Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System

1. INTRODUCTION.

The Space and Missile Systems Center Satellite Acquisition Process chart serves as a pictorial roadmap of key activities in the satellite acquisition processes. The chart illustrates the interaction of the three-key processes that must work in concert to deliver the capabilities required by the warfighters: the requirements process (Joint Capabilities Integration and Development System [JCIDS]); the acquisition process (Defense Acquisition System); and program and budget development (Planning, Programming, Budgeting, and Execution [PPBE] process). These three major decision support systems are illustrated in the top left front of this chart. This chart is based on policies and guidance from the following federal, Department of Defense (DoD), and Air Force documents and web sites:

- **DoD Directive 5000.01.** *The Defense Acquisition System*, May 12, 2003
- **DoD Instruction 5000.02.** *Operation of the Defense Acquisition System*, Dec. 8, 2008
- **Defense Acquisition Guidebook (DAG).** https://dag.dau.mil
- **CJCS Instruction 3170.01H.** *Joint Capabilities Integration and Development System*, Jan. 10, 2012
- **JCIDS Manual.** *Operation of the Joint Capabilities Integration and Development System*, Jan. 19, 2012
- **Air Force Instruction 63-101.** *Acquisition and Sustainment Life Cycle Management*, with Change 4, Aug. 3, 2011
- **Air Force Instruction 63-1201.** *Life Cycle Systems Engineering*, Sept. 12, 2011
- **Air Force Instruction 10-601.** *Operational Capability Requirements Development*, July 12, 2010
- **Space and Missile Systems Center.** *Acquisition Strategy Development Process Guide*, March 5, 2012
- The following Internet sites provide additional information:
  - **Acquisition Community Connection (ACC).** https://acc.dau.mil. *ACC* provides information on acquisition, technology, and logistics processes. ACC has links to acquisition-related communities of practice, other special interest areas, and to the DAU Continuous Learning Center.
  - **Space Acquisition Community of Practice (CoP).** https://acc.dau.mil/space. CoP provides access to learning assets specifically related to space acquisition.
  - **DAU Continuous Learning Center (CLC).** http://clc.dau.mil. The *CLC* provides access to lessons for professional development and current information on new initiatives.
  - **Defense Acquisition Portal,** https://dap.dau.mil. One-stop source for acquisition information and tools.
- **Directive-Type Memorandum (DTM) 09-027 - Implementation of the Weapon Systems Acquisition Reform Act of 2009**
- **DTM 09-025 - Space Systems Acquisition Policy, with Change 2, Dec. 9, 2011**
- **Federal Acquisition Regulation (FAR), Defense Federal Acquisition Regulation Supplement (DFARS), and Procedures, Guidance, and Information (PGI).** http://www.acq.osd.mil/dpap/

2. ACQUISITION PROCESS.

The acquisition process is structured by DoDI 5000.02 into discrete phases separated by major decision points (called milestones or decision reviews) with a number of key activities to provide the basis for comprehensive management and informed decision making. The number of phases and decision points are tailored to meet the specific needs of individual programs. Space systems acquisition follows the guidelines of DoