) maintaining status records to reflect current configurations, 4) auditing products to ensure that the documented descriptions and the products are consistent each with the other, and 5) managing the data associated with configuration management.

.3 *Technical performance measures.* Technical performance measures (TPM) refer to the set of technical parameters that managers choose to track as systems progress through the design and development process. Parameters to be tracked are selected based on cost, risk, or the determination that the parameter will be a key indicator of future system success. They serve as the metrics by which technical progress is measured and evaluated. Actual versus planned values of the parameters are tracked over time, and judgments are made by managers as to the extent to which deviation from plan is acceptable or not. Figure 13-2 depicts an example of a planned value and its related tolerance band over time.

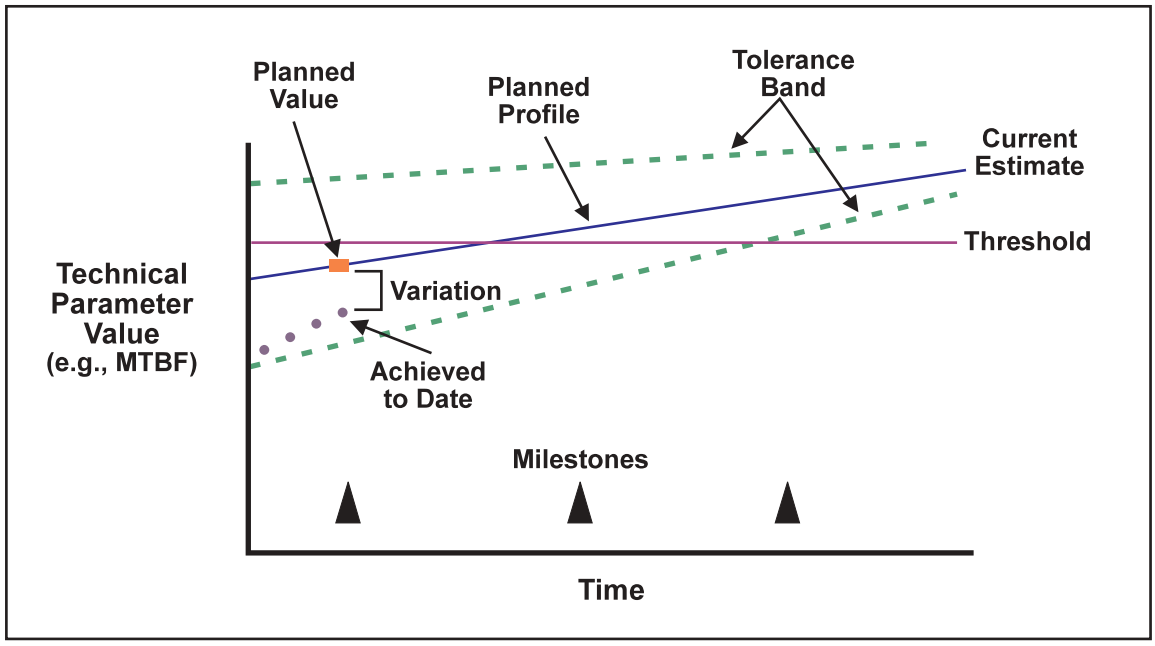


Figure 13-2. Technical Performance Tracking Chart

.4 *Technical reviews.* Technical reviews serve to assess the technical progress of a program through design and development. Reviews may be conducted at the system level, or at the level of a configuration item, or even lower levels in the system. In general, reviews are timed to coincide with a program transition point. The review strives to verify a prescribed level of product development. A positive review generally leads to a recommendation to continue the development into the next phase. In an integrated product and process environment, technical reviews take on a collaborative tone, more so than might otherwise be the case, since both Government and contractor personnel are working together in product development teams. The focus of any particular review is dependent on the stage of development of the product under review. Reviews held too early because of schedule pressures can result in high risk situations where decisions are prematurely made based on a level of assumed maturity that may not actually exist.

.5 *Risk management.* Risk management is discussed in Chapter 11 of this document. In systems engineering, risk management is used to determine which technical areas need added emphasis and oversight, where configuration control must be emphasized, what type of contracting strategy to employ, what tests need to be run, and what types and numbers of technical personnel are required.

13.3.3 Outputs from Analysis and Control

The fundamental product of the systems-engineering analysis and control activities is a design that meets the needs of the user and is producible and supportable at acceptable levels of cost and risk. Use of the analysis and control tools guides the design and development process through its succession of stages to attain the desired end-state. The design is documented as it progresses from stage to stage by means of intermediate and final specifications and baselines that describe the functional, performance, and physical attributes of the product.

.1 *Specifications.* Two fundamental types of specifications are entailed in product development, performance specifications and detail specifications. Performance specifications describe a product in performance terms. As such, they contain functional, performance, and interface descriptions and do not specify how to achieve the required performance. On the other hand, detail specifications describe a solution and generally include both the product and the process and materials used to build it. Systems engineering involves a series of translations that are documented in the program-unique specifications that describe the product under development. The first translation occurs when the operational requirements contained in the CDD are developed into technical language that describes the system level requirements. The output is the System Performance Specification. The system-level requirements are then allocated to the major items below system level, thereby establishing design requirements for each of those items. The associated requirements are documented in a series of Item Performance Specifications. The items are then designed, developed, and fabricated. The description of the item as it is physically produced is documented in the Item Detail Specification, which generally refers to the drawings, lists, code, etc. that make up the system. In areas where unique processes are employed or specific materials are involved, the producer may also develop both Process and Materials Specifications. The combination of specifications and other documents that describe the complete system are referred to as the Technical Data Package (TDP).

.2 *Baselines.* Associated with the specifications described above, there are normally a series of configuration management baselines defined. In DoD, configurations are normally managed through the definition of three baselines: 1) the system functional baseline, which describes system level requirements; 2) the allocated baseline, which describes design requirements for items below system level; and 3) the product baseline, which describes the product as it is produced. The functional baseline and the allocated baseline can be thought of as requirements baselines. They are normally elaborated in terms of function, performance, and interfaces. The product baseline, however, is a complete description of the system as produced, and includes performance, functional, and physical information. In program management, a primary issue is the decision regarding which baselines the Government should control and when Government control should be established. The decision will rest upon such issues as the support philosophy attending the system and possible re-procurement plans. There is no single approach that typifies every situation.

Endnotes

1. Throughout Chapter 13 – as in previous chapters – the terms *program* and *program management* are used when referring to a DoD acquisition program and its associated project management activities. See the Preface to this *U.S. DoD Extension* to the *PMBOK® Guide.*

Chapter 14

Project Software Acquisition Management

DoD Project Software Acquisition Management (SAM) is the process of managing the acquisition and development of software-intensive DoD systems from the *acquirer's* viewpoint.
The overall SAM process can be structured as follows:

14.1 SAM Activities — the planning and execution of the software acquisition process.

DoD software-intensive systems are those for which software is the largest segment of the system development cost, development risk, functionality, or development time. Such systems are complex and must satisfy a wide spectrum of user requirements gleaned from diverse user communities.

DoD software-intensive systems can be broken into the following three broadly generic categories: 1) Automated Information Systems (AIS) — which include classic Information Technology (IT) and Management Information Systems (MIS) for which *privacy* is typically a critical requirement; 2) Command, Control, Communications, Computers, and Intelligence Systems (C4I) — those systems that assist mission planners and combat commanders in mission planning, control, deployment, and employment of military forces for which *security* is typically a critical requirement; and 3) Weapons Computing Systems — those embedded computer systems that are typically high-performance, real-time systems designed as an integral part of a larger weapons system, and used by the U.S. Armed Forces for combat missions for which *safety* is typically a critical requirement.

However, because of various legal reporting and registration requirements embodied in the Clinger-Cohen Act (CCA), and subsequent legislation, very specific definitions of various types of software-intensive systems are included in various DoD policy-level documents. Depending on the specific nature of a system as defined below, differing system registration and other programmatic requirements, including review by the DoD Chief Information Officer (CIO) are levied on the system. These formal definitions (extracted from the DoD 5000 Series) include:

- **Automated Information System (AIS)**. An acquisition program that acquires IT, except IT that involves equipment that is an integral part of a weapon or weapons system or is a tactical communication system.

- **National Security System (NSS)**. Defined in the CCA, an NSS is any telecommunications or information system operated by the U.S. Government, the function, operation, or use of which involves intelligence activities, or involves cryptologic activities related to national security, or involves command and control of military forces, or involves equipment that is an integral part of a weapon or weapons system, or is critical to the direct fulfillment of military or intelligence missions. NSSs do not include systems that are to be used for routine administrative and business applications (including payroll, finance, logistics, and personnel management applications).

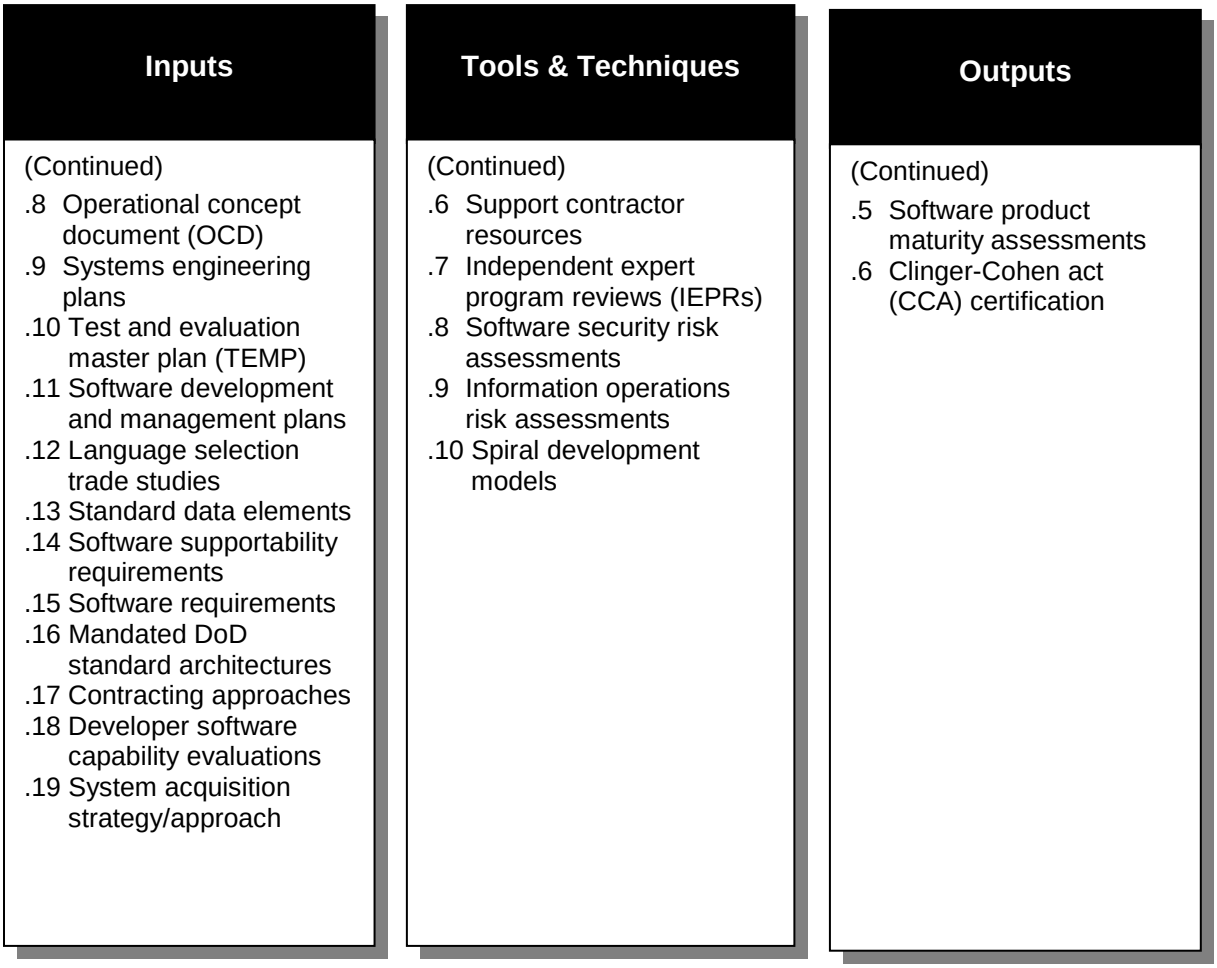
- **Information Technology (IT)**. Defined in the CCA, IT is any equipment, or interconnected system or sub-system of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. The term IT includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources. The term IT also includes NSSs but does not include any equipment that is acquired by a Federal contractor incidental to a Federal contract.

- **Mission Critical Information System**. A system that meets the definitions of "information system" and "national security system" in the CCA, the loss of which would cause the stoppage of warfighter operations or direct mission support of warfighter operations

- **Mission Essential Information System**. A system that meets the definition of "information system" in the CCA, that the acquiring Component Head or designee determines is basic and necessary for the accomplishment of the organizational mission.

14.1 SAM Activities

Inputs	Tools & Techniques	Outputs
.1 Legal compliance verification and certifications - CCA .2 Information operations risk assessment .3 Interoperability global information grid (GIG) compliance .4 C4I support plan .5 Information assurance requirements .6 Capability development document (CDD) .7 System/Subsystem specification (SSS)	.1 Software development maturity assessments .2 Software acquisition maturity assessments .3 Software measures .4 Life-cycle standards tailoring .5 Defense software reuse repositories	.1 Various management, support, and fielding plans .2 Software Items (SIs) .3 New data elements .4 Reusable software components



14.1.1 Inputs to SAM Activities

.1 *Legal compliance verification and certifications - CCA.* Such verifications and formal CIO certifications are undertaken in accordance with Title 40 U.S.C. § 1401, P.L. 106-259 and P.L. 106-398 to ensure compliance, prior to contract award and initiation of system development, with various legal requirements, such as the CCA, that apply to IT systems within the Federal Government, as well as for so-called NSSs. Additionally, certain mission-critical and mission-essential information systems as defined above must be formally registered in the DoD IT Registry system.

.2 *Information operations risk assessment.* Performed on appropriate systems as detailed in DoDD S-3600.1 (*Information Operations*). Required for all software-intensive systems.

.3 *Interoperability global information grid (GIG).* Compatibility, interoperability, and integration are key goals that must be specified and validated during the requirements generation process. Specific details are outlined in DoDD 4630.5, (*Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems*); DoDI 4630.8, (*Procedures for Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems*); and CJCS Instruction 6212.01B, (*Interoperability and Supportability on National Security*

Systems, and Information Technology Systems). Additionally, the Operational Capabilities Development Document (CDD), a user requirements document, typically specifies interoperability as a Key Performance Parameter (KPP). Finally, systems must be compliant with the GIG architecture, a collection of standards-based requirements.

.4 *C4I support plan.* A C4I Support Plan (C4ISP) is required for all DoD acquisition programs that "connect in any way to the communications and information infrastructure." The C4ISP is an evolutionary document assessed at each milestone review and includes systems description, identification of system IT components, employment concepts, direct and derived support requirements, information assurance needs, interoperability and connectivity characteristics, projected system shortfalls, and management and scheduling concerns. Additionally, the C4ISP explicitly identifies Information Exchange Requirements (IERs) using a variety of highly-formatted operational systems and technical architecture "views."

.5 *Information assurance requirements*. Information assurance requirements must be included as part of the system design activities to ensure availability, integrity, authentication, confidentiality, and non-repudiation of critical program technology and information. Additionally PMs are required to provide for the survivability of information systems by incorporating protection, detection, reaction, and reconstitution capabilities into the system design. Formal certification of information assurance criteria is required.

.6 *Capability development document (CDD).* The CDD is a key top-level user requirements document containing performance and related operational parameters for the proposed concept or system. It is prepared by the operational user (the "user") and is updated at each program milestone. Portions of the CDD are pertinent as high-level requirement inputs relevant to the development of software-intensive systems. They include sections documenting C4I integration requirements, computer resource constraints, computer resource unique needs, computer resource support requirements, IERs, and special software certification requirements. Additionally, CDDs are typically vetted against various system architectures to ensure they are compliant in various domain-specific areas.

.7 System/Subsystem specification (SSS). The SSS (or an equivalent Systems Requirement Specification) specifies top-level requirements for a system or sub-system and the methods to be used to ensure that each requirement has been met. In addition to being the definitive listing of systems-level requirements, in commonly used DoD configuration management approaches, the SSS or its equivalent typically establishes the functional baseline for the system and is part of the development contract.

While the format may vary, sections of a typical SSS affecting SAM activities include:

- Specification of software safety, security, and privacy requirements;
- Computer resource requirements;
- Computer resource utilization thresholds;
- Mandatory software requirements;
- Computer communications requirements; and

- Systems/software quality factors.

.8 *Operational concept document (OCD).* An OCD (format varies widely) may be used by the PMO in conjunction with the user community to obtain consensus among the acquirer, developer, the support agency, and the user regarding the operational concept of a proposed system. Specific sections of the OCD relevant to SAM activities include guidance on initial software support requirements, data sources, and timing requirements.

.9 *Systems engineering plans*. A variety of Government-prepared plans outlining systems development and programmatic activities are typically prepared prior to development. These plans typically include top-level schedules and guidance for subspecialty management, including software acquisition and development activities. Greater detail is provided in Chapter 13, Project Systems Engineering Management.

.10 *Test and evaluation master plan (TEMP).* The TEMP is a DoD systems-level plan for certain categories of DoD acquisition programs. Sections of the TEMP include requirements that can impact SAM activities, such as identification of test articles (specifically software modules), identification of computer-driven simulation models, hardware/software-in-the-loop test-beds, and specification of software maturity criteria. Greater detail is provided in Chapter 16, Project Test and Evaluation Project Management.

.11 *Software development and management plans*. Typically, a Software Development Plan (SDP) or an equivalent management plan has been used in DoD acquisition programs by developers to formally document their plans for the software development. Prepared by the developer, SDPs typically address:

- The development process to be used;
- Standards for products;
- Reusable software;
- The handling of critical requirements (safety, security, and privacy assurance);
- Computer hardware resource utilization and allocation;
- Provisions for acquirer access during development;
- Program planning and oversight;
- Software testing;
- Joint technical and management reviews;
- Schedules;
- Activity networks; and

- Program organization and resources.

Other plans, depending on the life cycle management standard being used (e.g., J-STD-016 or IEEE/EIQ 12207) may be placed upon the developer by contract in the form of such items as a Software Test Plan (STP), a Software Quality Assurance Plan (SQAP), and/or a Software Safety Plan (SSP), among other developer-prepared plans.

A key acquirer-prepared plan that, while not required by DoD policy, is encouraged at the Service level, is a Computer Resources Life Cycle Management Plan (CRLCMP). Format of the CRLCMP varies widely, but it typically includes identification of major computer resource acquisition management and support risks, identification of critical issues, metrics and measures.

.12 *Language selection trade studies*. Current regulations require the developer to perform a software engineering analysis to determine the most appropriate programming language for the program at hand.[1]

.13 *Standard data elements*. Data Administration policies require the use of standard data elements from the DoD Defense Data Repository System (DDRS) (described in DoD Directive 8320.1 (DoD Data Administration)) wherever possible on all new programs.

.14 *Software supportability requirements*. Prior to initiation of development activities, an assessment of software supportability requirements should be made. The assessment should include the software support and maintenance concept(s) (e.g., in-house, or contractor maintenance, funding, and the role of the designated DoD life-cycle software support center). Part of the assessment should include constraints on development tools, delineation of Computer Aided Software Engineering (CASE) environments, and specialized software support transition needs. These types of assessments may be formally documented in a Service-specific CRLCMP (see § 14.1.11) or its equivalent.

.15 *Software requirements.* Based on the SSS, the development methodology, and life-cycle standards being employed, a definitive listing of software requirements, including derived requirements, traceability and verification matrices for a given Software Item (SI), is determined as part of the Software Requirements Analysis (SRA) phase of development. These key requirements can be documented in a variety of formats (typically in a Software Requirements Specification or its equivalent) and usually make up the allocated baseline for a particular SI.

.16 *Mandated DoD standard architectures.* Open Systems Architectures are required wherever cost-effective on DoD projects. The DoD open-systems standards profile is specified in the Joint Technical Architecture (JTA), a document that encompasses various technical standards appropriate for use in DoD software-intensive systems. Unless shown not to be cost-effective, implementation of the JTA is required for all new or changes to existing IT systems, including National Security Systems (NSS). Various domain-specific Joint Operational Architectures (JOAs) and Joint System Architectures (JSAs) are in various stages of development and may be mandated as well. Other aspects of operational and systems architectures are required on DoD programs as well, i.e., compliance with the methodologies and documentation standards as found in the DoD's C4ISR[2] Architectural Framework (an overarching strategic methodology used to create comparable and integratable architectures for DoD systems).

.17 *Contracting approaches*. So-called "modular contracting" is strongly encouraged by the CCA. It can be used for acquiring some categories of DoD software-intensive systems. This approach includes two major features: 1) It requires contract award within 180 days after a solicitation is issued; and 2) it requires delivery of functionality at relatively short (18-month) intervals. Modular contracting requires partitioning of the system-level and software requirements in conjunction with an appropriately chosen architecture to support incremental development, integration, and testing.

.18 *Developer software capability evaluations.* Contractor selection criteria for work on DoD software-intensive systems include those with: 1) domain experience in developing comparable software systems; 2) successful past performance; and 3) a mature software development capability and process. For the latter criterion, contractors must undergo an evaluation and achieve, as a minimum, "full compliance with the Software Engineering Institute (SEI) Capability Maturity Model Level 3, or its equivalent in an approved evaluation tool."[3]

.19 *System acquisition strategy/approach*. All DoD systems are required to prepare a highly-formatted Acquisition Strategy, which guides program execution from initiation through post-production support. One key component of the Acquisition Strategy is the "Acquisition Approach," which identifies the approach the program will use to achieve full capability. Acquisition approaches can include a variety of Evolutionary Acquisition methodologies or a single step approach (i.e., a Grand Design or Once-Through strategy). The selected acquisition approach in turn influences the later structuring of software into various builds, the choice of software development paradigm, and possibly the tailoring of software development standards.

14.1.2 Tools and Techniques for SAM Activities

.1 *Software development maturity assessments*. An assessment of a developer's process maturity level is performed for many DoD software-intensive systems. A commonly used technique is the Software Capability Evaluation (SCE). The SCE is based on the Software Engineering Institute's (SEI) Software Capability Maturity Model[SM] (SW-CMM[SM]). It is a methodology that can be used by the DoD both as part of the contract selection process to evaluate the fidelity of the software processes used by the bidder, and during development to assess specific development risks of a developer under contract.

.2 *Software acquisition maturity assessments.* This is a capability-based methodology that can be used by DoD acquisition organizations to evaluate, assess, and improve their own internal software acquisition processes. One approach that has undergone field trials is SEI's Software Acquisition Capability Maturity Model[SM] (SA-CMM[SM]). Structured into five levels, this model can assess the maturity of the software acquisition processes employed by the Project Management Office.

.3 *Software measures*. DoD program offices should use a variety of software management metrics and quality metrics to assess progress against plan and quality levels of software products. The choice of specific metrics is in part driven by an assessment of a program's risk level and relevant management issues. Recommended selection methodologies and typical measures are documented in publications and tools generated by the DoD's Practical Software and Systems Measurement (PSSM) initiative.

.4 *Life-cycle standards tailoring*. A variety of commercial life-cycle development and documentation standards (e.g., J-STD-016 or IEEE/EIA 12207.X) can be employed by a developer for DoD SAM activities. Whatever standards and life-cycle models are selected by the software developer, they should be subjected to a collaborative, risk-driven tailoring effort as appropriate performed by the acquirer and the developer. The initial tailoring effort, driven in part by the system-level acquisition strategy, should be accomplished early in the program, with subsequent refinements over the life of the program.

.5 *Defense software reuse repositories*. The Common Operating Environment (COE) is a JTA-compliant reuse repository. The developer should make use of any appropriate software from these sources that can be used on specific programs to reduce system life-cycle cost.

.6 *Support contractor resources*. Within the DoD, acquisition program offices are typically supplemented by a variety of support contractors such as Service firms, systems engineering and technical assistance (SETA) contractors, and independent verification and validation (IV&V) contractors. This technique is often used for SAM activities in order to supplement technical knowledge and provide special expertise, periodic assessments, and management support. In many cases, such support is critical to success.

.7 *Independent expert program reviews (IEPRs).* All software-intensive systems are strongly encouraged by DoD and Service regulations to employ an independent expert review team consisting of a small group of DoD software systems engineering and technology experts. Typically implemented not later than the Critical Design Review (CDR), the team assesses technology and development risk, cost, schedule, design, development, project management process, and application of systems and software engineering best practices. Results are reported directly to the PM.

.8 *Software security risk assessments*. All modifications to DoD software require a documented impact analysis statement that addresses software reliability. Formal software change control procedures are required to be established by the PM. Additionally, an analysis for malicious code is required of all coding to include COTS products manufactured in foreign environment or by foreign nationals.

.9 *Information operations risk assessments*. For each information system development, PMs are required to conduct a risk assessment based on system criticality, threat, and vulnerability, and to incorporate appropriate countermeasures and demonstrate the effectiveness of these through certification testing conducted as part of development test and evaluation (DT&E). If appropriate, a responsible designated approving authority (DAA) must accredit the system prior to its use. Additionally, Critical Program Information (CPI) must be identified and an appropriate program protection plan developed to prevent compromise of leading edge classified technologies and sensitive data or systems. Techniques for the latter may include encryption, packing or bundling, and other anti-tamper techniques.

.10 *Spiral development models*. When acquiring software for a DoD system, a spiral development process that is cyclical, iterative and employs an iterative build-test-fix-test-deploy process should be used. Such a spiral approach facilitates requirements changes, incorporates continuous T&E and implements configuration and data man-

agement at appropriate levels. Spiral development is a key approach to an evolutionary development strategy.

14.1.3 Outputs from SAM Activities

.1 *Various management, support and fielding plans*. Depending on the category of software-intensive systems being acquired, the life cycle standard being employed, and the acquirer's fielding and support strategy, a variety of plans can be generated as an output of the software development process. Examples of the latter include the *Software Transition Plan*, a description of the plans for transitioning deliverable items to the designated software support agency; and a *Software Installation Plan,* a plan for installing software at user sites, including preparation, user training, and conversion from existing systems.

.2 *Software items (SIs).* The software portions of DoD software-intensive systems are typically acquired, developed, tested, and qualified on a *Software Item* or SI basis. SIs may be qualified via a series of formal qualification tests typically witnessed by the acquirer prior to the integration of the SI into a larger system. The software is typically documented in a product baseline document, the *Software Product Specification,* which references the executable software, source files, and support information for a given SI.

.3 *New data elements*. Development may result in creation of new data elements that are added to those defined in the Defense Data Repository System (DDRS) and become DoD standards.

.4 *Reusable software components*. Development activities may result in the creation of reusable software modules or data sets that can be added to those in the COE, subject to appropriate certification. Such contributions make these items available for DoD-wide reuse, thereby offering DoD a future cost-saving potential.

.5 *Software product maturity assessments.* A series of higher-order tests, such as Developmental and Operational Testing,[4] is performed on software-intensive systems. Prior to the initiation of such testing, the acquirer must certify that the developed software has demonstrated its maturity and is deemed ready to undergo such higher-order tests.

.6 *Clinger-Cohen act (CCA) certification*. For those DoD systems defined as "mission-critical or mission-essential IT system(s)" [see formal definitions of these at the beginning of this chapter], no deployment can occur until the appropriate CIO confirms in writing that the system has been developed in accordance with the CCA.

Endnotes

1. This requirement supercedes a prior DoD mandate that directed the use of the standard programming language, Ada, for all software-intensive systems for which the DoD was responsible for life-cycle support. Trade studies are now used to determine the most effective language for the domain under consideration.
2. Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR).
3. The most common model used is the Software Capability Maturity Model^{SM} (SW-CMM^{SM}), developed by the DoD's Software Engineering Institute (SEI). The SW-CMM^{SM} assesses an organization's software development process maturity on a scale from 1 to 5, with 1 indicating an organization with *ad hoc* processes while Level 5 represents a world-class software development organization with well-defined, measured, and optimizing processes in place. A Level 3 organization under the SW-CMM^{SM} scale is one with well-defined processes in place that are being followed. There is typically a direct correlation between software quality and cost/schedule estimation fidelity with SW-CMM^{SM} levels. The SW-CMM^{SM} is gradually being replaced by an integrated model called the CMMI.
4. The subject of DoD Project T&E management is addressed in Chapter 16 of this document.

Chapter 15

Project Logistics Management

Project Logistics Management (See Figure 15-1) embraces all the concerns associated with the material support of a DoD system throughout its entire life cycle. There are two overlapping phases of logistics: Acquisition Logistics and Sustainment Logistics. Acquisition Logistics addresses the technical and management activities conducted to ensure that supportability implications are considered up front and early as well as throughout the acquisition process to minimize support costs and to provide the user with the resources to sustain the system in the field. Sustainment Logistics relies on the support infrastructure from Acquisition Logistics efforts and begins when the system is fielded to the user and ends with the final system disposal. Many of today's fielded systems are being maintained beyond their planned life expectancy and therefore are in a continuous cycle of upgrade and modification. This requires the Acquisition Logistics process to run concurrently with the ongoing Sustainment Logistics efforts.

15.1 Logistics Management – those areas of logistics management relating to DoD acquisition activities and sustainment.

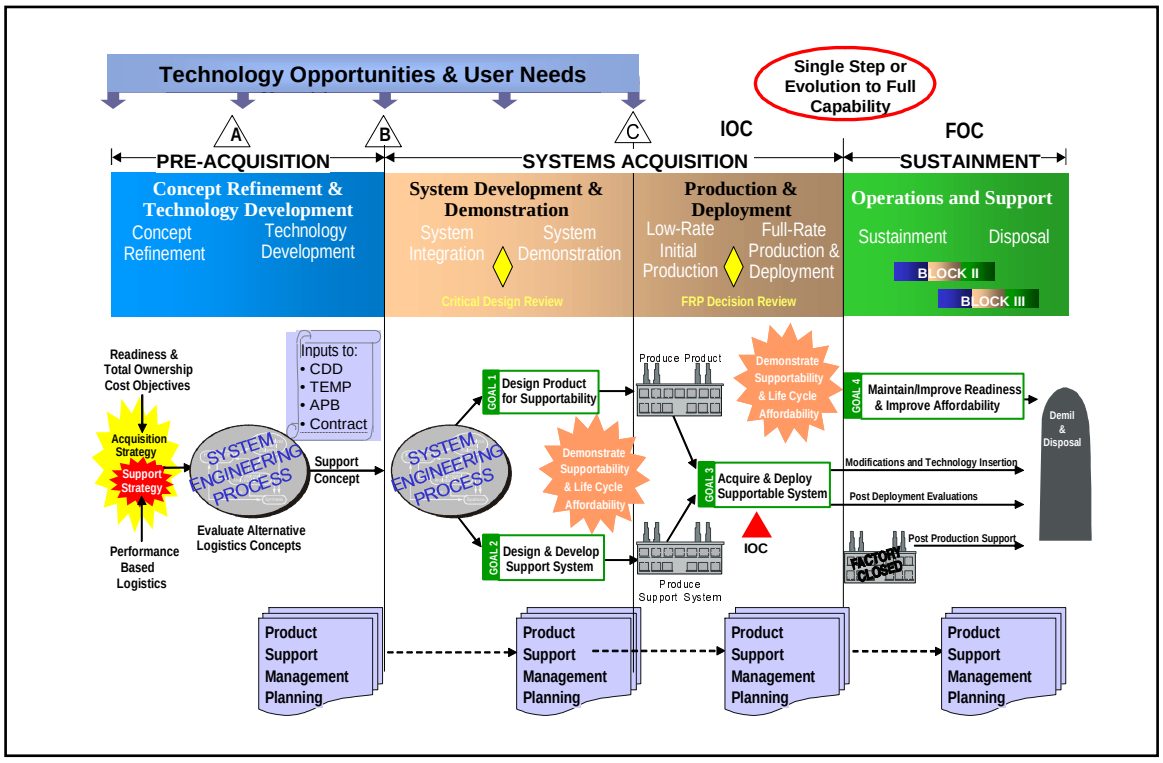
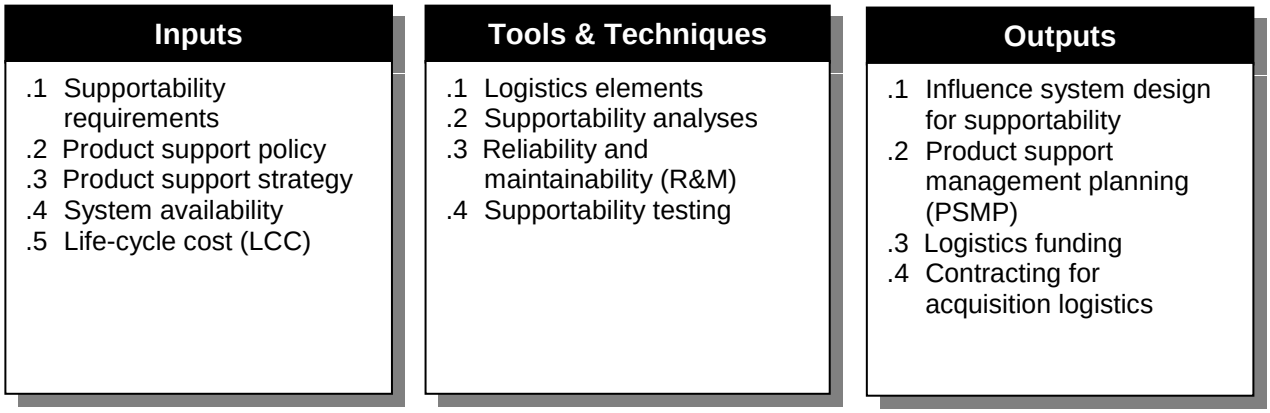


Figure 15-1. Logistics Management Process[1]

15.1 Logistics Management

This chapter will address supportability requirements, product support policy, product support strategy, system availability, and life-cycle cost. Tools will include the role of the ten logistics elements, supportability analyses, reliability and maintainability, and supportability testing necessary to field effective/efficient systems with complete support infrastructure. The outputs of these efforts influence system design for supportability, product support management planning, plus techniques for funding and contracting for logistics.



15.1.1 Inputs to Logistics Management

.1 *Supportability requirements*. The user or user representative generates a Capability Development Document (CDD) with validated needs developed to address mission area deficiencies, evolving threats, emerging technologies, or weapon system improvements in accordance with CJCSI 3170.01_. The PM shall work with the user to define and modify, as necessary, requirements in order to attain both key performance parameters and lowest life-cycle costs.

.2 *Product support policy.* The following items are paraphrased policy statements extracted from the DoD 5000 Series:

- It is the PM's responsibility to conduct acquisition logistics throughout the life of the system.
- As part of the Systems Engineering process, supportability analysis shall be conducted to provide the PM an analytical approach for effectively supporting the acquisition system throughout the life cycle.
- Support concepts should be established early and continuously refined.
- Support resource requirements shall be budgeted consistent with the support and development concept.

- Commercial resources shall be used if they are available and if they can readily meet the user's requirements.

- The introduction of unique types of automatic test systems (ATS) into DoD field, depot, and manufacturing operations should be minimized. Primary consideration should be given to using commercial off-the-shelf (COTS) testers and components or DoD ATS families of test equipment along with critical architecture elements and interfaces.

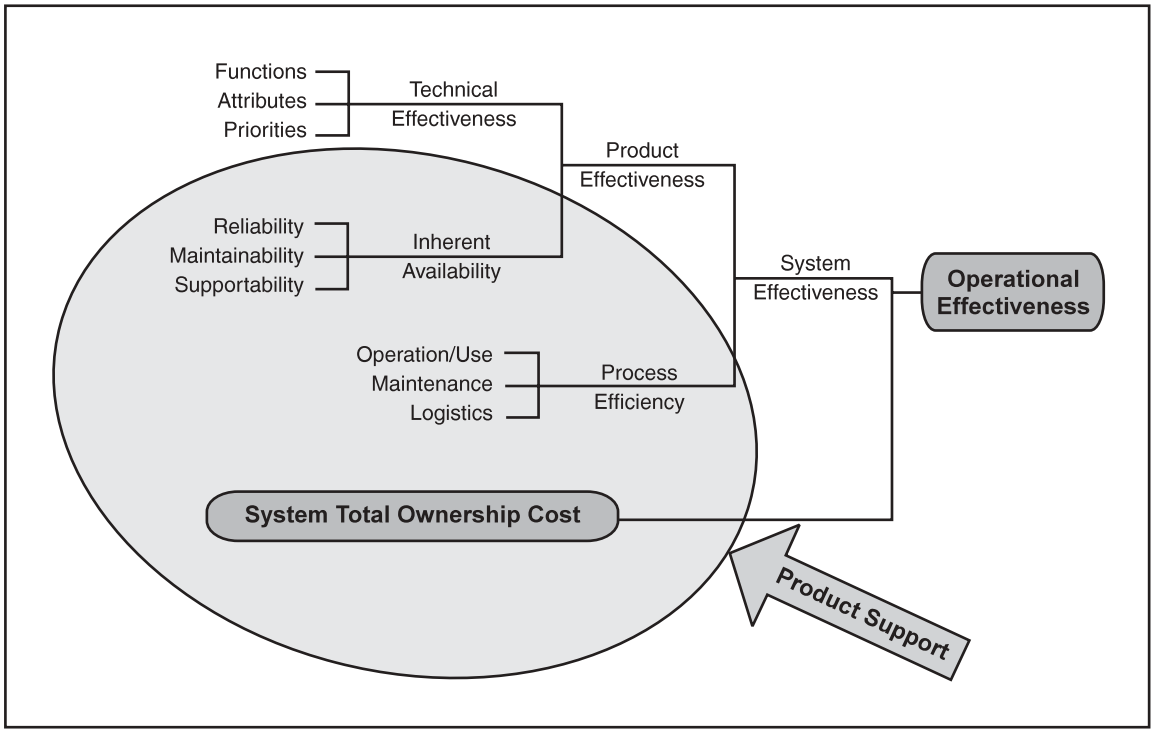


Figure 15-2. System Operational Effectiveness and Product Support

.3 *Product support strategy.* As part of the acquisition strategy and an integral part of the systems engineering process, a support strategy (Figure 15-2) shall be developed and documented that addresses life-cycle sustainment and continuous improvement of product affordability, reliability, and supportability, while sustaining readiness. The support strategy defines the supportability planning, analyses, and trade-offs conducted to determine the optimum support concept for a defense system and strategies for continuous affordability improvement throughout the product life cycle. The support strategy shall continue to evolve toward greater detail, so that by Milestone C, it contains sufficient detail to define how the program will address the support and fielding requirements that meet readiness and performance objectives, lower total ownership cost (TOC), reduce risks and avoid harm to the environment and human health.

- Performance-Based Logistics – A strategy for weapon system product support that employs the purchase of support as an integrated performance package designed to optimize system readiness. It meets performance goals for a weapon system through

a support structure based on performance agreements with clear lines of authority and responsibility.

.4 *System availability.* A parameter that reflects the readiness of the system and is of vital interest to the operational user. It is expressed as the probability that an item is in an operable state and ready to commit at the start of a randomly-scheduled mission. There are a number of definitions of availability. Operational Availability (A_o) includes measure of Logistics Down Time (LDT) plus the Administrative Delay Time (ADT); See Figure 15-3.

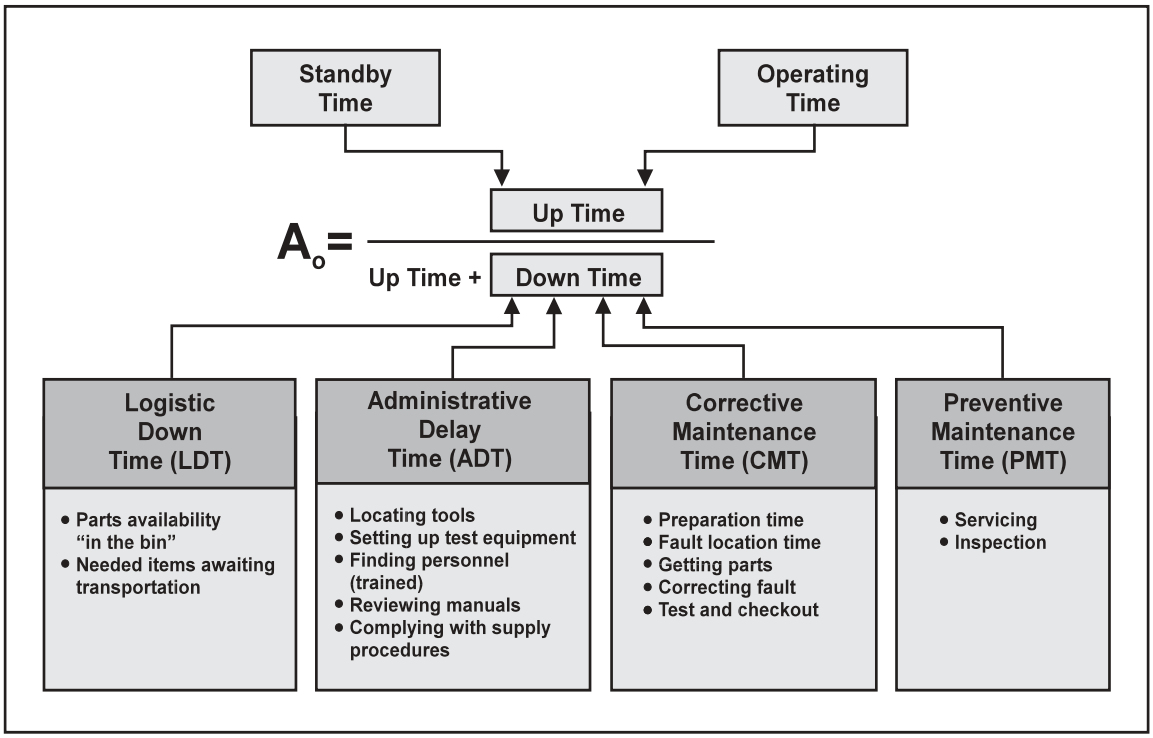


Figure 15-3. Operational Availability

.5 *Life-cycle cost (LCC).* The LCC is the total cost to the Government of acquisition and ownership of a DoD system over its full life. It includes the cost of development, acquisition, operation, support, and disposal. For a typical DoD system, cost distribution is depicted in Figure 15-4. This figure was developed by the Logistics Management Department of the DAU. With operational and support costs being approximately 60 percent of the total LCCs, it is essential that logistics considerations be designed in from the beginning of a program. As more DoD systems are being extended in service life, the percentage of costs attributed to operation and support continues to grow. LCC best practice goal is to introduce consideration of current and future cost consequences (along with schedule and performance) in making today's acquisition decisions.

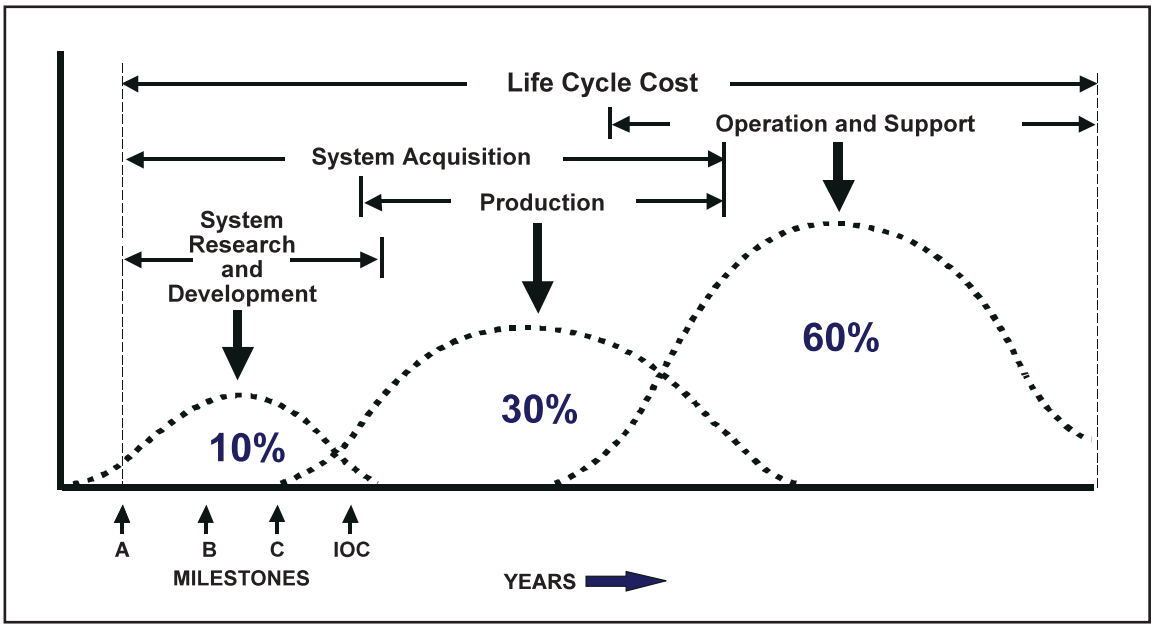


Figure 15-4. Nominal Cost Distribution (Generic DoD Acquisition Program)[2]

15.1.2 Tools and Techniques for Logistics Management

.1 *Logistics elements*. As shown in Figure 15-5 (Derived from the DAU *Acquisition Logistics Guide*, 3rd Edition, Dec 97) there are ten traditional Logistics elements that should be considered throughout the acquisition logistics process. The objective of each support function or element is to allow the user to meet peacetime and wartime readiness requirements. Successful implementation of these elements will directly impact LCCs and system supportability during the operational phase. The ten elements are:

- *Maintenance planning*. Maintenance planning is the process conducted to evolve and establish maintenance and support concepts and requirements for the lifetime of a material system. Acquisition programs should establish logistics support and maintenance concepts early in the program and refine them into detailed maintenance plans throughout the development process, with LCCs playing a key role in the process. Support and maintenance concepts should reflect the optimum balance between user needs and LCC.

- *Manpower and personnel*. Manpower and personnel is the process conducted to identify and acquire military and civilian personnel with the skills and grades required to operate and support the system over its planned lifetime at both peacetime and wartime rates. Acquisition logistics efforts should strive to minimize the manpower, personnel, and required skill levels to operate and support the system.

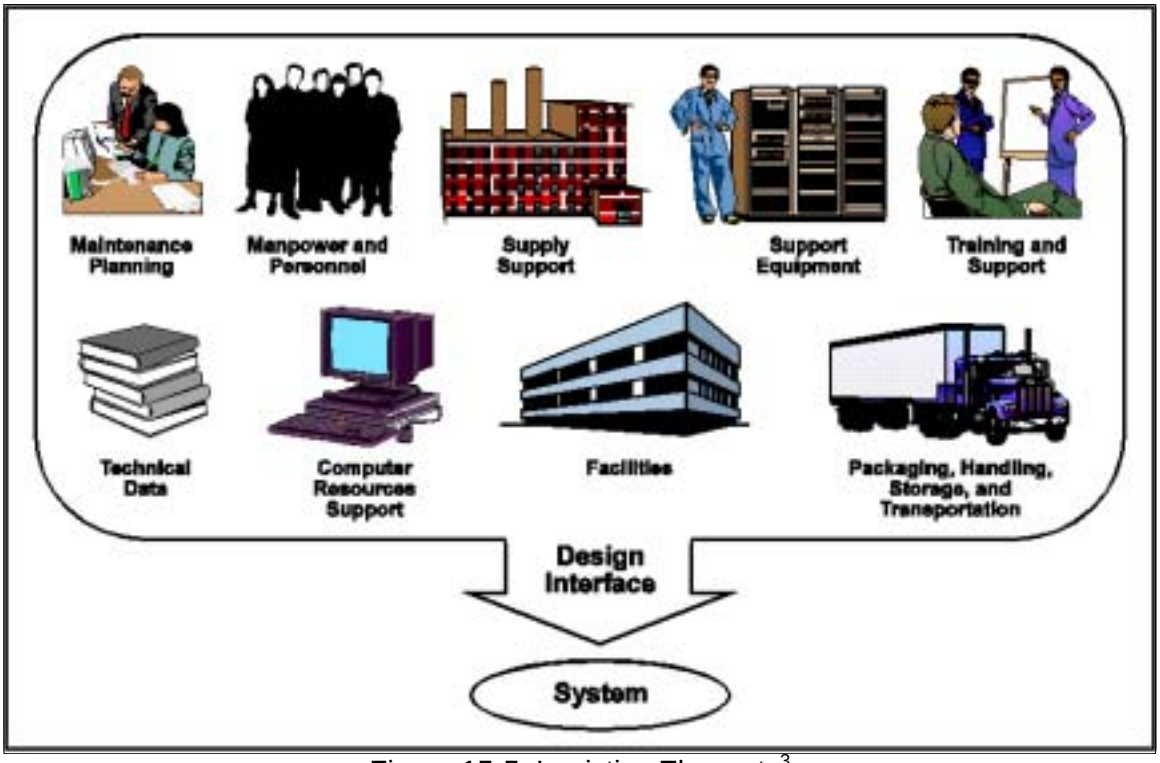


Figure 15-5. Logistics Elements[3]

- *Supply support*. Supply support includes initial support (provisioning) and follow-on support (routine replenishment). It is the process conducted to determine, acquire, catalog, receive, store, transfer, and issue items necessary for the support of end items. It also entails the same function regarding items to support the end items, such as support and test equipment, trainers, and simulators. To ease this complex task, acquisition logistics planning efforts should strive to reduce the variety of parts and maximize the standardization of parts used in end items and support items.

- *Support and test equipment*. Support and test equipment refers to all equipment (mobile or fixed) required to support the operation and maintenance of the defense systems, including ground handling equipment, tools, metrology/calibration equipment, manual/automatic test equipment, and other single/multi-use support items. Acquisition logistics efforts should strive to reduce or eliminate the number of tools and support equipment required to maintain the system. If tools and/or support equipment are shown to be absolutely needed, standardization should be considered.

- *Technical data*. Technical data are scientific or technical information (recorded in any form or medium) necessary to operate and/or maintain the system. Acquisition logistics efforts should be focused on optimizing the quantity, format, and interchangeability of technical data. Data requirements should be consistent with the planned support concept and represent the minimum essential to effectively support the fielded system. Government requirements for contractor-developed technical data should be coordinated with the data requirements of other program functional specialties to minimize data redundancies and inconsistencies. The program office should ensure compatibility with existing internal Government information processing systems;

however, maximum use should be made of contractor-available data systems and data formats when they can readily satisfy program needs.

- *Training and training support*. Training and training support include the processes, procedures, curricula, techniques, training devices, simulators, and other equipment necessary to train personnel to operate and support/maintain the system. This logistics element includes individual and crew training (both initial training and follow-on training), new equipment training, and initial, formal, and on-the-job training. In addition to the end-item system, logistics support planning normally includes acquisition, installation, operation, and support of training equipment/devices. Acquisition logistics efforts should minimize the training and training support required to prepare people to effectively operate and support the system.

- *Facilities.* Facilities include the permanent, semi-permanent, or temporary real property assets required to operate and support the system. This logistics element includes the conduct of studies to define necessary facilities or facility improvements and the determination of needs associated with locations, space, utilities, environmental considerations, real estate, and equipment. Acquisition logistics efforts should be directed at minimizing or eliminating the facilities required to operate and support the system. Where facilities are required, maximize the use of existing facilities.

- *Packaging, handling, storage, and transportation.* This element includes the resources, processes, procedures, design considerations, and methods to ensure that the end item, equipment, and support items are packaged/preserved, handled, stored, and transported properly. It further includes determination of environmental considerations, preservation requirements for short- and long-term storage, transportability requirements, and other methods needed to ensure elimination/minimization of damage to the end item and its necessary support infrastructure. Acquisition logistics efforts should minimize or eliminate undue/unnecessary packaging, handling, storage, and transportation requirements for the operation and maintenance of the defense system.

- *Computer resources support.* The totality of computer hardware, firmware, software, personnel, documentation, supplies, and services applied to a given system. Embedded computer resources (ECR) are physically incorporated in a larger system whose function is not purely data processing. ECR can be stand-alone, but are still integral to a larger system, and may be used for other purposes provided the primary function is to support the weapon system. Acquisition logistics efforts are normally focused on ECR and should strive to ensure that support is established in a cost-effective and timely manner.

- *Design interface.* This is the relationship of logistics-related design parameters, such as reliability and maintainability, to readiness and support resource requirements. These logistics-related design parameters are expressed in operational terms, rather than inherent values, and specifically relate to system readiness objectives and support costs of the system.

.2 *Supportability analyses*. Analysis efforts are performed to scope the requirements for each of the ten logistics elements. These analyses must not only concern themselves with operational support of the acquisition system, but also examine logistic require-

ments associated with T&E, as well as production support. The selection, level of detail, and timing of the analyses are structured and tailored to each system and program phase.

The supportability analyses are analytical efforts to influence the design of a system and to define support system requirements and criteria. The objective is to ensure that systematic and comprehensive analyses are conducted on a repetitive basis through all phases of the system life cycle in order to satisfy readiness objectives at an affordable cost.

.3 *Reliability and maintainability (R&M).* The following definitions are provided to emphasize key aspects of system design that strongly influence logistics support resources:

- **Reliability** – The ability of a system and its parts to perform its mission without failure, degradation, or demand on the support system. Mean Time Between Failure (MTBF) is a common measure of reliability. MTBF is defined as the total functioning life of a population of an item divided by the failures during that interval. Reliable weapon systems result in increased combat capability, fewer spare parts, less manpower, and a reduced impact on the logistics transportation system.

- **Maintainability** – The ability of an item to be retained in or restored to specified conditions when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair. Corrective Maintenance can be measured by Mean Time to Repair (MTTR); or, stated in more simple terms, how quickly can the system be fixed. Also, Mean Maintenance Time (MMT) not only includes corrective maintenance, but also accounts for preventive maintenance. Maintainable systems require fewer people and specialized skills, reduce maintenance times, and results in reduced LCCs.

.4 *Supportability testing*. To reduce risks, Reliability, Availability, and Maintainability (RAM) should be tested as early as possible. There are various techniques for testing, such as contractor demonstration as part of Government buy-off, to formal Development and Operational Testing. The PM must consider the amount of testing versus the impacts to program cost and schedule. The subject of test and evaluation is covered in Chapter 16, Project Test and Evaluation Management.

15.1.3 Outputs of Logistics Management

.1 *Influence system design for supportability*. Supportability requirements are reduced when R&M is designed into the system. Reliability and maintainability are force multipliers. Through supportability analysis, risks associated with R&M can be identified. Considerations for R&M can then influence the entire design process. Supportability analyses should be conducted as part of trade studies and systems engineering analyses. Supportability design criteria should be established and adjustments made to the system and sub-system requirements based on analyses results. A more complete description of this process is presented in Chapter 13, Project Systems Engineering Management.

.2 *Product support management planning (PSMP).* The PSMP includes planning for full life-cycle product support management as part of the support strategy documented in the acquisition strategy. The planning includes actions to assure sustainment, and to continually improve product affordability for programs in initial procurement, re-

procurement, and post-production support. The planning describes an integrated acquisition and logistics strategy for the remaining life of the system or sub-systems and shall be updated at least every five years during the product's life cycle.

.3 *Logistics funding.* The Planning, Programming, and Budgeting System (PPBS) is the DoD means for budgeting program requirements. Acquisition Logistics is an integral part of this process. Funds for Acquisition Logistics should be identified early in the program to ensure the necessary support is in place during the Sustainment Logistics phase. See Chapter 7 (Project Cost Management) of this document for PPBS information.

.4 *Contracting for acquisition logistics.* To attain required combat capability, the DoD must communicate its requirements in clear operational terms and then properly translate the requirements into viable contractual terms understood by the contractor. The program office translates the operational performance thresholds and goals into measurable contractual requirements. Industry must understand the operational environment and be prepared to meet these requirements. Through supportability analyses and logistics planning well-defined logistic requirements can be integrated into acquisition contracts early enough to effectively support the system when it moves to the sustainment logistics phase.

[1] Defense Acquisition University, Logistics Management Department.

[2] Defense Systems Management College, *Acquisition Logistics Guide*, 3d Ed, Defense Systems Management College Press, December 1997.

[3] Defense Systems Management College, *Acquisition Logistics Guide*, 3d Ed, Defense Systems Management College Press, December 1997, p. 7-1

Chapter 16

Project Test and Evaluation Management

The test and evaluation (T&E) process is an integral part of systems engineering. It identifies levels of system performance, provides data supportive of trade-off analysis, reduces risks, and assists the PM in correcting deficiencies. The T&E process also supports Milestone Decision Authorities (MDAs) by providing objective information on system performance. This Chapter discusses T&E planning and execution. Because of its unique importance to U.S. DoD program management, it is handled here in a separate chapter vice being incorporated into the Systems Engineering Chapter.

16.1 **T&E Planning** – the process for identifying what, how, where, and when T&E must be conducted in support of an acquisition of a system.

16.2 **T&E Execution & Reporting** – the activities involved in T&E and reporting the results from the T&E effort.

16.1 T&E Planning

Inputs	Tools & Techniques	Outputs
.1 Initial Capabilities Document (ICD) .2 Analysis of Alternatives (AoA) .3 Capabilities Development Document (CDD) .4 System performance specification .5 C4I support plan (C4ISP) .6 DoD acquisition policy	.1 Test and evaluation integrated product team (T&E IPT) .2 T&E IPT planning process	.1 Test and evaluation master plan (TEMP) .2 Failure definition/scoring criteria (FD/SC) .3 Contract T&E requirements .4 Detailed test plans .5 Environmental impact statements (EIS)

16.1.1 Inputs to T&E Planning

.1 *Initial Capabilities Document (ICD).* The ICD documents a mission deficiency and expresses the required operational capabilities in broad operational terms that are not system- or technology-specific. It states why non-material solutions to the deficiency are not adequate and identifies potential material solutions and constraints to be studied during the Concept and Technology Development Phase. The ICD is based on authoritative threat information. Pre-Milestone B programs will not have an approved CDD on which to base a detailed T&E plan. Therefore, T&E planners must review and understand the mission deficiencies identified in the ICD when developing an early Evaluation Strategy.

.2 *Analysis of Alternatives (AoA).* The AoA documents a cost and military utility analysis of the alternative system concepts intended to satisfy the operational needs stated in a ICD. The AoA is prepared for Milestone B and is updated as required for subsequent milestones. The AoA influences test planning by specifying mission-essential tasks and measures of effectiveness (MOE) that are testable and traceable to the ICD and that often become formal system requirements documented in the CDD. T&E planners must participate early in AoA preparation to ensure: 1) mission essential tasks and MOEs are linked to the ICD; 2) the MOEs are complete, testable, and support the needs of decision makers; and 3) future T&E assets required to test a proposed system are identified.

.3 *Capabilites Development Document (CDD).* The CDD documents operational performance characteristics for a proposed system. It converts the broadly stated operational needs in the ICD into system-specific requirements. The user prepares the CDD for Milestone B and updates it as required prior to each subsequent milestone. The CDD documents how users will operate, deploy, and support a system. It includes testable MOEs from the AoA at a level of specificity that facilitates developmental and operational test planning. T&E planners must continually review the CDD to ensure: 1) the system requirements are clear, testable, measurable, achievable, stated in performance-oriented (versus specification-like) terms, and are adequately linked to other documents; and 2) the planned T&E will answer all questions about the system's operational effectiveness and suitability.

.4 *System performance specification.* The system performance specification documents the functional and technical requirements of the system. Essential physical constraints are specified. The system performance specification is often a contract document or is a contract deliverable and is derived from the CDD. Further details may be found in Military Standard (MIL-STD)-961D, *Military Defense Specification Standard Practices*. (Note: MIL-STD-961D is fully exempt from the MIL-STD waiver process because it is a "Standard Practice.")

.5 *C4I support plan (C4ISP).* A C4ISP is required for all acquisition category (ACAT) programs that connect in any way the DoD's communications and information infrastructure, including IT systems and NSS programs. The plan identifies C4I needs, dependencies, and interfaces, focusing attention on interoperability, supportability, and sufficiency concerns throughout a program's life cycle. Test planners review the C4ISP for performance requirements not explicitly stated in other system requirement documents.

.6 *DoD acquisition policy.* The DoD 5000 Series regulate DoD system acquisition. These directives, instructions and guidance address T&E in support of system acquisition.

16.1.2 Tools and Techniques for T&E Planning

.1 *Test and evaluation integrated product team (T&E IPT).* DoD Regulations direct the PM to form and lead a T&E IPT. The T&E IPT is responsible for all T&E planning. In addition to the PM, the principal members of the T&E IPT typically include: 1) a user representative; 2) a developmental test agency representative; 3) an operational test agency representative; 4) a live fire test agency representative (if applicable); 5) a logistics tester/evaluator; and 6) an Office of the Secretary of Defense, Operational Test and Evaluation (OSD (OT&E)) oversight representative (if applicable).

.2 *T&E IPT planning process.* T&E IPTs generally follow the following steps in T&E planning: 1) review key program documents and determine test objectives for the system; 2) devise a test strategy (test events, schedule, resources, etc.) that will support the system acquisition strategy and achieve the test objectives; 3) prepare a Test and Evaluation Master Plan (TEMP) documenting the test strategy; 4) staff the TEMP for approval and coordination; 5) maintain oversight of detailed test plans developed by test agencies; and 6) review test results to determine if changes in T&E plans are warranted.

16.1.3 Outputs from T&E Planning

.1 *Test and evaluation master plan (TEMP).* The TEMP documents the overall structure and objectives of the T&E program. It provides a framework within which to generate detailed T&E plans and it documents schedule and resource implications associated with the T&E program. The TEMP identifies the necessary developmental test and evaluation (DT&E), operational test and evaluation (OT&E), and live fire test and evaluation (LFT&E) activities. It relates the program schedule, test management strategy and structure, and required resources to critical operational issues (COIs), critical technical parameters (CTPs), objectives and thresholds documented in the CDD, evaluation criteria, and milestone decision points. For multi-Service or joint programs, a single integrated TEMP is written by the lead Service. Service-unique T&E requirements, particularly evaluation criteria associated with COIs, may be addressed in a Service-prepared annex to the basic TEMP.

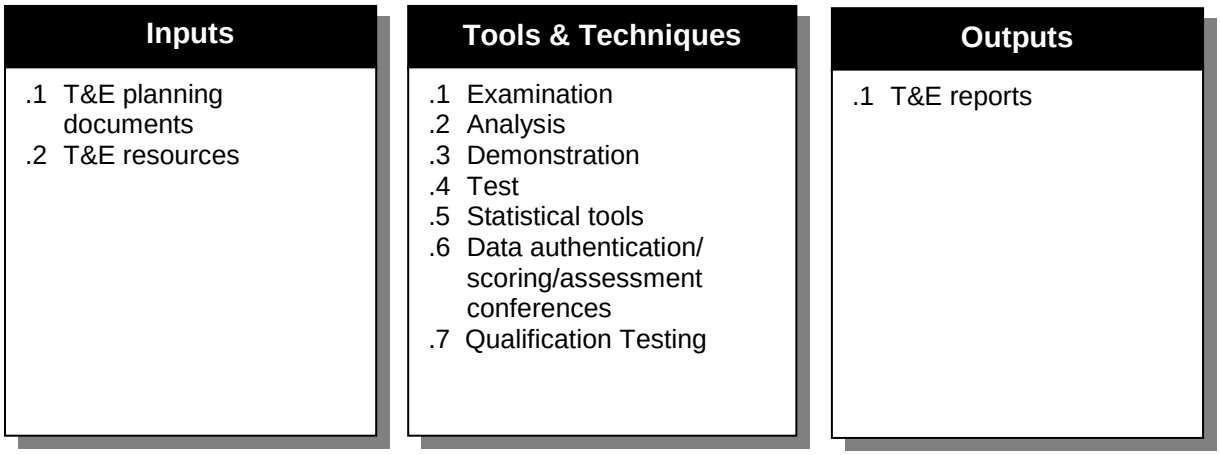
.2 *Failure definition/scoring criteria (FD/SC).* The T&E IPT develops the FD/SC. The FD/SC defines what constitutes a system failure and how test outcomes will be scored based on the cause of failure (hardware, training, technical manuals, support equipment, operator error, etc.).

.3 *Contract T&E requirements.* The T&E IPT, through the TEMP development process, will determine test requirements to be included in the contract for the system acquisition. The T&E IPT will provide the PM the information necessary to complete Section 4 of the performance specification. Section 4 identifies what verification methodology (examination, demonstration, analysis, test) will be used to verify the performance parameters stated in Section 3 of the performance specification. The T&E IPT will also provide the PM information to be included in Section E of the RFP/contract. Section E, entitled “Inspection and Acceptance” provides the what, who, how, and when with respect to system testing, and lays out contractor and Government testing responsibilities (e.g., number of test articles, test support requirements, planned duration of testing).

.4 *Detailed test plans.* Developmental, operational and live fire test agencies will prepare detailed test plans to execute the test objectives in the TEMP. The T&E IPT will review the detailed test plans for conformance with the TEMP.

.5 *Environmental impact statement (EIS).* The PM, with assistance from the testing agencies, will prepare an EIS addressing any environmental impacts caused by the proposed system's development and fielding, including the system testing.

16.2 T&E Execution and Reporting



16.2.1 Inputs to T&E Execution and Reporting

.1 *T&E planning documents.* The outputs of the T&E planning process (TEMP, FD/SC, contract test requirements, and detailed test plans) serve as the inputs for T&E execution and reporting. The TEMP identifies the overall T&E objectives and describes at a more macro level what types of developmental, operational, and live fire T&E will be conducted and when. The FD/SC provides testers and evaluators common guidance on how to score and report test results. The system acquisition contract states the contractor and Government responsibilities for the execution of the system T&E. Detailed test plans provide the in-depth information necessary to execute the tests.

.2 *T&E resources.* The specific resources required to conduct T&E will vary by program and the characteristics of the system being acquired. Common resources used for T&E are test articles, facilities, personnel and services offered by the 21 test sites forming the DoD's Major Range and Test Facility Base (MRTFB) and those offered by non-MRTFB test sites, troops for OT&E, and threat and target simulators. These resources, including funding requirements, are identified in T&E planning documents.

16.2.2 Tools and Techniques for T&E Execution and Reporting

.1 *Examination.* A method of performance verification and inspection of items, without the use of special laboratory appliances or procedures, that is used to determine conformance to specified requirements. Examination is generally non-destructive and typically

includes the use of sight, hearing, smell, touch, and taste; simple physical manipulation; mechanical and electrical gauging and measurement; and other forms of investigation.

.2 *Analysis.* A method of system performance verification that uses established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures in order to provide evidence that the stated requirements were met.

.3 *Demonstration.* A method of performance verification that is generally used to show the actual operation, adjustment, or reconfiguration of items in order to provide evidence that the designed functions were accomplished under specific scenarios. The test articles may be instrumented and quantitative data can be collected.

.4 *Test.* A method of performance verification and inspection that measures technical properties or elements of items, including functional operation, and involves the application of established scientific principles and procedures.

.5 *Statistical tools.* Statistical tools such as the binomial, exponential, and “t” distributions are used to determine the quantity of testing necessary to produce statistically significant data and to evaluate the statistical significance of the test results.

.6 *Data authentication/scoring/assessment conferences.* During and/or after testing, the T&E IPT holds conferences to determine the authenticity of test data (i.e., are the data valid or do they reflect instrumentation errors or other problems?), and score the test data (to what degree were there performance problems and what were the causes of the problems?). Assessment conferences are held after the completion of testing to review test results and assess whether the final system configuration met the performance requirements.

.7 *Qualification Testing.* The conduct of formally verifying and documenting performance requirements using the methods described above is what is known as "qualification testing."

16.2.3 Outputs from T&E Execution and Reporting

.1 *T&E reports.* T&E reports present test data and evaluative information. A variety of T&E reports may be issued during system testing. Reports documenting the outcome of individual test events may be released in near real time in order to provide timely support of the design development effort and verify compliance with the system performance specification. Test agencies write thorough reports of T&E results following completion of a test. DT&E, OT&E, and LFT&E agencies write comprehensive T&E reports to support milestone decisions.

Chapter 17

Project Manufacturing Management

Project Manufacturing Management involves planning, organizing, directing, controlling, and integrating the use of people, money, materials, equipment, and facilities to accomplish the manufacturing effort economically. It includes the processes required to efficiently produce the end-item systems required by the defense user. The overall desired result of effective manufacturing management is to provide a uniform, defect-free product with consistent performance that meets documented customer requirements, for a lower cost in terms of time and money.

The focus of manufacturing during production is to execute the manufacturing plan. This plan is a formal description of the approach for employing the facilities, tooling, and personnel resources needed to produce the design. The objective of this plan is to assure that the produced items reflect the intent of the designer, and are manufactured using processes that are repeatable, predictable, and reviewed for continuous improvement.

During pre-production efforts, as the manufacturing plan is being developed, project manufacturing management seeks to assure that the system and sub-system designs are producible (i.e., easy to fabricate, assemble, integrate, and test), and that the factory floors in the supply chain that will produce the system are properly characterized. The focus of these management efforts is to:

- Identify needed manufacturing resources and capabilities, in particular the manpower, materials, machinery, process methods and measurement devices;
- Understand and prioritize the risks associated with providing those resources; and
- Develop and implement risk mitigation strategies and approaches.

The three major tasks of project manufacturing management during the DoD systems acquisition cycle are:

17.1 Influencing Design — Producibility of the system design shall be a development priority. Design engineering efforts shall concurrently develop producible designs,

capable manufacturing processes, and the necessary process controls to satisfy requirements and minimize manufacturing costs.

17.2 **Planning for Production** — The PM shall use existing manufacturing processes whenever possible. When the design requires new manufacturing capabilities, the PM shall consider process flexibility (e.g., rate and configuration insensitivity).

17.3 **Production** — Full rate production of a system shall require a stable design, proven manufacturing processes, and available or programmed production facilities and equipment.

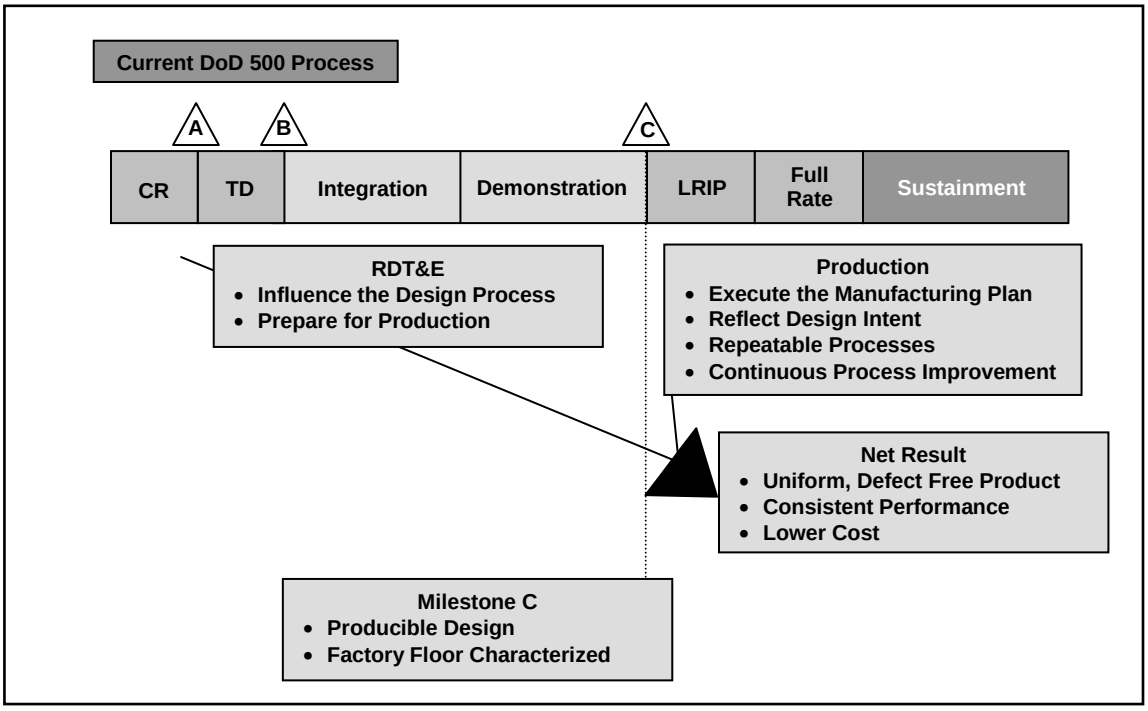


Figure 17-1. The Role of Manufacturing in the Acquisition Process[1]

17.1 Influencing Design

Inputs	Tools & Techniques	Outputs
.1 Reference	.1 Concurrent engineering (CE) .2 Design for "X" .3 Key characteristics/ processes .4 The "Five Ms" .5 Quality function deployment (QFD) 6. Electronic manufacturing ("e-Manufacturing")	.1 Trade studies

17.1.1 Inputs to Influencing Design

.1 *Reference*. Refer to Section 5.1.1.1 Product Description, and Chapter 13, Project Systems Engineering Management, of this Extension.

17.1.2 Tools and Techniques for Influencing Design

.1 *Concurrent engineering (CE).* Also known as Integrated Process and Product Development (IPPD), or Simultaneous Engineering, CE/IPPD has been successfully applied by the private sector (e.g., Chrysler Neon development) and by the Services on selected programs. CE/IPPD is a customer-focused management process that integrates all activities from product concept through manufacturing and fielding/support. Using a multifunctional team approach (engineering, logistics, manufacturing, subcontracting, human factors, et. al.), CE/IPPD is intended to address customer requirements, manufacturing and sustainment issues/constraints before, during, and after a design is produced and fielded. CE/IPPD simultaneously optimizes the product and its manufacturing and sustainment processes to meet cost, schedule, and performance objectives.

CE/IPPD has certain readily identifiable features when successfully applied. One feature is a focus on team(s) and teamwork. Many Total Quality Management (TQM) concepts have been applied in an effort to enhance team performance. Management must take leadership action to transform a group of individuals into a team. Another feature is that CE/IPPD teams are tool users. Some major tools used in the CE/IPPD process include Quality Function Deployment (QFD) to capture customer requirements, Design of Experiments (DOE) for achieving product and process robustness, and Statistical Process Control (SPC) for reducing variation on key process and product characteristics. Other tools include quality data (Pareto diagrams, fishbone charts, etc.) and quality management tools (affinity diagrams, inter-relationship digraphs, etc.).

.2 *Design for "X."* This terminology refers to a series of design approaches that utilize CE/IPPD teams and their design tools to achieve specific design-build objectives. Design for "X" includes Design for Manufacture and Assembly (DFMA), Design for Disassembly (DFD), Design for Recycling (DFR), etc. DFMA focuses specifically on defining product design options for ease of fabrication and assembly. The goal is to integrate the manufacturing engineer's knowledge of the factory floor (i.e., manufacturing processes) with the use of design principles and rules, in order to develop a more producible product. Note: the term "producibility" generally refers to a measure of the relative ease of manufacturing a product, in an economical, effective and timely manner. Producibility improvements are a major focus of those "Design for X" approaches such as DFMA that deal with fabrication, assembly, integration, and testing of a product's components up through its sub-systems to the complete system.

Examples of some of the more effective design rules used in DFMA to increase the producibility of an item include minimizing part count (both types and quantities of a given type), using standard components, designing parts for ease of fabrication, and avoiding separate fasteners. DFMA can also provide other benefits such as increasing reliability, reducing inventory, and shortening product development cycle time.

Design for Recycling focuses specifically on achieving an optimization of recycling of materials at the end of a product's life cycle. The ultimate goal is a design that optimizes the recycle and reuse of materials. In particular it focuses on material design solutions that minimize the use of hazardous materials.

.3 *Key characteristics/processes.* The identification of key product characteristics, their design limits, and the identification of key production processes and the determination of their capabilities are basic engineering tasks that support product development. A key characteristic is one whose variation from nominal has the greatest impact on fit, performance, or service life. For example, an automatic transmission has about 15,000 characteristics. The company need only manage about 100 to control those characteristics that most impact the functionality of the transmission. The other 14,900 characteristics are not unimportant, they are robust. That is, acceptable deviation from nominal is larger than for key characteristics.

Another way of identifying key characteristics is to use the risk mitigation concept. A typical product design may have hundreds, thousands, or millions of characteristics. It is not reasonable nor required that one attempt to control all of these characteristics. It is more effective and efficient to focus on those characteristics that are very important to the customer, those where manufacturing problems are likely to occur (or those where problems are difficult to detect during manufacturing), or those characteristics for which a failure, even if such is unlikely to occur, would cause severe consequences that are unacceptable to both the producer and the customer.

Key product characteristics come from the identification of key customer requirements. In a top-down approach, key customer characteristics become key product characteristics. Key product characteristics become key assembly characteristics. Key assembly characteristics become key part characteristics. Key part characteristics become key process characteristics and in turn key test or verification characteristics. The key process characteristics should be controlled using statistical process control. One tool used to identify customer requirements is QFD.

.4 *The "Five Ms."* The "Five Ms" — Manpower, Materials, Machines, process Methods, and Measurement systems — are the generalized types of resources that must be obtained and put in place to manufacture a product (any kind of product, be it paper studies, software, or even a service, not just a physical "good"). The "Five Ms" concept also serves as a design/process risk identification and mitigation technique, as well as a failure analysis tool, and is often shown visually using an Ishikawa "fishbone" diagram. The diagram helps prompt the reviewer/planner to identify the actual or potential impacts of a particular action or planned action upon the existing or expected arrangement of these resources. For example, design fabrication may require highly-skilled manpower — what happened/would happen if those skilled personnel were unavailable or stretched thin as a result of competing demands? Another example: a process uses a batch processing method, (i.e., a large amount of items are worked on at a given time); what happened/would happen if a sample inspection showed problems within the sample from that batch? The "Five Ms" is a simple and easy to use analysis techniques that can serve as a starting point for more detailed risk identification and reduction methods.

.5 *Quality function deployment (QFD).* Programs in development face many risk drivers to cost, performance and schedule. One of those drivers is customer requirements, especially when those requirements keep changing, are soft, or not fully or adequately developed. A core development task is the gathering of requirements and the translation of these requirements into technical solutions. QFD is a requirements identification and flowdown method used by many companies. It employs multifunctional teams to get the voice of the customer into the design specifications in a documented form that can be readily translated into process specifications and eventually even to factory floor work instructions.

User requirements and preferences are defined and categorized as user attributes, which are then weighted based on importance to the user. Users are then asked to compare how their requirements are being met now by a fielded system (or an alternative design approach) versus how they would be met by the new design. QFD provides the design team an understanding of customer wants (in clear text language), forces the customer to prioritize his/her wants, and compares/benchmarks one design approach against another. Each customer attribute is then satisfied by at least one technical solution.

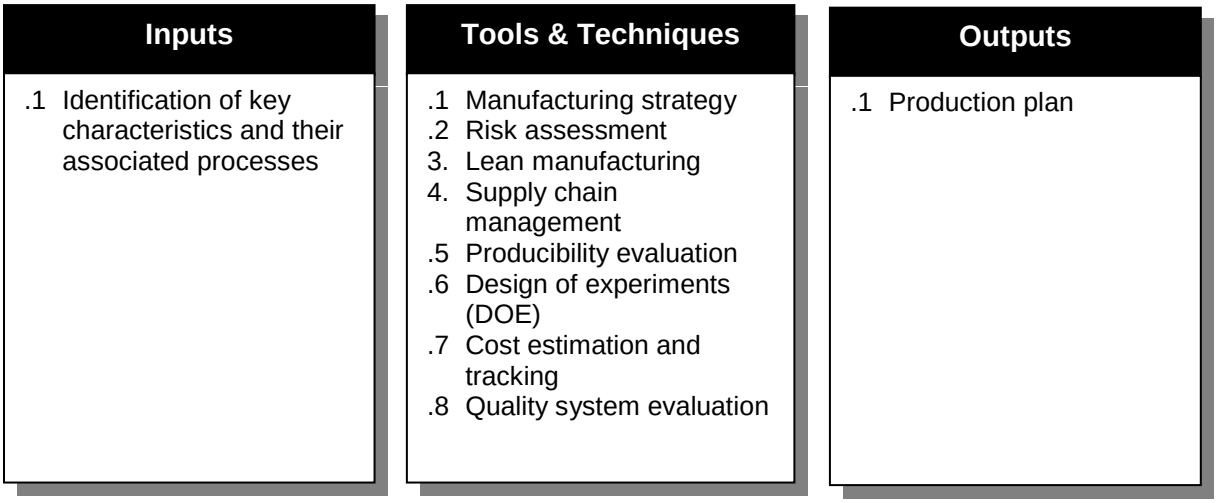
Values for those technical solutions are determined and again rated among competing designs. Then the technical solutions are evaluated against each other to identify conflicts. The preferred form for viewing all levels of a QFD product is the “house of quality,” a cross-hatched matrix format that uses different “walls,” the “ceiling,” the “floor,” and the “roof” to initially list customer requirements, identify relevant attributes and measures, do comparisons, and look for conflicts. A major advantage to the use of QFD’s “house of quality” matrix is that the format, by using the “ceiling” derived in a given phase as the requirements “wall” in the follow-on phase, deliberately prompts the identification of key product characteristics then, in turn, key process characteristics, and so forth, with QFD perhaps reaching all the way to the factory floor work instructions. This allows for documented traceability of manufacturing procedures all the way back to customer requirements.

.6 *Electronic manufacturing (“e-manufacturing”)*. The term “e-manufacturing” refers to the use of the Internet and all other electronic means to manage the entire manufacturing enterprise**.** This includes the use by CE/IPPD teams (among others) of the latest information technologies to leverage the exchange of information. For example, companies like Boeing use 3-D modeling and simulation programs to give all functional team members access to the design-build package as well as to examine alternate design approaches. Other ”e-manufacturing” tools used to promote effective team communications include virtual program offices and collaborative engineering work environments, for conducting day-to-day communications and other business activities that are required in spite of time and distance constraints between organizations. This allows for team inputs early in the development stage, when such inputs are the most cost effective, as well as throughout the life cycle of the system or product.

17.1.3 Outputs from Influencing Design

.1 *Trade studies.* The overall output from the effort to influence design is a balanced design, demonstrated and documented by trade studies that clearly show the match among process capabilities, control requirements where established, and product requirements. Such studies – designed to examine trade-offs and merits of alternative options - and their derived implementation strategies, should form the driving aspect of any detailed manufacturing and production plans.

17.2 Planning for Production



17.2.1 Inputs to Planning for Production

.1 *Identification of key characteristics and their associated processes.* Refer to Section 17.1.2.3.

17.2.2 Tools and Techniques for Planning for Production

.1 *Manufacturing strategy.* A manufacturing strategy is an overarching plan for assuring timely and cost-effective production of an item that meets all operational effectiveness and suitability requirements. Manufacturing strategy development must begin during the earliest stages of the system life cycle, and be developed in consonance with engineering, contracting, and logistics strategies.

Manufacturing strategy considerations include product rate and quantity requirements, quality planning and approach, the capability of the industrial base to support item rates and quantities over time, manufacturing technology insertion or improvement, and tooling/test equipment concepts. Finally, the manufacturing strategy must reflect the integration of manufacturing flexibility with product robustness.

.2 *Risk assessment.* Based on identification of key characteristics, the program office should develop a manufacturing risk evaluation to quantify the statement of manufacturing feasibility. Manufacturing risk assessment is a supporting tool for the contractor and program office decision-making process. It seeks to estimate the probabilities of success or failure associated with the manufacturing alternatives available.

These risk assessments may reflect alternative manufacturing approaches to a given design, or may be part of the evaluation of design alternatives, each of which has an associated manufacturing (process) approach. The quantified risk levels can then serve as the basis for the development of specific risk resolution techniques for the later phases of the acquisition cycle, and can provide guidance to the budget estimation process. (Note: See Chapter 11 (Project Risk Management) for risk assessment methodologies.)

.3 *Lean manufacturing*. Lean manufacturing refers to an evolving dynamic process of production covering the total enterprise and embracing all aspects of industrial operations

(product development, manufacturing, organization and human resources, and customer support) including customer-supplier networks, that is governed by a systemic set of principles, methods, and practices.

The term “Lean Manufacturing” was originally coined by MIT (Massachusetts Institute of Technology) researchers to describe extremely effective manufacturing and management principles and techniques used by the Toyota Motor Manufacturing Company in the 1980s to provide high quality, reasonably priced automobiles in a relatively short period of time from order to delivery — using far less resources or state-of-the-art technology than their American competitors, while meeting customer desires. The major ideas and concepts of lean manufacturing rely on successful, people-sensitive resource management methods, and are proving applicable worldwide across widely different industries, regardless of quantities of product desired.

Major tenets of lean manufacturing include:

- Identifying all material, process, and information steps required to actually provide a product, from early concepts to finished design, and raw materiel to finished goods (or services);
- Determining what steps in that “value stream” actually provide value as defined by the end-item user of the product (steps that do not add value are waste and should be eliminated or modified accordingly);
- Refining the steps in the value stream to allow for easy flow of items between steps, reducing work in process and related inventories;
- Making a product only as requested by the “downstream” steps, where requests are made as the result of confirmed requirements, i.e., “pull” from the end-item customer; and
- Conducting continuous improvement of processes and products, to better address the changing needs of the customer.

Some of the specific techniques and features of successful lean practitioners include value stream mapping, teamwork, multi-skilled workers, just-in-time material delivery and use, mistake-proofing the use of products and processes, visual controls, “kanban” material production “pull” signaling, machine support of workers, cell-based production vice assembly lines, multipurpose machines, rapid setup/changeover of existing machinery, and continuous improvement exercises on and off the factory floor. Note there are two critical aspects of proper implementation of lean: it does not use any tools or techniques in and of themselves — lean manufacturing is a comprehensive way of thinking as well as a toolbox with interlinked tools; and lean is not a manpower reduction tool, i.e., workers who improve their processes through the process should be shifted to more improvement activities, rather than discontinued.

Lean practices are being adopted worldwide in a wide variety of industries. The purpose of the Lean Aerospace Initiative (LAI) — a consortium of Government, industry, labor union and academic organizations that is coordinated by MIT — is to apply and adapt lean practices to improve DoD aerospace and related weapon systems acquisition. The results desired are improved quality, significant reduction of waste and non-value added” activities (and resulting substantial reductions in costs and time required to obtain systems), continuously improving processes and products, flexibility in producing different mixes or a greater diversity of products quickly, and improved relationships between primary producers and suppliers. Also see section 17.3.2.1.

4. *Supply chain management.* This term generally refers to all activities associated with the flow and transformation of materials and its related information from source to end-user. In practice, all organizations that are engaged in providing components and higher level

assemblies, sub-systems and systems, are considered links in the supply "chain" wherein any one that fails to provide the needed support could "break the chain" and imperil the entire end item product creation and delivery plan. This, combined with the reality that well over 70 percent of the monetary value of traditional system acquisition programs is contained in the subcontractor part of the supply chain, prompt the need for a thorough understanding and appreciation of the capabilities of and challenges to the supply chain. Therefore, manufacturing-related techniques and practices such as CE/IPPD, QFD, Design for X, lean manufacturing, and others must seek to maximize involvement of the suppliers in the product design and product/process development, to enable proper production and sustainment. Tools such as "e-manufacturing" should be implemented so as to enable maximum participation by suppliers, to identify problems early, and to formulate comprehensive solutions. Note that as "e-manufacturing" information sharing, machine control, and related "business to business" tools provide for more detailed insight into the operations and related finances of suppliers at all levels, the issues of "added value" of the "middle tier" suppliers must be addressed. Veteran practitioners of lean manufacturing generally advocate long-term relationships that include and support key suppliers in their own continuous improvement.

.5 *Producibility evaluation.* Producibility evaluation is further evidence that the risks associated with key characteristics (as well as non-key characteristics) and processes are acceptable. Objectives include review of the following:

- Development of design-build packages;
- Design and prove-out of special-purpose manufacturing equipment and tooling;
- Development of manufacturing assembly sequencing;
- Material and finishing information;
- Integration of subcontractor components or services;
- Generation of calibration information and techniques.

The manufacturing plan, which may be a contract deliverable, can form the basis for the producibility evaluation. Government reviews are performed to gain confidence that the contractor has sufficiently thought out the manufacturing process. These reviews can be done in conjunction with the normal design reviews or management reviews, or separately as Production Readiness Reviews (PRRs). To achieve maximum effectiveness, such reviews need to be started early in the development process, occur at frequent intervals, and continue well into full rate production. If PRR-equivalent reviews are deferred until late in development, the impacts of manufacturing process-related issues shall generally require a substantial allocation of monetary and other resources and/or a schedule slip in order to address — which in turn threatens the availability of planned resources.

.6 *Design of experiments (DOE).* There are many factors that affect the quality of the end item. In order to design and build quality into a product, one must control those factors that have the greatest impact on fit, performance, and service life. Most experimentation done today on the factory floor is haphazard. That is, manufacturing personnel first turn

one knob (speed) up, and another knob (temperature) down in an attempt to bring product quality in line with specification requirements. They often change several factors at the same time and fail to collect or analyze the data that describe the impact of the changes. Such actions are little more than tampering with the production system.

DOE provides a structured way to characterize processes. A multifunctional team analyzes a process and identifies the factors that most impact the quality of the end item. These factors are then put into an orthogonal (balanced) array for testing purposes. Utilizing Taguchi methodologies, the team runs a limited number of tests and data are collected and analyzed. The results will indicate not only which factors contribute the most to the end quality, but will also define the parameter settings for those factors. Now, rather than tweaking the system, production managers have in their hands profound knowledge of their factory floor processes that allows them to build quality into the products.

.7 *Cost estimation and tracking.* Certain Government and contractor policies and actions can have significant impact on manufacturing cost. These policies need to be considered during the planning and execution of weapon system development programs. They may impact decisions on production rate, long lead funding, and capital investment. With the increasing DoD emphasis on system affordability through Cost as an Independent Variable (CAIV), cost (both manufacturing and support) must be considered as a design and program planning driver throughout the acquisition process.

CAIV implies control of future acquisition, operating, and support costs during the design and development process under established and approved cost objectives. A CAIV goal is one in which a specific cost number is established as early as possible in the acquisition process, but not later than the start of system integration and demonstration. Another management technique is “should cost,” which is a detailed Government analysis of contractor costs and can provide a basis for better understanding of contractor operations.

A significant concern about the costs of manufacturing and other operations during development and production is the proper tracking of direct costs and the associated allocation of indirect overhead activities. In most accounting systems the shares of overhead activities are based not upon actual resource usage, but upon inappropriate or incorrect metrics, thus resulting in higher (or lower) overhead allocation for certain products. Methods such as activity-based costing (ABC), wherein overhead is assigned to a product based upon resources used as related to products provided, should be evaluated for possible application throughout the key members of the supply chain.

.8 *Quality system evaluation.* The contractor’s quality system will determine in large part the success of the product. DoD is now recognizing the utility of basic and advanced quality systems. The International Organization for Standards (ISO) 9000 series quality system is generally regarded as a basic quality system. It offers a comprehensive foundation to build a quality management and quality assurance system. It describes and explains the basic types of operational, “product-providing” activities normally performed by companies/organizations that engage in design and/or development and/or testing and/or production and/or sustainment, and outlines requirements for documentation that describes the processes used to perform these activities. The 2000 update to the 1994 version added more requirements, particularly in the areas of customer focus and metrics.

However, clear articulation of customer quality requirements may require advanced quality systems, which call for the use of highly developed and sophisticated practices in the areas of design and manufacturing. Those practices include requirements definition

tools, integrated process and product development, designing for robustness, supply chain management, controlling key characteristics, reducing variability, and other tools and techniques. Examples of advanced quality systems include the American National Standards Institute (ANSI)/American Society for Quality Control (ASQC) Q9000 series (based on ISO 9000), the Boeing Company D1-9000 quality standard which has been revised to become a supplement to the Aerospace International Quality Standard 9100 (which is based on ISO 9000), among others. The "Six Sigma" variation control approach to quality and the Malcolm Baldrige Quality Award criteria are also employed by many organizations as enablers and measurement criteria for advanced quality management systems.

17.2.3 Outputs from Planning for Production

.1 *Production plan.* The key output from planning for production is an understanding of the contractor's design, producibility, risks, and costs. Generally these are detailed, along with supporting data, in a preliminary production plan.

17.3 Production

17.3.1 Inputs to Production

.1 See Section 17.2.3.

17.3.2 Tools and Techniques for Production

.1 *Lean production management practices.* MIT researchers in the Lean Aerospace Initiative (LAI) are codifying the key management principles of lean manufacturing into recommended high-level practices and lower-level implementation tools and techniques. These practices, which are detailed in MIT's Lean Enterprise Model (LEM), include:

- Identify and optimize enterprise flow.
- Assure seamless information flow.
- Optimize capability and utilization of people.

- Make decisions at lowest possible level.
- Implement integrated product and process development (IPPD).
- Develop relationships based on mutual trust and commitment.
- Continuously focus on the customer.
- Promote lean leadership at all levels.
- Maintain challenge of existing processes.
- Nurture a learning environment.
- Ensure process capability and maturation.
- Maximize stability in a changing environment.

The LEM also includes metrics and enabling techniques for each of these 12 practices. See section 17.2.2.3 above for additional information on the LEM.

.2 *Process proofing.* As part of the transition to production (see DoD 4245.7, *Transition From Development to Production*, Sep 1985), a demonstration of the factory capability prior to significant levels of production is highly desirable. Prime contractor and key supplier process "line" proofing, i.e., realistic demonstration of factory production processes, serves to verify technical data package (TDP) content, exercise factory operations, verify key critical process(es) capability, and to provide systems integration experience. The decision to require process line proofing should be based on expected production rates and ramp-ups, special transition problems, or high-risk areas, at the system and key sub-system levels.

.3 *Metrics.* During the production phase of the product life cycle, the existing and planned measures of the effectiveness of the contractor's manufacturing efforts should be reviewed and refined. The objective of this phase is to produce, in a timely fashion, systems and equipment conforming to the technical documentation at a minimum cost and risk. Possible metrics include schedule adherence (e.g., on-time delivery), conformance measures (e.g., number of waivers and deviations), delivery cost, and quality measures (e.g., "first time through the process" yield rates). Note that many metrics are "high-level" i.e., they only indicate whether or not a variation from the desired objective exists. They do not identify the type of variations nor the reasons for the variations, or indicate how to properly identify and address those reasons. High-level metrics (such as "first time through" yields) must not be used as problem-defining or problem-solving measures.

.4 *Variability reduction and process control.* Variability reduction is a systematic approach to reducing product and process variability to improve cost, schedule and performance. It represents a cultural shift towards the quality of the product by introducing the idea that just falling within specification limits (known as goal-posting) is not the best measure of quality. Rather, the variability of a key process (from variables data) and the relationship of design limits to process limits (process capability) becomes a measure of merit.

Once key process variability is reduced (using tools like DOE or cause and effect diagrams), process control is used to monitor quality while the product is being produced. The most common form of statistical process control uses variables data (e.g., length, weight, hardness, etc.) sampled from a process to determine acceptability or rejection of the process based on those measurements.

.5 *Cost of quality (COQ).* Cost of quality methodologies were developed to provide a mechanism for managers to uncover their hidden factory, i.e., the often substantial portion of the organization that deals with needed corrections before (and also after) the product is shipped. This gave managers an opportunity to continuously improve all aspect of operations, not just the factory floor. COQ is broken down into three components.

First, there are appraisal costs. These are the costs associated with finding defects. Second, there are failure costs. Internal failures occur in the organization, and external failures occur once the product or service is delivered to the customer. Third, there are prevention costs associated with building in quality. The goal is to have a low (5-7 percent) cost of quality. Typically COQ is 25-30 percent of sales on most product programs, and 30-40 percent of sales in a Service organization.

Examination of the COQ profile will reveal whether the company is “prevention”- or “inspection”- oriented. If the COQ profile shows a mix of 50 percent failure, 35 percent appraisal, and 15 percent prevention components, then that organization is “inspection”-oriented. If the COQ profile shows 50 percent prevention, 35 percent appraisal, and 15 percent failure components, then the organization is “prevention”-oriented. A major difference is in how the appraisal is performed. An “inspection”-oriented firm is looking at the product and sorting the good from the bad. A “prevention”-oriented firm is monitoring the process to control the product, and inspection is reduced because quality is thereby enhanced. An organization focused on prevention is likely to have a much lower overall cost of quality than one that is inspection focused.

17.3.3 Outputs From Production

.1 *Quality products.* The outputs from production are affordable quality products that meet users’ requirements, in an environment that promotes variability reduction and continuous process and product improvement.

Endnotes

1. Figure 17-1 was developed by the Manufacturing Management Section of the Technology and Engineering Department of DAU.

SECTION IV

APPENDICES

A. Evolution of the *U.S. DoD Extension* to the *PMBOK® Guide*

B. Contributors

C. Glossary

Appendix A

Evolution of the U.S. DoD Extension to the *PMBOK® Guide*

A.1 Initial Development: Origin of the Concept[1]

For nearly three decades, the Defense Systems Management College (DSMC) has been the center of education, research, and consulting services in program (project) management for the U.S. Department of Defense (DoD). Until the mid-1980s, the College provided courses (most notably the 20-week Program Management Course) to members of the DoD workforce without any requirement for them other than the general desire for improved capabilities and services. This work has taken on significantly increased importance as a result of a series of U.S. laws culminating in 1991 in the Defense Acquisition Workforce Improvement Act (DAWIA). This legislation required the Secretary of Defense to develop a plan to enhance the professionalism and career opportunities available to acquisition personnel. (i.e., those personnel involved in the acquisition of materiel for the U.S. Armed Forces). This has set in motion the development of widely applicable professional certification requirements for PMs as well as managers in the contributing functional disciplines involved in defense programs. However, these requirements apply only to U.S. Government personnel, not to the contractor personnel who actually design and develop new systems for the DoD.

During the 1980s, a few members of the faculty at the College became interested in the activities of the Project Management Institute (PMI®). They joined the Institute and cooperatively sponsored some symposia of mutual interest. In 1990, the College and the PMI agreed to conduct an experiment involving the selection of recent graduates of the DSMC Program Management Course to take the PMI professional certification examination with only minimal additional preparation. Twenty-one took the exam, and 17 passed on the first try. The remainder passed following a re-take of one or two sections each of the eight-part examination. These results convinced managers in both institutions that the competencies underlying the DSMC curriculum and the knowledge areas in the PMI *PMBOK® Guide* were generally applicable in both arenas. It was obvious that the only

significant differences lay in the DoD-peculiar requirements and practices, including commercial practices used in DoD but not included in the *PMBOK® Guide*.

The results of that experiment led the to the idea that a codification of the defense-peculiar material along the lines of the basic PMI *PMBOK® Guide* might be a useful tool in the qualification and certification of program/project managers in the DoD and might facilitate establishment of a certification program available to defense contractor personnel. A formal research project was subsequently established at DSMC to support definition and development of such a tool. Simultaneously, a student at the Air Force Institute of Technology was conducting a research project to define a defense-specific project management body of knowledge. The resulting paper describing that research won the annual PMI student paper award in 1991.[2] It concluded that there was a definite need in the U.S. DoD for such a body of knowledge and that there was significant overlap of the knowledge areas required with the knowledge areas in the PMI *PMBOK® Guide*.

A.2 Development of the Concept

At the 1992 PMI symposium, the Aerospace and Defense Specific Interest Group (SIG) agreed to lend its support to the research centered at DSMC. Also at this symposium, a paper was presented on the developing qualification requirements for project managers in the U.S. Defense Department.[3] The presentation resulted in considerable discussion that revealed an impetus in other application areas for application-specific sections of the PMI *PMBOK® Guide*. As the *PMBOK® Guide* was undergoing a rigorous update process, it seemed an appropriate time to determine how best to address this perceived need. After much discussion with all anticipated stakeholders, the PMI Standards Committee adopted the concept of a generic *PMBOK® Guide* with application area extensions.

Subsequently, the PMI Certification Program began to consider the concept of modifying the PMI Project Management Professional (PMP®) certification program to include the opportunity to certify in specific application areas. This has come to fruition as the Certificate of Added Qualification (CAQ) program. Many members believe the availability of these CAQs could expand the usefulness (and use) of the PMP® certification in their businesses. This certainly seems likely in the defense project management community.

In 1992, as a corollary to these developments, and to increase the knowledge about PMI within the U.S. DoD, the DSMC instituted a PMP® preparation elective as part of its Program Management Course. As a result of the PMP® certification elective and other guidance provided by DSMC, the number of Defense project management professionals certified by PMI began an upward trend. Finally, in 1999, with the increased emphasis on applying commercial practices within the DoD, the need for such a document was recognized as critical. The DSMC (within the Defense Acquisition University (DAU) framework) authorized contract funding to speed completion of the drafts developed by mainly volunteer labor up to then. That allowed completion of the document. At about this same time, the DAU and PMI signed a memorandum of understanding (MOU) that set up the ground rules for potential acceptance of the Extension as a PMI Standard. This *U.S. DoD Extension* to the *PMBOK® Guide* is expected to support and accelerate the trend toward a widely accepted, commercially available professional development program for all project management practitioners in the U.S. DoD and in all industries doing business with the U.S. DoD. Reaction from non-U.S. reviewers of early drafts of the document indicates that it will also find tailored application in other countries.

A.3 Conclusion

U.S. Congressman Nicholas Mavroules — the author of the United States Defense Acquisition Workforce Improvement Act — stated the intent of the U.S. Congress: "We need to pay more attention to the people in the acquisition field. We need to train them better. We need to pay more attention to their career paths. We need to prepare them as professionals and then we need to respect them as professionals. This is the goal we are pursuing."[4] These are the same goals we all share, and they are the rationale for this document.

Endnotes

1. Ayer, F.L. and Bahnmaier, W. “Toward a Defense Extension to the Project Management Body of Knowledge” *International Journal of Project Management*, Vol. 13, No. 2, (Apr 1995) Elsevier Science, Ltd., pp. 125–128.
2. Kobylarz, K. “Establishing a Department of Defense Program Management Body of Knowledge,” Proceedings, 1991 PMI Seminar/Symposium, Dallas, TX, USA, (Sep-Oct 1991) pp. 275–279.
3. Ayer, F.L. and Cook, C.R. “Program Management in the U.S. Department of Defense: Acquisition Workforce Reform,” Proceedings, 1992 PMI Seminar/Symposium, Pittsburgh, PA, USA (Oct 1992) pp. 485–489.
4. Hearings before the Investigations Subcommittee, Acquisition Workforce, House of Representatives, Committee on Armed Services, No. 101–71, Washington, DC.

Appendix B

Contributors

B.1 Contributors

Because of the collegial process used to develop this document, and to avoid repetition, we have combined the list of people who contributed original text and people who reviewed and contributed modified text. The Defense Systems Management College and PMI are indebted to them for their support. The document would not exist without all of their inputs. They are:

- Paul Alfieri, Defense Acquisition University (Chapter 16, Project Test and Evaluation Management);
- Fred Ayer, Defense Acquisition University (Chapter 4, Project Integration Management; Appendix A);
- William Bahnmaier, Defense Acquisition University (Chapter 1, Introduction; Chapter 11, Project Risk Management);
- Norman Bull, Consultant to the Defense Acquisition University (Entire Document);
- Edmund Conrow, Consultant to the DoD Risk Management Working Group (Chapter 11, Project Risk Management);
- Carleton Cooper, Information Spectrum Inc./Defense Systems Management College (Various Chapters);
- Leslie Deneault, Defense Acquisition University (Chapter 12, Project Procurement Management);
- Lawrence Heller, Defense Acquisition University (Chapter 15, Project Logistics Management);
- Lewis Ireland, Lew Ireland and Associates (Chapter 8, Project Quality Management);
- Philip Irish, Information Resources Management College (Chapter 9, Human Resource Management);
- Brian Kelmar, Defense Acquisition University (Chapter 15, Project Logistics Management);
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- Joseph Miller, Defense Acquisition University (Chapter 15, Project Logistics Management);
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- George Prosnik, Defense Acquisition University (Chapter 14, Project Software Engineering Management);
- Sharon Richardson, Defense Acquisition University (Chapter 7, Project Cost Management);
- David Schmitz, Defense Acquisition University (Chapter 17, Project Manufacturing Management);
- Richard Shipe, Defense Acquisition University (Chapter 16, Test and Evaluation);
- John Thoren, SETA Corporation (Chapter 6, Project Time Management; Chapter 7, Project Cost Management; Chapter 14, Project Software Engineering Management); and
- Andrew Wold, The Boeing Company (Chapter 6, Time Management).

B.2 Production Staff

Special mention is due to the following employees and contractors of the Department of Defense, Defense Acquisition University (DAU):

- Greg Caruth, Director of the DAU Press (Production);
- Pat Bartlett, Bartlett Communications (Editing and Layout); and
- Debbie Gonzalez, DAU Press (Proofreading).

B.3 Reviewers

In addition to the *U.S. DoD Extension* Contributors, the following individuals provided formal comments on the Exposure Draft of this document:

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Appendix C

Glossary

C.1 Inclusions and Exclusions

This glossary includes a limited collection of terms (acronyms/abbreviations and definitions) that are likely to be found in the *U.S. DoD Extension* to the *PMBOK® Guide*. Material has been adapted from the *Defense Systems Management College Glossary, Defense Acquisition Acronyms and Terms*, Tenth Edition of January, 2001. A few words in this Glossary may have slightly different definitions in the *PMBOK® Guide* Glossary.

C.2 Common Acronyms/Abbreviations

AA	Advance Agreement
ABC	Activity-Based Costing
ACAT	Acquisition Category
ACMC	Assistant Commandant of the Marine Corps
ACO	Administrative Contracting Officer
ACTD	Advanced Concept Technology Demonstration
ACWP	Actual Cost of Work Performed
ADM	Acquisition Decision Memorandum
ADR	Alternative Dispute Resolution
ADT	Administrative Delay Time
AFALC	Air Force Air Logistics Center
AFMC	Air Force Materiel Command
AIS	Automated Information System
AKSS	Acquisition Knowledge Sharing System
ALC	Air Logistics Center (AF)
AMC	Army Materiel Command
ANSI	American National Standards Institute
Ao	Operational Availability
AoA	Analysis of Alternatives (formerly called COEA)

AP	Acquisition Plan
APB	Acquisition Program Baseline
APUC	Average Procurement Unit Cost
ARPA	Advanced Research Projects Agency
AS	Acquisition Strategy
ASD(C3I)	Assistant Secretary of Defense (Command, Control, Communications, and Intelligence); (obsolete – now ASD, Networks and Information Integration (NI2))
ASQC	American Society for Quality Control
AT	Anti-Tampering
ATD	Advanced Technology Development/Demonstration
ATE	Automatic Test Equipment
ATS	Automatic Test Systems
AUPC	Average Unit Procurement Cost
AUW	Authorized Un-priced Work
B&P	Bid and Proposal
BA	Budget Authority; Budget Activity
BAC	Budgeted Cost at Completion
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BES	Budget Estimate Submission
BFM	Business Financial Manager
BIT	Built-In Test; Binary Digit
BITE	Built-In Test Equipment
BLRIP	Beyond Low Rate Initial Production
BOK	Body of Knowledge
BRAC	Base Realignment and Closure
BY	Budget Year; Base Year
C2	Command and Control
C3I	Command, Control, Communications, and Intelligence
C4	Command, Control, Communications, and Computers
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISP	Command, Control, Communications, Computers, Intelligence Support Plan
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CA	Cost Account
CAAT	Control, Avoidance, Assumption, and Transfer
CAD	Computer-Aided Design
CAE	Component Acquisition Executive
CAIG	Cost Analysis Improvement Group (OSD)
CAIV	Cost as an Independent Variable

CALS	Continuous Acquisition Life-Cycle Support
CAM	Computer-Aided Manufacturing; Cost Account Manager
CAO	Contract Administration Office
CAPPS	Contract Appraisal System
CAQ	Certificate of Added Qualification
CARD	Cost Analysis Requirements Description
CASE	Computer-Aided Software Engineering
CBB	Contract Budget Base
CBO	Congressional Budget Office
CBR	Concurrent Budget Resolution
CCA	Clinger-Cohen Act; Component Cost Analysis
CCB	Configuration Control Board
CCDR	Contractor Cost Data Reporting
CDD	Capability Development Document
CDF	Cumulative Distribution Function
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CE	Concurrent Engineering; Concept Exploration
CER	Cost Estimating Relationship
CFE	Contractor-Furnished Equipment
CI	Configuration Item
CICA	Competition in Contracting Act (1984)
CIO	Chief Information Officer
CITA	Commercial or Industrial-Type Activities
CJCS	Chairman, Joint Chiefs of Staff
CJCSI	Chairman, Joint Chiefs of Staff Instruction
CLIN	Contract Line Item Number
CLS	Contractor Logistics Support
CM	Configuration Management
CMT	Corrective Maintenance Time
CO	Contracting Officer
COCO	Contractor Owned/Contractor Operated (Facilities)
COE	Common Operating Environment
COEA	Cost and Operational Effectiveness Analysis (obsolete – see AoA)
COI	Critical Operational Issues
COR/COTR	Contracting Officer's (Technical) Representative
COQ	Cost of Quality
COTS	Commercial Off-The-Shelf
CPA	Chairman's Program Assessment
CPAF	Cost-Plus-Award Fee
C/PD	Cost/Pricing Data

CPFF	Cost-Plus-Fixed Fee
CPI	Critical Program Information
CPIF	Cost-Plus-Incentive Fee
CPIPT	Cost Performance Integrated Product Team
CPM	Contract Performance Management
CPR	Cost Performance Report
CR	Concept Refinement Phase
CRD	Capstone Requirements Document
CRLCMP	Computer Resources Life-Cycle Management Plan
CSCI	Computer Software Configuration Item
C/SCSC	Cost/Schedule Control Systems Criteria
C/SSR	Cost/Schedule Status Report
CTC	Contract Target Cost
CTP	Critical Technical Parameters
CUI	Controlled Unclassified Information
CV	Cost Variance
CWBS	Contract Work Breakdown Structure
CY	Calendar Year; Current Year
DAA	Designated Approving Authority
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DAES	Defense Acquisition Executive Summary
DARPA	Defense Advanced Research Projects Agency (formerly ARPA)
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DCAA	Defense Contract Audit Agency
DCAS	Defense Contract Administration Services
DCMA	Defense Contract Management Agency
DCMC	Defense Contract Management Command
DDN	Defense Data Network
DDR&E	Director, Defense Research and Engineering (OSD)
DDRS	Defense Data Repository System
DEM/VAL	Demonstration/Validation Phase (obsolete – replaced by PDRR which is also now obsolete)
DEPSECDEF	Deputy Secretary of Defense
DFARS	Department of Defense Federal Acquisition Regulation Supplement
DFAS	Defense Finance and Accounting Service
DFD	Design for Disability
DFMA	Design for Manufacture and Assembly
DFR	Design for Recycling
DIA	Defense Intelligence Agency

DID	Data Item Description
DII	Defense Information Infrastructure
DLA	Defense Logistics Agency
D Level	Depot Level of Maintenance
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DoD-R	Department of Defense – Regulation
DoD-M	Department of Defense – Manual
DOE	Design of Experiments
DON	Department of the Navy
DOT&E	Director, Operational Test and Evaluation (OSD)
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership, Personnel and Facilities
DPA&E	Director, Program Analysis and Evaluation
DPG	Defense Planning Guidance
DPM	Deputy Program Manager
DPML	Deputy Program Manager for Logistics
DPRO	Defense Plant Representatives Office (obsolete - now DCMA (plant name))
DRB	Defense Resources Board
DRFP	Draft Request for Proposal
DRMO	Defense Reutilization and Marketing Office
DSMC	Defense Systems Management College
DT	Developmental Test; Developmental Testing
DTC	Design-to-Cost
DT&E	Developmental Test and Evaluation
DTIC	Defense Technical Information Center
DTLCC	Design to Life-Cycle Cost
DTUPC	Design-to-Unit Production Cost
DUSD(AR)	Deputy Under Secretary of Defense (Acquisition Reform); (Function subsumed into office of Director, Defense Procurement and Acquisition Policy)
DUSD(S&T)	Deputy Under Secretary of Defense (Science and Technology)
D/V	Demonstration/Validation Phase (obsolete – replaced by PDRR which is also now obsolete)
EA	Evolutionary Acquisition; Environmental Assessment
EAC	Estimated Cost at Completion or Estimates at Completion
EC/EDI	Electronic Commerce/Electronic Data Interchange
ECP	Engineering Change Proposal
ECR	Embedded Computer Resources
EDM	Engineering Development Model

EIS	Environmental Impact Statements
EIT	Electronic and Information Technology
EMD	Engineering and Manufacturing Development Phase (obsolete – replaced by System Demonstration Part of System Development and Demonstration (SDD))
EO	Executive Order
EVM	Earned Value Management
EVMIG	Earned Value Management Implementation Guide
EVMS	Earned Value Management System
EVMSO	Earned Value Management Support Office
FAA	Functional Area Analysis
FACNET	Federal Acquisition Computer Network
FAR	Federal Acquisition Regulation
FARA	Federal Acquisition Reform Act of 1996
FASA	Federal Acquisition Streamlining Act of 1994
FAT	First Article Testing
FCA	Functional Configuration Audit
FD/SC	Failure Definition/Scoring Criteria
FFP	Firm Fixed Price
FM	Financial Management
FOC	Full Operational Capability
FOT&E	Follow-on Operational Test and Evaluation
FPAF	Fixed Price Award Fee
FRP	Full Rate Production
FRPDR	Full Rate Production Decision Review
FS	Flexible Sustainment
FSN	Federal Stock Number
FUE	First Unit Equipped
FY	Fiscal Year
FYDP	Future Years Defense Program
GAO	General Accounting Office
GDP	Gross Domestic Product
GFE	Government-Furnished Equipment
GFP	Government-Furnished Property
GIG	Global Information Grid
GPRA	Government Performance and Results Act
GOCO	Government-Owned, Contractor-Operated (Facility)
GOGO	Government-Owned, Government-Operated (Facility)
GSE	Ground Support Equipment
HAC	House Appropriations Committee
HASC	House Armed Services Committee

HBC	House Budget Committee
HCA	Head of Contracting Activity
HQ	Headquarters
IBR	Integrated Baseline Review
ICA	Independent Cost Analysis
ICD	Initial Capabilities Document
ICE	Independent Cost Estimate
ICP	Inventory Control Point
IDE	Integrated Digital Environment
IEPR	Independent Expert Program Reviews
IER	Information Exchange Requirement
IG	Inspector General
IIPT	Integrating Integrated Product Team
I LEVEL	Intermediate Level of Maintenance
ILS	Integrated Logistics Support (Army, Navy, Air Force, replaced at OSD by the term “acquisition logistics”)
IMP	Integrated Master Plan
IMS	Integrated Management System; Integrated Master Schedule
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IP	Intellectual Property
IPCE	Independent Parametric Cost Estimate
IPD	Integrated Product Development
IPPD	Integrated Product and Process Development
IPR	In-Progress/Process Review
IPT	Integrated Product Team
IR&D	Independent Research and Development
ISO	International Organization for Standardization
IST	Integrated Surveillance Team
IT	Information Technology
IV&V	Independent Verification and Validation
J&A	Justification and Approval
JCALS	Joint Computer-Aided Acquisition and Logistics Support
JCS	Joint Chiefs of Staff
JIT	Just-in-Time
JLC	Joint Logistics Commanders
JOA	Joint Operational Architectures
JROC	Joint Requirements Oversight Council
JSA	Joint System Architectures
JSPS	Joint Strategic Planning System
JTA	Joint Technical Architecture

JV 2010	Joint Vision (for the year) 2010
KPP	Key Performance Parameter
KR/Kr/KTR/Ktr	Contractor
LAI	Lean Aerospace Initiative
LCC	Life-Cycle Cost
LCCE	Life-Cycle Cost Estimate
LDT	Logistics Down Time
LEM	Lean Enterprise Model
LFT&E	Live Fire Test and Evaluation
LOR/A	Level of Repair/Analysis
LRIP	Low Rate Initial Production
LS	Logistic Support
LSA	Logistic Support Analysis (obsolete)
LSAR	Logistic Support Analysis Record (obsolete)
M&S	Modeling and Simulation
MAA	Mission Area Analysis
MAIS	Major Automated Information System
MAISRC	Major Automated Information System Review Council (obsolete – see Information Technology Acquisition Board)
MANTECH	Manufacturing Technology
MATDEV	Materiel Developer (Army)
MBI	Major Budget Issue
MBWA	Management by Walking Around
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MEL	Master Equipment List
MFP	Major Force Program
MILCON	Military Construction (Appropriation)
MIL-HDBK	Military Handbook
MILPERS	Military Personnel (Appropriation)
MIL-SPEC	Military Specification
MIL-STD	Military Standard
MIS	Management Information Systems
MMT	Mean Maintenance Time
MNS	Mission Need Statement
MOA	Memorandum of Agreement
MOE	Measure of Effectiveness
MOP	Memorandum of Policy (JCS); Measure of Performance
MOU	Memorandum of Understanding
MPP	Master Program Plan
MPS	Master Program Schedule

MRTFB	Major Range and Test Facility Base
MS	Milestone
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
MYP	Multiyear Procurement
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
NCC	Negotiated Contract Cost
NDAA	National Defense Authorization Act
NDI	Nondevelopmental Item
NMS	National Military Strategy
NSC	National Security Council
NSS	National Security Systems
NTE	Not-to-Exceed
O&M	Operations and Maintenance
O&S	Operations and Support
OA	Obligation Authority
OBS	Organizational Breakdown Structure
OCD	Operational Concept Document
OFPP	Office of Federal Procurement Policy
OIPT	Overarching Integrated Product Team
OMB	Office of Management and Budget
OPNAV	Office of the Chief of Naval Operations
ORD	Operational Requirements Document (being replaced by CDD)
OSA	Open Systems Architecture
OSD	Office of the Secretary of Defense
OT	Operational Testing
OTB	Over-target Baseline
OT&E	Operational Test and Evaluation
OUSD(AT&L)	Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics)
P3I	Preplanned Product Improvement
P&D	Production and Deployment Phase
PA&E	Program Analysis and Evaluation
PAT	Process Action Team
PAUC	Program Acquisition Unit Cost
PB	President's Budget
PBD	Program Budget Decision
PBL	Performance-Based Logistics
PCA	Physical Configuration Audit
PCO	Procuring Contracting Officer

PDM	Program Decision Memorandum (OSD)
PDR	Preliminary Design Review
PDRR	Program Definition and Risk Reduction (obsolete - formerly DEM/VAL phase of the life cycle (also obsolete))
PE	Program Element
PEM	Program Element Monitor (AF)
PEO	Program Executive Officer
PERT	Program Evaluation Review Technique
PF/DOS	Production, Fielding/Deployment, and Operational Support
PIPT	Program Integrated Product Team
PL	Public Law
PM	Program Manager; Project Manager; Product Manager
PMAC	Performance Management Advisory Council
PMB	Performance Measurement Baseline
PMCoP	Program Management Community of Practice
PMD	Program Management Document; Program Management Directive (AF)
PMI	Program Management Institute
PMIS	Program Management Information System
PMP	Project Management Professional; Program Master Plans
PMO	Program Management Office
PMT	Preventative Maintenance Time
POA&M	Plan of Actions and Milestones
POC	Point of Contact
POE	Program Office Estimate
POM	Program Objectives Memorandum
PPBS	Planning, Programming, and Budgeting System (DoD)
PPBES	Planning, Programming, Budgeting and Execution System (replaces PPBS)
PRR	Production Readiness Review
PSA	Principal Staff Assistant
PSMP	Product Support Management Planning
PSSM	Practical Software and Systems Measurement
PWBS	Program Work Breakdown Structure
PY	Prior Year
QA	Quality Assurance
QC	Quality Control
QDR`	Quadrennial Defense Review
QFD	Quality Function Deployment
QM	Quality Management
R&D	Research and Development
R&M	Reliability and Maintainability

RAM	Reliability, Availability and Maintainability; Responsibility Assignment Matrix
RBA	Revolution in Business Affairs
RBL	Reliability-Based Logistics
RDT&E	Research, Development, Test, and Evaluation
RFI	Requests for Information
RFP	Request for Proposal
RFQ	Request for Quotation
RHP	Risk-Handling Plan
RMA	Revolution in Military Affairs
RMB	Risk Management Board
RMP	Risk Management Plan
S&T	Science and Technology
SA	Supportability Analysis
SAC	Senate Appropriations Committee
SAE	Service Acquisition Executive
SAM	Software Acquisition Management
SAMP	Single Acquisition Management Plan (AF)
SAR	Selected Acquisition Report; Subsequent Application Review
SASC	Senate Armed Services Committee
SBC	Senate Budget Committee
SCE	Software Capability Evaluation
SDD	System Development and Demonstration Phase
SDP	Software Development Plan
SDR	Software Design Review
SE	Systems Engineering
SECDEF	Secretary of Defense
SECNAV	Secretary of the Navy
SEI	Software Engineering Institute
SETA	Systems Engineering and Technical Assistance
SFR	System Functional Review
SI	Software Item
SIC	Standard Industrial Classification
SIG	Special Interest Group
SLEP	Service Life Extension Program
SME	Subject-Matter Experts
SOO	Statement of Objectives
SOW	Statement of Work
SPC	Statistical Process Control
SPI	Single Process Initiative
SPM	System Program Manager (AF); Software Programmer's Manual

SPO	System Program/Project Office (AF)
SQAP	Software Quality Assurance Plan
SRA	Software Requirements Analysis
SRR	System Requirements Review
SRS	Software Requirements Specification
SSA	Source Selection Authority; Software Support Agency
SSAC	Source Selection Advisory Council
SSEB	Source Selection Evaluation Board
SSP	Source Selection Plan; Software Safety Plan
SSR	Software Specification
SSS	System/Subsystem Specification
STANAG	Standardization Agreement
STP	Software Test Plan
SV	Schedule Variance
SW	Software
T&E	Test and Evaluation
TAB	Total Allocated Budget
TAFT	Test, Analyze, Fix, and Test
TAV	Total Asset Visibility
TBD	To be Determined/Developed
TBIM	Trigger Based Item Management
TCS	Total Customer Satisfaction
TD	Technology Development
TDP	Technical Data Package
TDS	Technology Development Strategy
TEMP	Test and Evaluation Master Plan
TINA	Truth-in-Negotiations Act
TM	Technical Management
TOA	Total Obligation Authority
TOC	Total Ownership Cost; Theory of Constraints
TPM	Technical Performance Measurement/Measures
TQL	Total Quality Leadership
TQM	Total Quality Management
TQO	Total Quality Organization
UCF	Uniform Contract Format
UCMJ	Uniform Code of Military Justice
UPS	Uniform Procurement System
U.S.	United States
USA	United States Army
USAF	United States Air Force
USC	United States Code

USD(AT&L)	Under Secretary of Defense (Acquisition, Technology, and Logistics)
USD(C)	Under Secretary of Defense (Comptroller)
USMC	United States Marine Corps
USN	United States Navy
USSOCOM	United States Special Operations Command
UE	Unit Equipment
VCJCS	Vice Chairman of the Joint Chiefs of Staff
VCNO	Vice Chief of Naval Operations
VCSA	Vice Chief of Staff of the Army
VCSAF	Vice Chief of Staff of the Air Force
VE	Value Engineering
VECP	Value Engineering Change Proposal
VHSIC	Very High Speed Integrated Circuit
VLSI	Very Large Scale Integration
WBS	Work Breakdown Structure
WIPT	Working-Level Integrated Product Team
WWW	World Wide Web

C.3 Definitions

A

Acquisition – The conceptualization, initiation, design, development, test, contracting, production, deployment, logistic support (LS), modification, and disposal of weapons and other systems, supplies, or services (including construction) to satisfy DoD needs, intended for use in or in support of military missions.

Acquisition Category (ACAT) – A method of grouping programs for control purposes:

ACAT I programs are Major Defense Acquisition Programs (MDAPs). An MDAP is defined as a program estimated by the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD (AT&L)) to require eventual expenditure for research, development, test, and evaluation of more than $365 million (fiscal year (FY) 00 constant dollars) or procurement of more than $2.190 billion (FY 00 constant dollars), or those designated by the USD(AT&L) to be ACAT I. ACAT I programs have two sub-categories:

1. **ACAT ID** for which the Milestone Decision Authority (MDA) is USD(AT&L). The “D” refers to the Defense Acquisition Board (DAB), which advises the USD(AT&L) at major decision points.

2. **ACAT IC** for which the MDA is the DoD Component Head or, if delegated, the DoD Component Acquisition Executive (CAE). The “C” refers to Component.

(The USD(AT&L) designates ACAT I programs as either ACAT ID or ACAT IC.)

ACAT IA programs are Major Automated Information Systems (MAISs) or programs designated by the Assistant Secretary of Defense for Networks and Information Integration (ASD(NI2)) to be ACAT IA. ACAT IA programs have two sub-categories:

1. **ACAT IAM** for which the MDA is the Chief Information Officer (CIO) of the Department of Defense (DoD), the ASD(NI2). The “M” (in ACAT IAM) refers to Major Automated Information System (MAIS).

2. **ACAT IAC** for which the DoD CIO has delegated milestone decision authority to the CAE or Component CIO. The “C” (in ACAT IAC) refers to Component.

(The ASD(NI2) designates ACAT IA programs as either ACAT IAM or ACAT IAC.)

ACAT II programs are defined as those acquisition programs that do not meet the criteria for an ACAT I program, but do meet the criteria for a major system.

ACAT III programs are defined as those acquisition programs that do not meet the criteria for an ACAT I, an ACAT IA, or an ACAT II.

Acquisition Decision Memorandum (ADM) – A memorandum signed by the Milestone Decision Authority (MDA) that documents decisions made as the result of a milestone decision review or in-process review.

Acquisition Executive – The individual within the Department and Components charged with overall acquisition management responsibilities within his or her respective organization. The Under Secretary of Defense for Acquisition, Technology, and Logistics (USD (AT&L)) is the Defense Acquisition Executive (DAE) responsible for all acquisition matters within the Department of Defense. The Component Acquisition Executives (CAE) for each of the Components is the Secretary of the Military Departments or Heads of Agencies with power of re-delegation. The CAEs are responsible for all acquisition matters within their respective Component.

Acquisition Life Cycle – The life of an acquisition program consists of phases, each preceded by a milestone or other decision point, during which a system goes through development, test and evaluation, and production. Currently, the five phases are: 1) Concept Refinement (CR); 2) Technology Development (TD); 3) System Development and Demonstration (SDD); 4) Production and Deployment (P&D); and 5) Operations and Support (O&S). Although not considered phases, mission need determination comes before CR, and disposal occurs at the end of the system's useful life.

Acquisition Logistics – Technical and management activities conducted to ensure supportability implications are considered early and throughout the acquisition process to minimize support costs and to provide the user with the resources to sustain the system in the field.

Acquisition Management – Management of all or any of the activities within the broad spectrum of "acquisition," as defined above. Also includes training of the defense acquisition workforce, and activities in support of planning, programming, budgeting and execution system (PPBES) for defense acquisition systems/programs. For acquisition programs this term is synonymous with program management.

Acquisition Plan (AP) – A formal written document reflecting the specific actions necessary to execute the approach established in the approved acquisition strategy and guiding contractual implementation. (Refer to Federal Acquisition Regulation (FAR) Subpart 7.1 and Department of Defense Federal Acquisition Regulation Supplement (DFARS) Subpart 207.1 and Acquisition Strategy.)

Acquisition Program – A directed, funded effort designed to provide a new, improved, or continuing materiel, weapon, or information system capability, or service, in response to a validated operational or business need. Acquisition programs are divided into categories, which are established to facilitate decentralized decision making, execution, and compliance with statutory requirements.

Acquisition Program Baseline (APB) – A document that contains the most important cost, schedule, and performance parameters (both objectives and thresholds) for the program. It is approved by the Milestone Decision Authority (MDA), and signed by the program manager (PM) and his/her direct chain of supervision, e.g., for acquisition category (ACAT) ID programs it is signed by the PM, program executive officer

(PEO), component acquisition executive (CAE), and defense acquisition executive (DAE).

Acquisition Excellence (Reform) – An ongoing series of initiatives sponsored by OSD (especially USD(AT&L) and the Director, Defense Procurement and Acquisition Policy to streamline and tailor the acquisition process. Initiatives include statutory and regulatory reform, CAIV, reform of specifications and standards policy, preference for commercial items, electronic data interchange and the use of the IPPD/IPT management philosophy for systems development and oversight.

Acquisition Strategy (AS) – A business and technical management approach designed to achieve program objectives within the resource constraints imposed. It is the framework for planning, directing, contracting for, and managing a program. It provides a master schedule for research, development, test, production, fielding, modification, postproduction management, and other activities essential for program success. The acquisition strategy is the basis for formulating functional plans and strategies (e.g., test and evaluation master plan (TEMP), acquisition plan (AP), competition, proto-typing, etc.). (See Acquisition Plan.)

Acquisition Streamlining – Any effort that results in more efficient and effective use of resources to design, develop, or produce quality systems. This includes ensuring that only necessary and cost-effective requirements are included, at the most appropriate time in the acquisition cycle, in solicitations and resulting contracts for the design, development, and production of new systems, or for modifications to existing systems that involve redesign of systems or sub-systems.

Actual Cost of Work Performed (ACWP) – The costs actually incurred and recorded in accomplishing the work performed within a given time period.

Administrative Contracting Officer (ACO) – The Government contracting officer who is responsible for Government contracts administration.

Advance Funding – Budget authority (BA) provided in an appropriation act that allows funds to be committed to a specific purpose (obligated) and spent during that fiscal year (FY) even though the appropriation actually is for the next FY. Advance funding generally is used to avoid requests for supplemental appropriations for entitlement programs late in a FY, when the appropriations for the current FY are too low.

Advance Procurement – Authority provided in an appropriations act to obligate and disburse during a FY from the succeeding year's appropriation. The funds are added to the budget authority for the FY and deducted from the budget authority of the succeeding fiscal year. Used in major acquisition programs to obtain components whose long lead-time require purchase early in order to reduce the overall procurement lead-time of the major end item. Advance procurement of long lead components is an exception to the DoD “full funding” policy.

Advanced Concept Technology Demonstration (ACTD) – A means of demonstrating mature technology to address critical military needs. ACTDs themselves are not acquisition programs, but are designed to provide a residual, usable capability upon completion, and/or transition into acquisition programs. Funding is programmed to

support two years in the field. ACTDs are funded with Advanced Technology Development (ATD)) funds.

Advanced Technology Demonstration (ATD) – Projects within the ATD budget activity which are intended to demonstrate technical feasibility and maturity, and reduce technical risks and uncertainties at the relatively low costs of informal processes.

Affordability – A determination that the life-cycle cost of an acquisition program is in consonance with the long-range investment and force structure plans of the DoD or individual DoD Components.

Allocated Baseline – The initially approved documentation describing a configuration item's (CI) functional and interface characteristics that are allocated from those of a higher level CI; interface requirements with other CIs; design restraints; and verification required to demonstrate the achievement of specified functional and interface characteristics. Allocated baseline consists of the development specifications that define functional requirements for each CI.

Analysis of Alternatives (AoA) – An analysis intended to aid decision making by illuminating the risk, uncertainty, and the relative advantages and disadvantages of alternatives being considered to satisfy a mission need. The AoA shows the sensitivity of each alternative to possible changes in key assumptions (e.g., threat) or variables (e.g., performance capabilities). Part of the CAIV process.

Anti-Tampering (AT) – The system engineering activities intended to prevent and/or delay exploitation of critical technologies in U.S. systems. These activities involve the entire life cycle of systems acquisition, including research, design, development, testing, implementation, and validation of anti-tamper measures. Properly employed, anti-tamper measures will add longevity to a critical technology by deterring efforts to reverse-engineer, exploit, or develop countermeasures against a system or system component.

Apportionment – The action by which the Office of Management and Budget (OMB) distributes amounts available for obligation in an appropriation account. The distribution makes amounts available on the basis of specified time periods (usually quarters), programs, activities, projects, objects, or combinations thereof. The apportionment system is intended to achieve an effective and orderly use of funds. The amounts so apportioned limit the obligations that may be incurred.

Appropriation – An authorization by an act of Congress that permits Federal agencies to incur obligations and make payments from the Treasury. An appropriation usually follows enactment of authorizing legislation. An appropriation act is the most common means of providing budget authority (see Budget Authority (BA)). Appropriations do not represent cash actually set aside in the Treasury; they represent limitations of amounts which agencies may obligate during a specified time period.

Approved Programs – The technical and operational, schedule, and quantity requirements reflected in the latest approved Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD (AT&L)) acquisition decision memorandum (ADM), or other document reflecting a more current decision of the

USD(AT&L) or other appropriate approval authority (such as the President's Budget, the future years defense program (FYDP), and supporting documentation).

Authorization – An act of Congress which permits a Federal program or activity to begin or continue from year to year. It sets limits on funds that can be appropriated, but does not grant funding which must be provided by a separate Congressional appropriation.

Automated Information System – An acquisition program that acquires Information Technology (IT), except IT that: involves equipment that is an integral part of a weapon or weapons system; or is a tactical communication system.

Availability – A measure of the degree to which an item is in an operable and committable state at the start of a mission when the mission is called for at an unknown (random) point in time.

Average Procurement Unit Cost (APUC) – APUC is calculated by dividing total procurement cost by the number of articles to be procured. Total procurement cost includes flyaway, rollaway, sailaway cost (that is, recurring and nonrecurring costs associated with production of the item such as hardware/software, system engineering, engineering changes, and warranties) plus the costs of procuring technical data, training, support equipment, and initial spares.

B

Base Year (BY) – A reference period which determines a fixed price level for comparison in economic escalation calculations and cost estimates. The price level index for the BY is 1.000.

Baseline – Defined quantity or quality used as starting point for subsequent efforts and progress measurement that can be a technical cost or schedule baseline.

Best Value – The most advantageous trade-off between price and performance for the Government. Best value is determined through a process that compares strengths, weaknesses, risk, price, and performance, in accordance with selection criteria, to select the most advantageous value to the Government.

Biennial Budget – The fiscal year (FY) 86 National Defense Authorization Act (NDAA) required the submission of two-year budgets for the DoD beginning with FY 88/89. A biennial budget, as currently structured, represents program budget estimates for a two-year period in which FY requirements remain separate and distinct. The Congress, however, still appropriates annual budget authority.

Breakout – Execution of acquisition strategy to convert some parts or system components from contractor furnished to Government furnished. Rather than having the prime contractor provide from its sources, the Government procures items directly, and provides them to the prime.

Budget Authority (BA) – Authority provided by law to enter into obligations that will result in immediate or future outlays. It may be classified by the period of availability,

by the timing of congressional action, or by the manner of determining the amount available.

Budget Estimate Submission (BES) – The DoD Component's budget submissions to the Office of the Secretary of Defense (OSD) showing budget requirements for inclusion in the DoD budget.

Budget Year(s) (BY) – The year(s) following the current fiscal year (FY), and for which the budget estimate is prepared.

Budgeted Cost – The sum of the budgets for completed work packages and portions of open work packages, plus the appropriate portion of budgets for level of effort and apportioned effort.

Budgeted Cost of Work Scheduled (BCWS) – The sum of the budgets for all work (work packages, planning packages, etc.) scheduled to be accomplished (including in-process work packages), plus the amount of level of effort and apportioned effort scheduled to be accomplished within a given time period. Also called the Performance Measurement Baseline (PMB).

Budgeted Cost of Work Performed (BCWP) – A measurement of the work completed (in Earned Value Management (EVM) terminology). BCWP is the value of work performed, or "earned," when compared to the original plan, that is, the Budgeted Cost of Work Scheduled. The BCWP is called the Earned Value.

Business and Financial Management – Business and financial functions, including management of acquisition funds and contracting activities, typically include: the acquisition plan (AP) (checklist), acquisition strategy (road map); contract types, award and monitoring; cost estimating, formulation of input for the program objectives memorandum (POM), the budget, and other programmatic or financial documentation of the planning, programming, budgeting and execution system (PPBES); request for proposal (RFP) preparation; source selection; contractor surveillance; and budget execution (paying bills).

C

Capability – A measure of the systems' ability to achieve mission objectives, given the system condition during the mission.

Capstone Requirements Document (CRD) – A document resulting from a combination of two or more Initial Capabilities Document (ICD) and Capability Development Document (CDD) programs when considered together in a system-of-systems. The CRD concept takes advantage of independent systems which can be integrated together to create a master system which satisfies a higher level requirement. The CRD identifies master system requirements and serves as a guide for CDD development of independent system components and as a vehicle for program oversight. It is being phased out and will be replaced by functional architectures.

Charter (Program Manager's (PM's)) – A document that provides authority to conduct the program within cost, schedule, and performance constraints approved by the decision authority. Establishes manpower resources for the program office and includes assignment of personnel to perform the functions of technical

assignment of personnel to perform the functions of technical management/systems engineering, logistics, business and financial management, as well as the designation of a contracting officer. It also defines the PM's line of authority and reporting channels.

Combat Developer – Command or agency that formulates doctrine, concepts, organization, materiel requirements, and objectives. May be used generically to represent the user community role in the materiel acquisition process. (Army and Marine Corps)

Commercial Item – A commercial item is any item, other than real property, that is of a type customarily used for non-Governmental purposes and that has been sold, leased, or licensed to the general public; or has been offered for sale, lease, or license to the general public; or any item evolved through advances in technology or performance and that is not yet available in the commercial marketplace, but will be available in the commercial marketplace in time to satisfy the delivery requirements under a Government solicitation. Also included in this definition are Services in support of a commercial item, of a type offered and sold competitively in substantial quantities in the commercial marketplace based on established catalog or market prices for specific tasks performed under standard commercial terms and conditions; this does not include Services that are sold based on hourly rates without an established catalog or market price for a specified service performed.

Commercial Off-The-Shelf (COTS) – Commercial items that require no unique Government modifications or maintenance over the life cycle of the product to meet the needs of the procuring agency.

Component Cost Analysis (CCA) – A cost estimate prepared by an office or other entity of a military department that is outside the chain of command of that military department's authority responsible for developing or acquiring the program.

Computer Software Configuration Item (CSCI) – Analogous to a hardware configuration item, that is, a CSCI is software program (typically) which performs a common end-use function, follows its own development cycle, and is individually managed. It is also called a Software Item (SI).

Concept Exploration (CE) – Previously a phase of the acquisition life cycle. It was the initial phase of the system acquisition process. During this phase, the acquisition strategy was developed and system alternatives were proposed and examined. Being replaced by the Concept Refinement (CR) Phase.

Concurrent Budget Resolution (CBR) – Resolution passed by both Houses of Congress, but not requiring the signature of the President, setting forth or revising the congressional budget for the United States Government. Scheduled to be adopted by the Congress on or before April 15 of each year (Title 2 U.S.C. § 632).

Configuration Item (CI) – An aggregation of hardware, firmware, computer software, or any of their discrete portions, which satisfies an end use function and is designated by the Government for separate configuration management. Configuration items may vary widely in complexity, size, and type, from an aircraft, electronic, or ship system to a test meter or round of ammunition. Any item required for logistic support and designated for separate procurement is a CI.

Configuration Management (CM) – The technical and administrative direction and surveillance actions taken to identify and document the functional and physical characteristics of a configuration item (CI), to control changes to a CI and its characteristics, and to record and report change processing and implementation status. It provides a complete audit trail of decisions and design modifications.

Constant Dollars – A method of relating dollars in several years by removing the effects of inflation and showing all dollars at the value they would have in a selected base year (BY). Constant (base year) dollar series are derived by dividing current dollar estimates by appropriate price indices, a process generally known as deflating. The result is a time series as it would presumably exist if prices were the same throughout as in the BY in other words, as if the dollar had constant purchasing power. Any changes in such a series would reflect only changes in the real (physical) volume of output. Constant dollar figures are commonly used for gross domestic product (GDP) and its components.

Constant Year Dollars – See Constant Dollars.

Constructive Change – A contract change without formal written authority.

Consumable – Administrative or housekeeping items, general purpose hardware, common tolls, or any item not specifically identified as controlled equipage or spare parts.

Continuous Acquisition and Life-Cycle Support (CALS) – A core strategy to share integrated digital product data through a set of standards to achieve efficiencies in business and operational mission areas.

Contract Administration Office (CAO) – The activity identified in the DoD Directory of Contract Administration Services Components assigned to perform contract administration responsibilities.

Contract Authority – A type of budget authority that permits a Federal agency to incur obligations before appropriations have been passed or in excess of the amount of money in a revolving fund. Contract authority must be funded subsequently by an appropriation so that the commitments entered into can be paid.

Contract Award – Occurs when the contracting officer has signed and distributed the contract to the contractor.

Contract Work Breakdown Structure (CWBS) – A complete WBS for a contract. It includes the DoD-approved Program WBS (PWBS) extended to the agreed contract reporting level and any discretionary extensions to lower levels for reporting or other purposes. It includes all the elements for the products (hardware, software, data, or services) which are the responsibility of the contractor. This comprehensive WBS forms the framework for the contractor's management control system.

Contracting Activity – Certain commands designated by the Services as contracting activities. Also, the subordinate command in which the principal contracting office is located. It may include the program office, related functional support offices, and contracting offices. The Department of Defense Federal Acquisition Regulation Sup-

plement (DFARS) lists the contracting activities. Examples are Naval Air Systems Command (NAVAIR) and Air Force Materiel Command (AFMC). Contracting activity is synonymous with Procuring Activity. The Head of Contracting Activity (HCA) has certain approval and authority responsibilities.

Contracting Officer (CO) – A person with authority to enter into, administer, and/or terminate contracts and make related determinations and findings.

Contractor Logistics Support (CLS) – The performance of maintenance and/or material management functions for a DoD system by a commercial activity. Historically done on an interim basis until systems support could be transitioned to a DoD organic capability. Current policy now allows for the provision of system support by contractors on a long-term basis. Also called Long-Term Contractor Logistics Support.

Cost/ Pricing Data – Used by the contractor to respond to a Government request for proposal (RFP). The Truth-in-Negotiations Act (TINA) requires the bidding contractors certify that the data are complete, current, and accurate as of the date the contractor and the Government agree on a price.

Cost Analysis Improvement Group (CAIG) – Organization within the office of the Director, Program Analysis and Evaluation (PA&E) which advises the Defense Acquisition Board (DAB) on matters concerning the estimation, review, and presentation of cost analysis of future weapon systems. The CAIG also develops common cost estimating procedures for DoD.

Cost as An Independent Variable (CAIV) – Methodologies used to acquire and operate affordable DoD systems by setting aggressive, achievable life-cycle cost objectives, and managing achievement of these objectives by trading off performance and schedule, as necessary. Cost objectives balance mission needs with projected outyear resources, taking into account anticipated process improvements in both DoD and industry. CAIV has brought attention to the Government's responsibilities for setting/adjusting life-cycle cost objectives and for evaluating requirements in terms of overall cost consequences.

Cost Performance Integrated Product Team (CPIPT) – An integrated product team (IPT) established to perform cost performance trade-offs.

Cost Risk – The risk that a program will not meet its acquisition strategy cost objectives that were developed using cost as an independent variable (CAIV) or cost objectives established by the acquisition authority.

Cost Variance (CV) – An output of the Earned Value Management System (EVMS) which measures cost overrun or cost underrun relative to the program performance measurement baseline. It is equal to the difference between BCWP and ACWP, that is, CV = BCWP – ACWP.

Critical Design Review (CDR) – A review that may be conducted to determine that the detailed design satisfies the performance and engineering requirements of the development specification; to establish the detailed design compatibility among the item and other items of equipment, facilities, computer programs, and personnel; to as-

sess producibility and risk areas; and to review the preliminary product baseline specifications. Normally conducted between System Integration and System Demonstration of the System Development and Demonstration (SDD) Phase.

Critical Program Information (CPI) – Program information, technologies, or systems that, if compromised, would degrade combat effectiveness, shorten the expected combat effective life of the system, or significantly alter program direction. This includes classified military information or Controlled Unclassified Information (CUI) about such program information, technologies, or systems.

Current-Year Dollars, Then-Year Dollars – Dollars that include the effects of inflation or escalation and/or reflect the price levels expected to prevail during the year at issue.

Current Year (CY) – The fiscal year in progress. Also called the execution year. (See Budget Year (BY).)

D

DAB – See Defense Acquisition Board.

DAB Program – Requires an Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD(AT&L)) decision at each milestone review point (acquisition category (ACAT) ID program).

Defense Acquisition Board (DAB) – The DAB is the Department's senior-level forum for advising the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD(AT&L)) on critical decisions concerning acquisition category (ACAT) ID programs.

Defense Acquisition Deskbook – An automated reference tool sponsored by the Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics) (OUSD (AT&L)) to assist program offices in implementing the DoD 5000 Series. It consists of a World Wide Web (WWW) home page with a bulletin board, an information structure of discretionary information, and a reference library of statutory and regulatory guidance. The information structure and reference library may be accessed through commercially available Web browsers, and are available by CD subscription from the home page location. The Deskbook is now referred to as the "Legacy" Deskbook and is included as part of the DoD AT&L Knowledge Sharing System (AKSS).

Defense Acquisition Executive (DAE) – The individual responsible for all acquisition matters within the DoD.

Defense Contract Management Agency (DCMA) – The contract administration function is performed by DCMC, which is part of the Defense Logistics Agency (DLA).

Defense Planning Guidance (DPG) – Document issued annually by the Secretary of Defense (SECDEF) to DoD components providing strategic framework for developing the Service program objective memorandums (POMs). Result of planning efforts by the Joint Staff, Office of the Secretary of Defense (OSD), and the Services.

Defense Systems Management College (DSMC) – A DoD college dedicated to educating DoD military and civilian personnel and industry in the DoD systems acquisition process, and conducting research and consulting to support and improve DoD acquisition program management requirements. DSMC is now a part of the Defense Acquisition University (DAU) and resides on the Capital/Northeast campus of DAU.

Demonstration and Validation (DEM/VAL) – A budget activity formerly in the Research, Development, Test, and Evaluation (RDT&E) appropriation. Normally funded the first part of the System Development and Demonstration (SDD) Phase. Term has been replaced by the term "Advanced Component Development and Prototypes."

Department of Defense Strategic Plan – A plan required by the Government Performance and Results Act (GPRA) of 1993. The plan is submitted to the Director of the Office of Management and Budget (OMB) and Congress and must contain, among other things, a comprehensive mission statement, general goals and objectives, an identification of key external factors beyond the Department's control, descriptions of how goals are to be achieved, how performance goals are related to general goals and objectives, and the program evaluations used to establish or revise general goals and objectives. The Secretary of Defense has determined that the Quadrennial Defense Review (QDR) is the DoD Strategic Plan required by GPRA.

Deploy/Deployment – Fielding a weapon system by placing it into operational use with units in the field/fleet.

Developmental Test and Evaluation (DT&E) – Any engineering-type test used to verify status of technical progress, verify that design risks are minimized, substantiate achievement of contract technical performance, and certify readiness for initial operational testing. Development tests generally require instrumentation and measurements and are accomplished by engineers, technicians, or soldier operator-maintainer test personnel in a controlled environment to facilitate failure analysis.

DoD Components – The Office of the Secretary of Defense (OSD); the military departments; the Chairman, Joint Chiefs of Staff (CJCS) and Joint Staff; the Unified Combatant Commands; the defense agencies; and DoD field activities.

DoD Component Acquisition Executive (CAE) – A single official within a DoD Component who is responsible for all acquisition functions within that Component. This includes Service Acquisition Executives (SAEs) for the military departments and acquisition executives in other DoD Components, such as the U.S. Special Operations Command (USSOCOM) and Defense Logistics Agency (DLA), who have acquisition management responsibilities.

E

Earned Value Management System (EVMS) – Industry-developed set of 32 standards adopted for use by DoD in 1996 for evaluation of contractor management systems. A complete listing of the standards is contained in the American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) EVMS Standard (ANSI/EIA -748-98). The EVMS replaced the Cost/Schedule Control Systems Criteria (C/SCSC), which contained 35 standards for evaluation of contractor management systems. Contractors with systems formally recognized by DoD as meeting the 35 C/SCSC

standards prior to November 1996 are considered compliant with the 32 EVMS standards.

Economic Analysis – A systematic approach to a given program, designed to assist the manager in solving a problem of choice. The full problem is investigated. Objectives and alternatives are searched out and compared in light of their benefits and costs through the use of an appropriate analytical framework.

Electronic and Information Technology (EIT) – Any equipment or interconnected system or sub-system of equipment used in the creation, conversion, or duplication of data or information. In addition, EIT encompasses:

- Telecommunication products (for example: telephones);
- Information kiosks;
- Transaction machines;
- World Wide Web sites;
- Multimedia (including videotapes); and
- Office equipment (for example: copiers and fax machines).

Enactment – Action by the Congress on the President's Budget. Includes hearings, budget resolution, authorizations and appropriations acts. Result is appropriations (funding) for Federal Government.

Engineering and Manufacturing Development (EMD) –

1. Previously the third phase in the acquisition process, following the old Milestone II. The principal objectives of this phase were to: translate the most promising design approach into a stable, interoperable, producible, supportable, and cost-effective design; validate the manufacturing process or production process; and demonstrate system capabilities through testing.
2. A budget activity in the Research, Development, Test and Evaluation (RDT&E) appropriation. Has been replaced by the term “System Development and Demonstration (SDD).”

Engineering Development Model (EDM) A production representative system that may be used during the Engineering and Manufacturing Development (EMD) phase to resolve design deficiencies, demonstrate maturing performance, and develop proposed production specifications and drawings. May also be used for initial operational test and evaluation (IOT&E).

Equipment – Any equipment used by the DoD Component directly or used by a contractor under a contract with the Component that requires the use of such equipment, or the use, to a significant extent, of such equipment in the performance of a service or the furnishing of a product.

Estimated Cost at Completion (EAC) – Actual direct costs, plus indirect costs or allocable to the contract, plus the estimate of costs (direct and indirect) for authorized work remaining.

Event-Based Contracting – Supports “event-driven acquisition strategy” by linking specific contractual events to the “exit criteria” for the acquisition phase, or to intermediate development events established for the acquisition strategy.

Event-Driven Acquisition Strategy – An acquisition strategy that links program decisions to demonstrated accomplishments in development, testing, and production.

Evolutionary Acquisition (EA) – An acquisition strategy approach characterized by the design, development, and deployment of a preliminary capability using current technology that includes provisions for the evolutionary addition of future capabilities as requirements are further defined and technologies mature.

Evolutionary Requirements Definition – Mission needs are first expressed in broad operational capability terms, then progressively evolved to system specific performance requirements.

Exit Criteria – Program specific accomplishments that must be satisfactorily demonstrated before a program can progress further in the current acquisition phase or transition to the next acquisition phase. Exit criteria are normally selected to track progress in important technical, schedule, or management risk areas.

F

Failure – The event in which any part of an item does not perform as required by its performance specification. The failure may occur at a value in excess of the minimum required in the specification, i.e., past design limits or beyond the margin of safety.

Federal Acquisition Computer Network (FACNET) – FACNET allows the electronic interchange of procurement information between the private sector and the Federal Government and among Federal agencies. FACNET allows Federal agencies to electronically provide notice of solicitations for contracts, receive responses to solicitations and associated requests for information, provide public notice of contract awards, make payments to contractors, and archive data relating to each procurement action.

Federal Acquisition Regulation (FAR) – The regulation for use by Federal executive agencies for acquisition of supplies and services with appropriated funds. The FAR is supplemented by the Military Departments and by DoD. The DoD supplement is called the DFARS (Department of Defense FAR Supplement).

First Article Testing (FAT) – Production testing that is planned, conducted, and monitored by the materiel developer. FAT includes preproduction and initial production testing conducted to ensure that the contractor can furnish a product that meets the established technical criteria.

First Unit Equipped (FUE) Date – The scheduled date system or end item and its agreed upon support elements are issued to the designated initial operational capability unit and training specified in the new equipment training plan has been accomplished.

Fiscal Guidance – Annual guidance issued by the Secretary of Defense (SECDEF), consistent with Defense Planning Guidance (DPG). Provides fiscal constraints that must be observed by DoD Components in the formulation of force structures and by the OSD and joint staff in reviewing proposed programs.

Fiscal Year (FY) – U.S. Government: 1 October to 30 September (12 months).

Flexible Sustainment (FS) – A concept that provides procedural freedom to optimize life-cycle costs through trade-offs which are accomplished either during initial or follow-on acquisition. The principal elements of FS are reliability based logistics (RBL) techniques and trigger based item management (TBIM). Both of these processes attempt to take maximum advantage of commercial industry capabilities and practices.

Flyaway Costs – Costs related to the production of a useable end item of military hardware. Includes the cost of creating the basic unit (airframe, hull, chassis, etc.), an allowance for changes, propulsion equipment, electronics, armament, and other installed Government-furnished equipment (GFE), and nonrecurring “start-up” production costs. Equates to Rollaway and Sailaway costs.

Focused Logistics – A Joint Chiefs of Staff (JCS) initiative which seeks the fusion of information, logistics, and transportation technologies to provide rapid crisis response by allowing for the tracking and shifting of assets en route and the delivery of tailored logistics and sustainment packages directly at the strategic, operational, or tactical level of operations.

Follow-On Operational Test and Evaluation (FOT&E) – The test and evaluation (T&E) that may be necessary after Milestone III to refine the estimates made during operational test and evaluation (OT&E), to evaluate changes, and to reevaluate the system to ensure that it continues to meet operational needs and retains its effectiveness in a new environment or against a new threat.

Force Levels – Number of aircraft, ships, troops, and other forces that are required to accomplish assigned tasks or missions. Normally identified by specified aircraft model, ship type, Army divisions, etc.

Forces – Broadly, the fighting elements (combatant) of the overall defense structure; units, equipment, etc., shown in the future years defense program (FYDP).

Force Structure – The composition of a Service, or all Services together, in terms of the number of major combat and support units, and their relationship to each other.

Full Funding – The annual appropriation of funds for the total estimated costs to be incurred in the delivery of a given quantity of a usable end item. A budget rule applied to procurement and military construction.

Full Operational Capability (FOC) – The full attainment of the capability to employ effectively a weapon, item of equipment, or system of approved specific characteristics, which is manned and operated by a trained, equipped, and supported military unit or force.

Functional Baseline – Documentation describing a system's/segments functional characteristics and the verification required to demonstrate the achievement of those specified functional characteristics. The system or segment specification establishes the functional baseline.

Functional Configuration Audit (FCA) – The formal examination of the functional characteristics of a configuration item (CI) as demonstrated by test data to verify that the item has achieved the performance specified in its functional or allocated configuration prior to acceptance.

Future Years Defense Program (FYDP) – The official DoD document that summarizes forces and resources associated with programs approved by the Secretary of Defense (SECDEF). Its three parts are the organizations affected, appropriations accounts (research, development, test, and evaluation (RDT&E), operations and maintenance (O&M), etc.), and the 11 major force programs (strategic forces, airlift/sealift, R&D, etc.). The primary data element in the FYDP is the Program Element (PE).

G

Goldwater-Nichols – Name given to the Defense Reorganization Act of 1986, which restructured certain aspects of DoD management. Named for Senator Barry Goldwater and Representative Bill Nichols, co-authors.

H

Head of Agency – In DoD, the Secretary of Defense (SECDEF), and the Secretaries of the Army, Navy, and Air Force are heads of agencies. Subject to the direction of the SECDEF, the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD(AT&L)), the Director of Defense Procurement and Acquisition Policy, and the directors of the defense agencies have been delegated authority to act as head of agency for their respective agencies (i.e., to perform functions under the Federal Acquisition Regulation (FAR) or Department of Defense FAR Supplement (DFARS) reserved to an agency head), except for such actions that by terms of statute, or any delegation, must be exercised within the Office of the Secretary of Defense (OSD). Title 10 U.S.C. §167 provides the Combatant Commander, Special Operations Command with head of agency authority similar to that of the Service secretaries.

Highly Sensitive Classified Program – An acquisition special access program established in accordance with DoD 5200.1-R, *Information Security Program Regulation*, and managed in accordance with DoD Directive 0-5205.7, *Special Access Program Policy*.

Human Factors – The systematic application of relevant information about human abilities, characteristics, behavior, motivation, and performance. It includes principles and applications in the areas of human engineering, anthropometrics, personnel selection, training, life support, job performance aids, and human performance evaluation.

Human Performance – The ability of actual users and maintainers to meet the system's performance standards, including reliability and maintainability, under the conditions in which the system will be employed.

I

"Ilities" – The operational and support requirements a program must address (e.g., availability, maintainability, vulnerability, reliability, logistic supportability, etc.).

Impoundment – An action by the President that prevents the obligation or expenditure of budget authority. Deferrals and rescissions are the two types of presidential impoundment.

Incremental Funding – The provision (or recording) of budgetary resources for a program or project based on obligations estimated to be incurred within a fiscal year (FY) when such budgetary resources will cover only a portion of the obligations to be incurred in completing the program or project as programmed. This differs from full funding, where budgetary resources are provided or recorded for the total estimated obligations for a program or project in the initial year of funding. (For distinction, see Full Funding.) Most commonly used for research and development (R&D) as opposed to production, which must be fully funded.

Independent Cost Analysis (ICA) – An analysis of program office and/or Component life-cycle cost estimates conducted by an impartial body disassociated from the management of the program.

Independent Cost Estimate (ICE) – A life-cycle cost estimate for ACAT I programs prepared by an office or other entity that is not under the supervision, direction, or control of the military department, defense agency, or other component of the DoD that is directly responsible for carrying out the development or acquisition of the program, or if the decision authority has been delegated to a Component, prepared by an office or other entity that is not directly responsible for carrying on the development or acquisition of the program.

Industrial Capability Analysis – An analysis of the industrial capability to design, develop, support, and if appropriate, restart an acquisition program (Title 10 U.S.C. § 2440). It is a required part of the acquisition strategy for ACAT I programs.

Information Technology (IT) – Any equipment or interconnected system or sub-system of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. IT includes computers, ancillary equipment, software, firmware and similar procedures, services and related resources. The term “IT” also includes National Security Systems (NSS). It does not include any equipment that is acquired by a Federal contractor incidental to a Federal contract.

Inherent Availability – Availability of a system with respect only to operating time and corrective maintenance. It ignores standby and delay times associated with preventive maintenance as well as administrative and logistics down time.

Inherent Reliability and Maintenance (R&M) Value – Any measure of reliability or maintainability that includes only the effects of item design and installation, and assumes an ideal operating and support environment.

Initial Operational Capability (IOC) – The first attainment of the capability to employ effectively a weapon, item of equipment, or system of approved specific characteristics with the appropriate number, type, and mix of trained and equipped personnel necessary to operate, maintain, and support the system. It is normally defined in the Capability Development Document (CDD).

Initial Operational Test and Evaluation (IOT&E) – Operational test and evaluation conducted on production, or production representative articles, to determine whether systems are operationally effective and suitable, and which supports the decision to proceed beyond low rate initial production (LRIP).

Initial Provisioning – The process of determining the range and quantity of items (i.e., spares and repair parts, special tools, and test and support equipment) required to support and maintain an item for an initial period of service. Its phases include the identification of items of supply, the establishment of data for catalog, technical manual and allowance list preparation, and the preparation of instructions to assure delivery of necessary support items with related end articles.

Initial Spares – Items procured for logistics support of a system during its initial period of operation.

Integrated Baseline Review – The PM's review of a contractor's performance measurement baseline. It is conducted by PMs and their technical staffs or Integrated Product Teams (IPTs) on contracts requiring compliance with DoD EVMS criteria or Cost/Schedule Status Report (C/SSR) requirements within six months after contract award.

Integrated Product and Process Development (IPPD) – A management process that integrates all activities from product concept through production and support, using a multifunctional team, to simultaneously optimize the product and its manufacturing and sustainment processes to meet cost, schedule, and performance objectives.

Integrated Product Team (IPT) – A multifunctional team assembled around a product or service, and responsible for advising the project leader, PM, or MDA on cost, schedule, and performance of that product. There are three types of IPTs: Program IPTs (PIPTs), Working-level IPTs (WIPTs), and Overarching IPTs (OIPTs).

Intellectual Property – Includes inventions, trademarks, patents, industrial designs, copyrights, and technical information including software, data designs, technical know-how, manufacturing information and know-how, techniques, technical data packages (TDPs), manufacturing data packages, and trade secrets.

Interim Contractor Support – Temporary contractor support that allows the Service to defer investment in all or part of the support resources (spares, technical data, support equipment, training equipment, etc.) while the organic capability is being phased in.

Intermediate Level Maintenance – That level which maintains/repairs items for which the organizational level is incapable, but which do not have to go to depot level for major work.

Inventory Control Point (ICP) – The organizational element within a distribution system which is assigned responsibility for system-wide direction and control of materiel including such management functions as the computation of requirements, the initiation of procurement or disposal actions, the development of worldwide quantitative and monetary inventory data, and the positioning and repositioning of materiel.

Issue Papers – The Office of the Secretary of Defense (OSD) documents defining issues raised during review of the program objectives memorandum (POM).

J

Joint Logistics Commanders (JLC) – Senior logistics military officers of the U.S. Army, U.S. Navy, Marine Corps, U.S. Air Force, and Defense Logistics Agency (DLA). Includes the Commander, U.S. Army Materiel Command (AMC); Deputy Chief of Naval Operations (Logistics); Deputy Chief of Staff (Installations and Logistics), USMC; Commander, Air Force Materiel Command; and Director, DLA.

Joint Requirements Oversight Council (JROC) – Assists the Chairman, Joint Chiefs of Staff in identifying and assessing the priority of joint military requirements (including existing systems and equipment) to meet the national military strategy. The Vice Chairman of the Joint Chiefs of Staff (VCJCS) chairs the Council and decides all matters before the Council. The permanent members include the Vice Chiefs of the U.S. Army (VCSA) and U.S. Air Force (VCSAF), the Vice Chief of Naval Operations (VCNO), and the Assistant Commandant of the Marine Corps (ACMC). The Council directly supports the Defense Acquisition Board (DAB) through the review, validation, and approval of key cost, schedule, and performance parameters at the start of the acquisition process, prior to each milestone review, or as requested by the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)).

Justification and Approval (J&A) – A document required by the Federal Acquisition Regulation (FAR) that justifies and obtains approval for contract solicitations that use other than full and open competition.

Just-In-Time (JIT) – A “pull” system, driven by actual demand. The goal is to produce or provide one part JIT for the next operation. Reduces stock inventories, but leaves no room for schedule error. As much a managerial philosophy as it is an inventory system.

K

Key Performance Parameters (KPPs) – Those capabilities or characteristics so significant that failure to meet the threshold value of performance can be cause for the system selected to be reevaluated or the program to be reassessed or terminated. KPPs are a critical subset of all the performance parameters found in the ORD, and are included in the performance portion of the APB. KPPs are validated by the JROC for ACAT I programs. For ACAT IA programs, KPPs are validated by the JROC or cognizant PSA.

L

Lethality – The probability that weapon effects will destroy the target or render it neutral.

Life-Cycle Cost (LCC) – The total cost to the Government of acquisition and ownership of that system over its useful life. It includes the cost of development, acquisition, operations, and support (to include manpower), and where applicable, disposal. For defense systems, Life-Cycle Cost is also called Defense Systems Total Ownership Cost (TOC).

Life Cycle (Weapon System) – All phases of the system's life including research, development, test and evaluation (RDT&E), production, deployment (inventory), operations and support (O&S), and disposal.

Line Item (Budget) – A specific program end item with its own identity (e.g., B-1B Bomber).

Live Fire Test and Evaluation (LFT&E) – A test process that is defined in Title 10 U.S.C. § 2366, that must be conducted on a covered system, major munition program, missile program, or product improvement to a covered system, major munition program, or missile program before it can proceed beyond low rate initial production (LRIP). A covered system is any vehicle, weapon platform, or conventional weapon system that includes features designed to provide some degree of protection to the user in combat and that is an acquisition category (ACAT) I or ACAT II program.

Logistic Support (LS) Elements A traditional group of items, that taken together constitute logistics support. These include: maintenance planning; manpower and personnel; supply support; support equipment; technical data; training and training support; computer resources support; facilities; packaging, handling, storage, and transportation; and, design interface.

Low-Rate Initial Production (LRIP) The minimum number of systems (other than ships and satellites) to provide production representative articles for operational test and evaluation (OT&E), to establish an initial production base, and to permit an orderly increase in the production rate sufficient to lead to full-rate production upon successful completion of operational testing. For major defense acquisition programs (MDAPs), LRIP quantities in excess of 10 percent of the acquisition objective must be reported in the selected acquisition report (SAR). For ships and satellites LRIP is the minimum quantity and rate that preserves mobilization.

M

Maintainability – The ability of an item to be retained in, or restored to, a specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair.

Maintenance Plan – A detailed description of maintenance decisions on each repairable item candidate within the system Work Breakdown Structure (WBS). There are typically a family of maintenance plans covering each major sub-system, e.g., radar subsystem, hydraulic sub-system, etc. The maintenance plan is based on the level of repair analysis and is the basis for each of the traditional elements of logistic support (LS).

Major Automated Information System (MAIS) Acquisition Program – An AIS that is designated by Assistant Secretary of Defense (Network and Information Integration) (ASD(NI2)) as a MAIS, or estimated to require program costs in any single year in excess of $32 million in fiscal year (FY) 2000 constant dollars, total program costs in excess of $126 million in FY 2000 constant dollars, or total life-cycle costs in excess of $378 million in FY 2000 constant dollars. MAISs do not include highly sensitive

classified programs (as determined by the Secretary of Defense) or tactical communication systems.

Major Defense Acquisition Program (MDAP) – An acquisition program that is not a highly sensitive classified program (as determined by the Secretary of Defense) and that is designated by the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD(AT&L)) as an MDAP, or estimated by the USD(AT&L) to require an eventual total expenditure for research, development, test and evaluation (RDT&E) of more than $365 million in FY 2000 constant dollars or, for procurement, of more than $2.190 billion in FY 2000 constant dollars.

Major Force Program (MFP) – A MFP is an aggregation of program elements which reflects a macro-level force mission or a support mission of DoD and contains the resources necessary to achieve an objective or plan. It reflects fiscal time-phasing of mission objectives to be accomplished and the means proposed for their accomplishment. The future years defense program (FYDP) is composed of 11 (6 combat and 5 support oriented) major force programs:

Program 1 – Strategic Forces;
Program 2 – General Purpose Forces;
Program 3 – Intelligence and Communications;
Program 4 – Airlift and Sealift Forces;
Program 5 – Guard and Reserve Forces;
Program 6 – Research and Development;
Program 7 – Central Supply and Maintenance;
Program 8 – Training, Medical, and other General Personnel Activities;
Program 9 – Administration and Associated Activities;
Program 10 – Support of Other Nations; and
Program 11 – Special Operations Forces.

Major Program – A term synonymous with major defense acquisition program (MDAP).

Major System (DoD) – A combination of elements that shall function together to produce the capabilities required to fulfill a mission need, including hardware, equipment, software, or any combination thereof, but excluding construction or other improvements to real property. A system shall be considered a major system if it is estimated by the DoD Component Head to require an eventual total expenditure for research, development, test, and evaluation (RDT&E) of more than $140 million in FY 2000 constant dollars, or for procurement of more than $660 million in FY 2000 constant dollars, or if designated as major by the DoD Component Head. The estimate shall consider all blocks that will make up an evolutionary acquisition program (to the extent that subsequent blocks can be defined).

Manpower – The total supply of persons available and fitted for service. Indexed by requirements including jobs lists, slots, or billets characterized by descriptions of the required people to fill them.

Manpower and Personnel – The process of identifying and acquiring military and civilian personnel with the skills and grades required to operate and support a materiel system over its lifetime at peacetime and wartime rates. One of the traditional elements of logistic support (LS).

Manpower Estimate – An estimate of the number of personnel required to operate, maintain, support, and train for the acquisition upon full operational deployment. Required for all acquisition category (ACAT) I programs.

Manufacturing Technology (MANTECH) – Refers to any action which has as its objective: the timely establishment or improvement of the manufacturing processes, techniques, or equipment required to support current and projected programs, and the assurance of the availability to produce, reduce lead-time, ensure economic availability of end items, reduce costs, increase efficiency, improve reliability, or to enhance safety and antipollution measures.

Measures of Effectiveness (MOE) – A measure of operational success that must be closely related to the objective of the mission or operation being evaluated. For example, the number of enemy submarines sunk or enemy tanks destroyed may be satisfactory MOEs if the objective is to destroy such weapons systems. However, if the real objective is to protect shipping or an infantry battalion, then the best course of action might be one which results in fewer friendly submarines or tanks actually killed. MOEs denoted in the Analysis of Alternatives (AoA), Initial Capabilities Document (ICD) and Test and Evaluation Master Plan (TEMP) must be consistent. A meaningful MOE must be quantifiable and a measure to what degree the real objective is achieved.

Measures of Performance (MOP) – Measures of a system's technical performance expressed as speed, payload, range, time on station, frequency, or other distinctly quantifiable performance features. Several MOPs may be related to the achievement of a particular MOE.

Milestone (MS) – Major decision points in a program's life cycle.

Milestone Decision Authority (MDA) – The individual designated in accordance with criteria established by the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)), or by the Assistant Secretary of Defense for Networks and Information Integration (ASD(NI2)) for AIS acquisition programs, to approve entry of an acquisition program into the next phase of the acquisition process.

Mission Area – A segment of the defense mission as established by the Secretary of Defense (SECDEF). Each DoD component has mission areas (e.g., Navy – anti-submarine warfare, Army – ground combat, etc.) for which it must equip its forces.

Mission Area Analysis (MAA) – The process by which operational deficiencies are determined, technological opportunities for increased system effectiveness and/or cost reduction are assessed, and mission needs identified. Being replaced by term "Functional Area Analysis (FAA)."

Mission Critical Information System – A system that meets the definitions of "information system" and "national security system" in the Clinger-Cohen Act (CCA), the loss of which (the system) would cause the stoppage of warfighter operations or direct mission support of warfighter operations. (Note: The designation of mission critical should be made by a Component Head, a Combatant Commander or their desig-

nee.) A Mission Critical Information Technology System has the same meaning as a Mission Critical Information System.

Mission Essential Information System – A system that meets the definition of "information system" in the Clinger-Cohen Act (CCA), that the acquiring Component Head or designee determines is basic and necessary for the accomplishment of the organizational mission. (Note: The designation of mission essential should be made by a Component Head, a Combatant Commander or their designee.) A Mission Essential Information Technology System has the same meaning as a Mission Essential Information System.

Mission Need Statement (MNS) – A non-system specific statement of operational capability need previously prepared in accordance with the Chairman, Joint Chiefs of Staff Instruction (CJCSI) 3170.01_. The MNS is planned for phase-out and replacement by the Initial Capabilities Document (ICD). In the past, this document was developed by DoD components and forwarded to the operational validation authority for validation and approval.

Mission Reliability – The probability that a system will perform its required mission critical functions for a given period of time under conditions stated in the mission profile.

Modification – A configuration change to a produced configuration item (CI). Any modification that is of sufficient cost and complexity that it could itself qualify as an acquisition category (ACAT) I or ACT IA program, must be considered a separate acquisition program.

Multiyear Procurement (MYP) – A method of competitively purchasing up to five years requirements in one contract which is funded annually as appropriations permit. If necessary to cancel the remaining quantities in any year, the contractor is paid an agreed upon portion of the unamortized nonrecurring start-up costs. Approved by the Congress.

N

National Military Strategy (NMS) – Joint Strategic Planning System (JSPS) document developed by the Joint Staff. Provides the advice of the Chairman, Joint Chiefs of Staff (CJCS), in consultation with the other members of the JCS and the Combatant Commanders, to the President, the National Security Council (NSC), and the Secretary of Defense (SECDEF) on the national military strategy. It is designed to assist the SECDEF in preparation of the Defense Planning Guidance (DPG).

National Security System (NSS) – Any telecommunications or information system operated by the U.S. Government, the function, operation, or use of which:

- Involves intelligence activities;
- Involves cryptologic activities related to national security;
- Involves command and control of military forces;
- Involves equipment that is an integral part of a weapon or weapons system; or,
- Subject to the limitation below, is critical to the direct fulfillment of military or intelligence missions. This does not include a system that is to be used for

routine administrative and business applications (including payroll, finance, logistics, and personnel management applications).

Nondevelopmental Item (NDI) – A nondevelopmental item is any previously developed item of supply used exclusively for Government purposes by a Federal agency, a state or local Government, or a foreign Government with which the United States has a mutual defense cooperation agreement; any item described above that requires only minor modifications or modifications of the type customarily available in the commercial marketplace in order to meet the requirements of the processing department or agency.

Nonmajor Defense Acquisition Program – A program other than a major defense acquisition program (MDAP) acquisition category (ACAT) I or a highly sensitive classified program: i.e., ACAT II, III and IV programs.

Nonmateriel Solution – Solutions to mission needs (operational deficiencies) that can be satisfied by changes in doctrine, tactics, operational concepts, training, or organizations.

O

Objective – The performance value that is desired by the user and which the program manager (PM) is attempting to obtain. The objective value represents an operationally meaningful, time critical, and cost effective increment above the performance threshold for each program parameter.

Obligation Authority (OA) –

1. A congressional authorization to procure goods and services within a specified amount by appropriation or other authorization.

2. The administrative extension of such authority, as by apportionment or funding.

3. The amount of authority so granted.

Open Systems Acquisition of Weapons Systems – An integrated technical and business strategy that defines key interfaces for a system (or a piece of equipment under development) in accordance with those adopted by formal consensus bodies (recognized industry standards bodies) as specifications and standards, or commonly accepted (de facto) standards (both company proprietary and non-proprietary) if they facilitate utilization of multiple suppliers.

Operational Availability (Ao) – The degree (expressed in terms of 1.0 or 100 percent as the highest) to which one can expect an equipment or weapon systems to work properly when it is required. The equation is uptime over uptime plus downtime, expressed as Ao. It is the quantitative link between readiness objectives and supportability.

Operational Requirements – User - or user representative - generated validated needs developed to address mission area deficiencies, evolving threats, emerging

technologies, or weapon system cost improvements. Operational requirements form the foundation for weapon system unique specifications and contract requirements.

Operational Requirements Document (ORD) – Previously used to document the user's objective (desired) and threshold (minimum acceptable) level of requirements for operational performance of a proposed concept or system. Format is contained in previous editions of CJCS 3170.01_. Being phased out and replaced by the Capability Development Document (CDD).

Operational Test and Evaluation (OT&E) – The field test, under realistic conditions, of any item (or key component) of weapons, equipment, or munitions for the purpose of determining the effectiveness and suitability of the weapons, equipment, or munitions for use in combat by typical military users; and the evaluation of the results of such tests.

Operations and Support (O&S) – Those resources required to operate and support a system, sub-system, or a major component during its useful life in the operational inventory.

Organizational Level Maintenance – The maintenance and repair performed by the activity level (organization) which uses the system's equipment within the activity's capability.

Out-Years – Normally, the years beyond the year being worked in the upcoming budget. If budget for fiscal years (FY) 02-03 is being prepared, out-years are FY04 and beyond. Also used to refer to years beyond the current program objectives memorandum (POM), e.g., POM covers 02-07, out-years are 08 and beyond.

Overarching Integrated Product Team (OIPT) – An integrated product team (IPT) led by the appropriate Office of the Secretary of Defense (OSD) director, and composed of the program manager (PM), program executive officer (PEO), component staff, user/user representative, and OSD staff involved in the oversight and review of a particular acquisition category (ACAT) ID program.

Oversight – Review activity by OSD, DoD components and congressional committees of DoD programs to determine current status, ascertain if the law or other desires of the Congress are being followed, or as a basis for possible future legislation.

P

Performance – Those operational and support characteristics of the system that allow it to effectively and efficiently perform its assigned mission over time. The support characteristics of the system include both supportability aspects of the design and the support elements necessary for system operation.

Physical Configuration Audit (PCA) – Physical examination to verify that the configuration item(s) (CIs) "as built" conform to the technical documentation which defines the item. Approval by the Government program office of the CI product specification and satisfactory completion of this audit establishes the product baseline. May be conducted on first full production or first low rate initial production (LRIP) item.

Planning, Programming, Budgeting System (PPBS) – The primary resource allocation process of DoD. One of three major decision making support systems for defense acquisition. It is a formal, systematic structure for making decisions on policy, strategy, and the development of forces and capabilities to accomplish anticipated missions. PPBS is a cyclic process containing three distinct, but interrelated phases: planning, which produces Defense Planning Guidance (DPG); programming, which produces approved program objectives memorandum (POM) for the military departments and defense agencies; and budgeting, which produces the DoD portion of the President's national budget. In 2003, being replaced by the Planning, Programming, Budgeting and Execution System (PPBES).

Preliminary Design Review (PDR) – A review conducted on each configuration item to evaluate the progress, technical adequacy, and risk resolution of the selected design approach; to determine its compatibility with performance and engineering requirements of the development specification; and to establish the existence and compatibility of the physical and functional interfaces among the item and other items of equipment, facilities, computer programs, and personnel. Normally conducted during the early part of the System Development and Demonstration (SDD) Phase.

Preplanned Product Improvement (P3I) – Planned future improvement of developmental systems for which design considerations are effected during development to enhance future application of projected technology. Includes improvements planned for ongoing systems that go beyond the current performance envelope to achieve a needed operational capability.

President's Budget (PB) – The Federal Government budget for a particular fiscal year transmitted no later than the first Monday in February to the Congress by the President in accordance with the Budget Enforcement Act of 1992. Includes all agencies and activities of the executive, legislative, and judicial branches.

Procurement Data Package – Includes documentation prepared expressly for the identification, description, and verification of items, materials, supplies, and services that are to be purchased, inspected, packaged, packed, and supplied, or delivered to users.

Procuring Contracting Officer (PCO) – The individual authorized to enter into contracts for supplies and services on behalf of the Government by sealed bids or negotiations who is responsible for overall procurement of the contract.

Product Baseline – The initially approved documentation describing all of the necessary functional and physical characteristics of the configuration item (CI); any required joint and combined operations; the selected functional and physical characteristics designated for production acceptance testing; and tests necessary for deployment/installation, support, training, and disposal of the CI. This baseline is usually initiated at the Critical Design Review (CDR) and finalized at the Physical Configuration Audit (PCA), and normally includes product, process, and material specifications, engineering drawings, and other related data.

Production and Deployment (P&D) – The fourth phase in the acquisition process following Milestone C. Operational and support systems are procured, items are manufactured, operational units are trained, and the systems are deployed.

Production Readiness Review (PRR) – A formal examination of a program to determine if the design is ready for production, production engineering problems have been resolved, and the producer has accomplished adequate planning for the production phase. Normally performed as a series of reviews toward the end of System Development and Documentation (SDD) Phase.

Program Acquisition Cost – The estimated cost of development research, development, test, and evaluation (RDT&E), procurement, and system specific military construction (MILCON) necessary to acquire the defense system. RDT&E costs are accumulated from the point in time when the DoD acquisition program is designated by title as a program element (PE) or major project within a PE. MILCON costs include only those projects that directly support and uniquely identify with the system.

Program Acquisition Quantity – The total number of fully configured end items (to include research and development (R&D) units) a DoD component intends to buy through the life of the program, as approved by the Under Secretary of Defense (Acquisition and Technology) (USD(AT&L)). This quantity may extend beyond the future years defense program (FYDP) years but shall be consistent with the current approved program.

Program Acquisition Unit Cost (PAUC) – Computed by dividing the Program Acquisition Cost by the Program Acquisition Quantity. The PAUC and Average Procurement Unit Cost (APUC) are the subject of the Unit Cost Reports. Programs for which the current estimate of either the PAUC or APUC has increased by 15 percent or more over the currently approved APB must report a unit cost breach to the Congressional defense committees.

Program Budget Decision (PBD) – The Secretary of Defense (SECDEF) decision documents that affirm or change dollar amounts or manpower allowances in the Services' budget estimate submissions (BES).

Program Change Decision – A decision by the Secretary of Defense (SECDEF) issued in a prescribed format that authorizes changes in the structure of the future years defense program (FYDP).

Program Change Request (PCR) – Prepared in a prescribed format, it is a proposal for out-of-cycle changes to data recorded in the approved future years defense program (FYDP).

Program Cost – The total of all expenditures, in any appropriation and fund, directly related to the automated information system (AIS) definition, design, development, and deployment, and incurred from the beginning of the Concept Refinement (CR) phase through deployment at each separate site. For incremental and evolutionary program strategies, program cost includes all increments. Program cost does not include operations and support costs incurred at an individual site after operational cutover of any increment at that site, even though other sites may exist that have not yet completed deployment.

Program Cost Categories –

- **Research, Development, Test, and Evaluation (RDT&E)** appropriations fund the efforts performed by contractors and Government activities, including procurement of end items, weapons, equipment, components, materials, and services required for development of equipment, material, computer application software, and its development and initial operational test and evaluation (OT&E). RDT&E also funds the operation of dedicated research and development (R&D) installations activities for the conduct of R&D programs.

- **Procurement** appropriations fund those acquisition programs that have been approved for production (to include low rate initial production (LRIP) of acquisition objective quantities), and all costs integral and necessary to deliver a useful end item intended for operational use or inventory upon delivery.

- **Operations and Maintenance (O&M)** appropriations fund expenses such as civilian salaries, travel, minor construction projects, operating military forces, training and education, depot maintenance, stock funds, and base operations support.

- **Military Personnel (MILPERS)** appropriations fund costs of salaries and other compensation for active and retired military personnel and reserve forces based on end strength.

- **Military Construction (MILCON)** appropriations fund major projects such as bases, schools, missile storage facilities, maintenance facilities, medical/ dental clinics, libraries, and military family housing.

Costs budgeted in the O&M and MILPERS appropriations are considered **expenses**. Costs budgeted in the Procurement and MILCON appropriations are considered **investment**s. Costs budgeted in the RDT&E and family housing appropriations include both expenses and investments.

Program Decision Memorandum (PDM) – The Secretary of Defense's (SECDEF) approval of a military department or defense agency Program Objectives Memorandum (POM). Issued after Defense Resources Board (DRB) deliberations on the POMs.

Program Definition and Risk Reduction (PDRR) – In the previous DoD system life cycle, this was the second phase in the acquisition process, following Milestone I. Consists of steps necessary to verify preliminary design and engineering, build prototypes, accomplish necessary planning, and fully analyze trade-off proposals. The objective was to validate the choice of alternatives and to provide the basis for determining whether to proceed into engineering and manufacturing development (EMD). Replaced by System Development and Demonstration (SDD) activities.

Program Deviation Reports – Reports baseline breaches to the Defense and Component Acquisition Executives (CAEs), and when appropriate to the Congress.

Program Element (PE) – The 11 major force programs are subdivided into PEs. The PE is the basic building block of the future years defense program (FYDP). It is defined as "an integrated combination of men, equipment, and facilities which together constitute and identifiable military capability or support activity." It identifies the

mission to be undertaken and the organizational entities to perform the mission. Elements may consist of forces, manpower, materials, services, and/or associated costs as applicable. The PE consists of seven digits ending with a letter indicating the appropriate service.

Program Executive Officer (PEO) – A military or civilian official who has primary responsibility for directing several major defense acquisition programs (MDAPs) and for assigned major system and non-major system acquisition programs. A PEO has no other command or staff responsibilities within the Component, and only reports to and receives guidance and direction from the DoD Component Acquisition Executive (CAE).

Program Management – The process whereby a single leader exercises centralized authority and responsibility for planning, organizing, staffing, controlling, and leading the combined efforts of participating/assigned civilian and military personnel and organizations, for the management of a specific defense acquisition program or programs, throughout the system life cycle.

Program Management Directive (PMD) – The official Headquarters (HQ) U.S. Air Force document used to direct acquisition responsibilities to the appropriate Air Force major commands, agencies, program executive offices (PEOs), or designated acquisition commander. All Air Force acquisition programs require PMDs.

Program Manager (PM) – The individual designated in accordance with criteria established by the appropriate Component Acquisition Executive (CAE) to manage an acquisition program, and appropriately certified under the provisions of the Defense Acquisition Workforce Improvement Act (DAWIA) (Title 10 U.S.C. § 1701 et. seq.). A PM has no other command or staff responsibilities within the Component.

Program Manager Charter – See Charter (Program Manager's).

Program Objectives Memorandum (POM) – An annual memorandum in prescribed format submitted to the Secretary of Defense (SECDEF) by the DoD component heads which recommends the total resource requirements and programs within the parameters of SECDEF's fiscal guidance. A major document in the planning, programming, and budgeting system (PPBS) (now PPBES); the POM is the basis for the component budget estimates. The POM is the principal programming document which details how a component proposes to respond to assignments in the defense planning guidance (DPG) and satisfy its assigned functions of the future years defense program (FYDP). The POM shows programmed needs for five or six years, and includes manpower, force levels, procurement, facilities, and research and development (R&D).

Program Office Estimate (POE) – A detailed estimate of acquisition and ownership costs normally required for high level decisions. The estimate is performed early in the program and serves as the base point for all subsequent tracking and auditing purposes.

Programming –

1. The projection of activities to be accomplished and the resources that will be required for specified periods in the future, normally six years.
2. The process of estimating and requesting resources for a program, especially in terms of quantitative requirements for funding manpower, materiel, and facilities for program office operations and for design, development and production of a defense system.

Program Work Breakdown Structure (WBS) – The WBS structure that encompasses an entire program. It consists of at least three levels of the program with associated definitions and is used by the Government PM and contractor to develop and extend a Contract Work Breakdown Structure (CWBS). Examples of WBSs for various items of defense materiel which may be used as a guide for acquisition programs are contained in MIL-HDBK 881.

Project – Synonymous with term “program” in general DoD usage. Specifically, a planned undertaking having a finite beginning and ending, involving definition, development, production, and logistics support of a major weapon or weapon support system or systems. A project may be the whole or a part of a program. The Project Management Institute (PMI) defines a program as a series of projects managed in a coordinated way.

Project Definition – The process of thoroughly exploring all aspects of a proposed project and examining the relations between required performance, development time, and cost. The areas of technical uncertainty are examined and possible trade-offs are evolved in order to achieve a satisfactory balance between performance, development time, and cost.

Project Manager – See Program Manager (PM). Within the PMI definition a group of projects managed in a coordinated way constitute a program.

Prototype – An original or model on which a later system/item is formed or based. Early prototypes may be built during system integration of the System Development and Demonstration (SDD) Phase and tested prior to Critical Design Review (CDR).

Provisioning The process of determining and acquiring the range and quantity (depth) of spares and repair parts, and support and test equipment required to operate and maintain an end item of material for an initial period of service. Usually refers to first outfitting of a ship, unit, or system.

Q

Quality – The composite of material attributes including performance features and characteristics of a production or service to satisfy a customer's given need.

R

Readiness – State of preparedness of forces or weapon system or systems to meet a mission. Based on adequate and trained personnel, material condition, supplies/ reserves of support system and ammunition, numbers of units available, etc.

Reapportionment – A revision by the Office of Management and Budget (OMB) of a previous apportionment of budgetary resources for an appropriation or fund account. A revision would ordinarily cover the same period, projects, or activity covered in the original apportionment.

Reclama – A formal appeal to the Service comptroller or the Secretary of Defense's (SECDEF) tentative budget decision on the Service budget estimates.

Reliability – The ability of a system and its parts to perform its mission without failure, degradation, or demand on the support system.

Reliability, Availability, and Maintainability (RAM) – Requirement imposed on acquisition systems to insure they are operationally ready for use when needed, will successfully perform assigned functions, and can be economically operated and maintained within the scope of logistics concepts and policies. RAM programs are applicable to materiel systems; test measurement and diagnostic equipment, training devices; and facilities developed, produced, maintained, procured, or modified for use. (See individual definitions for Reliability, Availability, and Maintainability.)

Repair – The restoration or replacement of parts or components of real property or equipment as necessitated by wear and tear, damage, failure of parts or the like, in order to maintain it in efficient operating condition.

Repair Parts – Consumable bits and pieces, that is, individual parts or nonrepairable assemblies, required for the repair of spare parts or major end items.

Reprogramming – The transfer of funds between program element or line items within an appropriation for purposes other than those contemplated at the time of appropriation. Reprogramming is generally accomplished pursuant to consultation with, and approval by, appropriate congressional committees, if above thresholds prescribed for different appropriations, i.e., procurement, military construction (MILCON), operations and maintenance (O&M), military personnel (MILPERS) and research, development, test, and evaluation (RDT&E).

Requirements Authority – The individual within the DoD Components charged with overall requirements definition and validation. The Vice-Chairman of the Joint Chiefs of Staff (VCS), in the role as Chairman of the Joint Requirements Oversight Council (JROC), is the requirements authority for all potential major defense acquisition programs (MDAPs) and is responsible for all requirements policy and procedures, including Integrated Architectures (IAs), Capstone Requirements Documents (CRDs), and Initial Capabilities Documents (ICDs), and Capability Development Documents (CDDs). The Requirements Authority for other acquisition category programs is specified in Chairman of the Joint Chiefs of Staff Instruction 3170.01_, *Requirements Generation System (RGS)*. (Note: The RGS is being replaced by the Joint Capabilities Integration and Development System (JCIDS).

Research, Development, Test, and Evaluation (RDT&E) –

1. Activities for the development of a new system that include basic and applied research, advanced technology development, advanced component development and prototypes, system development and demonstration, and developmental and operational testing and the evaluation of test results. Includes activities to expand the performance of fielded systems.
2. An appropriation consisting of budget activities for basic research, applied research, advanced technology development, advanced component development and prototypes, system development and demonstration (SDD), RDT&E management and support and operational systems development.

Revolution in Business Affairs (RBA) – An effort to reengineer the Department of Defense's business practices, shrink the department's supporting infrastructure and make the remaining infrastructure significantly more efficient. It includes not only reducing overhead and streamlining infrastructure but also taking maximum advantage of acquisition reform, outsourcing and privatizing a wide range of support activities when the necessary competitive conditions exist, leveraging commercial technology, dual-use technology and open systems, reducing unneeded specifications and standards, utilizing integrated product and process development (IPPD), and increasing cooperative programs with allies.

Revolution in Military Affairs (RMA) – Dramatic changes in the art of warfare precipitated by rapid technological advances. Exploiting the RMA means not only acquiring new systems based on advanced technology but also developing the concepts, doctrine and organizations to fully utilize the new technologies in a way to dominate the battlefield.

Risk – A measure of the inability to achieve program objectives within defined cost and schedule constraints. Risk is associated with all aspects of the program, e.g., threat, technology, design processes, work breakdown structure (WBS) elements, etc. It has two components, the probability of failing to achieve a particular outcome, and the consequences of failing to achieve that outcome. The ability to follow industrial best practices can also be a measure of risk.

Risk Analysis – A detailed examination of each identified program risk which refines the description of the risk, isolates the cause, and determines the impact of the program risk in terms of its probability of occurrence, its consequences, and its relationship to other risk areas or processes. An assessment of the degree of application of best practices can also be a part of the analysis.

Risk Areas – The program areas which are the primary sources of program risk. Risk areas include, but are not necessarily limited to, threat and requirements, technology, design and engineering, manufacturing, support, cost, and schedule.

Risk Assessment – The process of identifying program risks within risk areas and critical technical processes, analyzing them for their consequences and probabilities of occurrence and compliance with best practices, and prioritizing them for handling.

Risk Assumption – A risk-handling option in which selected program risks are accepted and monitored by the management team.

Risk Avoidance – A risk-handling option which eliminates risk by modifying the concept, requirements, specifications, or practices that create the unacceptable risk.

Risk Control – A risk-handling option which monitors a known risk and then takes specific actions to minimize the likelihood of the risk occurring and/or reduce the severity of the consequences.

Risk Documentation – The recording, maintaining, and reporting of all risk assessment results, risk-handling analysis, and risk-monitoring results.

Risk Monitoring – A process that systematically tracks and evaluates the performance of risk items against established metrics throughout the acquisition process and develops further risk reduction handling options as appropriate.

Risk Transfer –

1. A risk-handling option which reallocates system requirements or design specifications between different system elements in order to reduce overall system risk, system element risk, or process risk.
2. A risk-handling option which shares selected program risks between the Government and the prime system contractors by means of various contractual arrangements.
3. A risk-handling option which shares select program risks between Government agencies involved in the acquisition process by means of memorandums of understanding (MOUs) or similar agreements.

Rollaway Costs – See Flyaway Costs.

S

Sailaway Costs – See Flyaway Costs.

Schedule Risk – The risk that a program will not meet its acquisition strategy schedule objectives or major milestones established by the acquisition authority.

Schedule Variance (SV) – The difference between the Budgeted Cost of Work Performed (BCWP) and the Budgeted Cost of Work Scheduled (BCWS) (SV = BCWP – BCWS).

Science and Technology (S&T) Program – Consists of projects in basic research, applied research, and advanced technology development.

Selected Acquisition Reports (SAR) – Standard, comprehensive, summary status reports on major defense acquisition programs (MDAPs) (acquisition category (ACAT) I) required for periodic submission to the Congress. They include key cost, schedule, and technical information.

Service Acquisition Executive (SAE) – The official responsible for acquisition programs in a military service or component. This official also is referred to as the Component Acquisition Executive (CAE).

Service Life Extension Program (SLEP) – Modification(s) to fielded systems undertaken to extend the life of the system beyond what was previously planned.

Should-Cost Estimate – An estimate of contract price which reflects reasonably achievable contractor economy and efficiency. It is accomplished by a Government team of procurement, contract administration, audit and engineering representatives performing an in-depth cost analysis at the contractor's and subcontractor's plants. Its purpose is to develop a realistic price objective for negotiation purposes.

Single Process Initiative (SPI) – The process for making block changes to existing contracts to replace multiple Government unique manufacturing and management systems with common facility-wide systems so as to unify the manufacturing and management requirements of these contracts on a facility-wide basis.

"Smart" Munitions – Munitions which "think for themselves" and have self-contained ability to search, detect, acquire, and engage targets. They will be delivered to target areas by guns, rockets, missiles, or aircraft with the carriers (platforms) delivering from one to a multitude of the munitions.

Software Domain – A distinct functional area that can be supported by a class of software systems with similar requirements and capabilities. A domain may exist before there are software systems to support it.

Software Failure – The inability, due to a fault in the software, to perform an intended logical operation in the presence of the specified/data environment.

Software-intensive System – A system in which software represents the largest segment in one or more of the following criteria: system development cost, system development risk, system functionality, or development time.

Software Maintainability – The probability that the software can be retained in or restored to a specified status in a prescribed period compatible with mission requirements.

Software Reliability – The probability that the required software will perform the intended logical operations for the prescribed mission(s) and periods(s) in the specified data/environment, without failure.

Source Selection Advisory Council (SSAC) – Senior military or Government civilian personnel designated by the Source Selection Authority (SSA) to serve as staff and advisors during the source selection process. The SSA usually delegates the following duties to the SSAC — selecting/approving the source selection evaluation board (SSEB) membership, reviewing the evaluation criteria, and weighing these criteria.

Source Selection Authority (SSA) – The official designated to direct the source selection process, approve the selection plan, select the source(s), and announce contract award.

Source Selection Evaluation Board (SSEB) – A group of military and/or Government civilian personnel, represents functional and technical disciplines. The SSEB is charged with evaluating proposals and developing summary facts and findings

during source selection. Occasionally defense contractor personnel also serve on these boards, but only when there is clearly no conflict of interest pertaining to the source selection.

Standardization Agreement – The record of an agreement among several or all the North Atlantic Treaty Organization (NATO) member nations to adopt like or similar military equipment, ammunition, supplies and store; and operational, logistic, and administrative procedures. National acceptance of a NATO allied publication issued by the Military Agency for Standardization may be recorded as a Standardization Agreement (STANAG).

Streamlining –

1. An acquisition strategy communicating what is required in functional terms at program initiation. Allows flexibility for application of contractor's expertise, judgment and creativity in meeting requirements. Ensures only cost-effective requirements are included in solicitation and contracts.
2. Broadly used to denote efforts to shorten acquisition process.

Supplemental Appropriation – An appropriation enacted as an addition to a regular annual appropriation act. Supplemental appropriations provide additional budget authority (BA) beyond original estimates for programs or activities which are too urgent to be postponed until the next regular appropriation.

Supportability Analysis (SA) – An analytical tool, conducted as part of the Systems Engineering (SE) process, to determine how to most cost-effectively support the system over its entire life cycle. It provides the basis for related design requirements that may be included in specifications.

Surveillance Monitor – The individual in the Contract Administrative Office (CAO) who is responsible for coordinating earned value management system (EVMS) criteria surveillance functions with other members of the CAO organization and with the auditor, to assure that the surveillance objectives are accomplished.

Sustainability – The “staying power” of U.S. forces, units, weapons systems, and equipment usually measured in number of days capability to sustain combat.

System Requirements Review (SRR) – Conducted to ascertain progress in defining system technical requirements. Determines the direction and progress of the systems engineering effort and the degree of convergence upon a balanced and complete configuration. Normally held during the Technology Development (TD) Phase, but may be repeated after the start of System Development and Documentation (SDD) Phase. to clarify the contractor's understanding of redefined/new user requirements.

Systems Engineering – A comprehensive, iterative technical management process that includes translating operational requirements into configured systems, integrating the technical inputs of the entire design team, managing interfaces, characterizing and managing technical risk, transitioning technology from the technology base into program specific efforts, and verifying that designs meet operational needs. It is a life cycle activity that demands a concurrent approach to both product and process development.

T

Tailoring – The manner in which certain core issues (program definition, program structure, program design, program assessments, and periodic reporting) are addressed in a particular program. The Milestone Decision Authority (MDA) seeks to minimize the time it takes to satisfy an identified need consistent with common sense, sound business management practice, applicable laws and regulations, and the time sensitive nature of the requirement itself. Tailoring may be applied to various aspects of the acquisition process, including program documentation, acquisition phases, the time and scope of decision reviews, supportability analysis, and decisions levels consistent with all applicable statutory requirements.

Teaming – An agreement of two or more firms to form a partnership or joint venture to act as a potential prime contractor; or an agreement by a potential prime contractor to act as a subcontractor under a specified acquisition program; or an agreement for a joint proposal resulting from a normal prime contractor-subcontractor, licensee-licenser, or leader company relationship.

Technical Data Package (TDP) – A technical description of an item adequate for supporting an acquisition strategy, production, engineering, and logistics support (LS). The description defines the required design configuration and procedures to ensure adequacy of item performance. It consists of all applicable technical data such as drawings, associated lists, specifications, standards, performance requirements, quality assurance provisions, and packaging details. One of the traditional LS elements.

Technical Management (TM) – Technical management is a broad term including the management of a totally integrated effort of system engineering (including hardware and software), test and evaluation (T&E), and production and logistics support over the system life cycle.

Technical Performance Measurement (TPM) – Describes all the activities undertaken by the Government to obtain design status beyond that treating schedule and cost. A TPM manager is defined as the product design assessment which estimates, through tests, the values of essential performance parameters of the current design of work breakdown structure (WBS) product elements. It forecasts the values to be achieved through the planned technical program effort, measures differences between achieved values and those allocated to the product element by the system engineering process, and determines the impact of these differences on system effectiveness.

Technical Risk – The risk that arises from activities related to technology, design and engineering, manufacturing, and the critical technical processes of test, production, and logistics.

Technology Project – A directed, incrementally funded effort designed to provide new capability in response to technological opportunities or an operational or business (e.g., accounting, inventory cataloging, etc.) need. Technology projects are “pre-systems acquisition,” do not have an acquisition category, and precede program initiation. Technology is the output of the science and technology program that is used

in systems acquisition. The decision authority and information necessary for decision-making on each project shall be specified by the appropriate S&T Executive (for projects not yet approved for Milestone B) or by the MDA (for projects past Milestone B).

Test and Evaluation Master Plan (TEMP) – Documents the overall structure and objectives of the test and evaluation (T&E) program. It provides a framework within which to generate detailed T&E plans and it documents schedule and resource implications associated with the T&E program.

Then-Year Dollars – See Current-Year Dollars; i.e. dollars that have been escalated from a base year to keep pace with inflation and outlay rates.

Threat – The sum of the potential strengths, capabilities, and strategic objectives of any adversary that can limit or negate U.S. mission accomplishment or reduce force, system, or equipment effectiveness.

Threshold – The minimum acceptable value which, in the user's judgment, is necessary to satisfy the need. If threshold values are not achieved, program performance is seriously degraded, the program may be too costly, or the program may no longer be timely. If the threshold values are not otherwise specified, the threshold value for performance shall be the same as the objective value, the threshold value for schedule shall be the objective value plus six months for ACAT I and three months for ACAT IA programs, and the threshold value for cost shall be the objective value plus 10 percent.

Total Allocated Budget – The sum of all budgets allocated to the contract. Total allocated budget consists of the performance measurement baseline and all management reserve.

Total Asset Visibility (TAV) – The ability to gather information at any time about the quantity, location, and condition of assets anywhere in the DoD logistics system.

Total Obligation Authority (TOA) – A DoD financial term which expresses the value of the direct program for a given fiscal year (FY). It is based on the congressionally approved budget authority (BA) for the program, plus or minus financing and receipts or other adjustments.

Total Ownership Cost (TOC) – The sum of financial resources to organize, equip, sustain, and operate military forces to meet national goals, policies, and standards of readiness, environmental compliance, safety, and quality of life concerns. The TOC for Defense systems consists of the costs to research, develop, acquire, own, operate, and dispose of weapon and support systems. It includes direct costs and indirect costs attributable to the systems and infrastructure costs not directly attributable to the system. Product support mainly concerns the portion of TOC that occurs after the system is deployed (the sustainment and disposal phase of a system's life cycle). At the individual program level, Total Ownership Cost is synonymous with the life-cycle cost of the system.

Total Quality Management (TQM) – A management philosophy committed to a focus on continuous improvements of product and services with the involvement of the entire workforce.

Two-Year Budget – Beginning with the President's Budget submitted in January 1987, the DoD portion was for a two-year period (FY88/89). The intent was for the Congress to authorize and appropriate for DoD for a two-year period, providing program stability among other positive effects. This was requested by Congress on behalf of DoD. The even years (1986, etc.) are “on-years,” the odd ones “off-years.” To date, DoD has not received a two year appropriation.

U

Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD (AT&L)) – The USD(AT&L) has policy and procedural authority for the defense acquisition system, is the principal acquisition official of the Department, and is the acquisition advisor to the Secretary of Defense (SECDEF). In this capacity the USD(AT&L) serves as the Defense Acquisition Executive (DAE), the Defense Senior Procurement Executive, and the National Armaments Director, the last regarding matters of the North Atlantic Treaty Organization (NATO). For acquisition matters, the USD(AT&L) takes precedence over the Secretaries of the Services after the SECDEF and Deputy SECDEF. The USD(AT&L) authority ranges from directing the Services and Defense Agencies on acquisition matters, to establishing the Department of Defense Federal Acquisition Regulation Supplement (DFARS), and chairing the Defense Acquisition Board (DAB) for major defense acquisition program (MDAP) reviews.

Uniform Procurement System (UPS) – An interagency group of senior procurement officials, known as the Council on the Uniform Procurement System, chaired by the Administrator, Office of Federal Procurement Policy (OFPP).

User – An operational command or agency that receives or will receive benefit from the acquired system. Combatant Commanders and their Service component commands are the users. There may be more than one user for a system. The Service component commands are seen as users for systems and organize, equip, and train forces for the Combatant Commanders of the unified and specified commands. The Chiefs of Services and heads of other DoD components are validation and approval authorities and are not viewed as users. Users are sometimes referred to as “warfighters.”

User Representatives – A command or agency that has been formally designated by proper authority to represent single or multiple users in the requirements and acquisition process. The Services and the Service components of the Combatant Commanders are normally the user representative. There should be only one user representative for a system.

V

Value Engineering (VE) – Value engineering is a functional analysis methodology that identifies and selects the best value alternative for designs, materials, processes, systems, and program documentation. VE applies to hardware and software;

development, production, and manufacturing; specifications, standards, contract requirements, and other acquisition program documentation; facilities design and construction; and management or organizational systems and processes to improve the resulting product.

W

Warranty – A promise or affirmation given by a contractor to the Government regarding the nature, usefulness, or condition of the supplies or performance of services furnished under a contract.

Weapon System – An item or set of items that can be used directly by warfighters to carry out combat or combat support missions to include tactical communication systems.

Weighted Guidelines – A Government technique for developing fee and profit negotiation objectives, within percentage ranges established by regulation.

Work Breakdown Structure (WBS) – An organized method to break down a project into logical subdivisions or subprojects at lower and lower levels of details. It is very useful in organizing a project. See MIL-HDBK 881 for examples of WBSs.

X

Y

Z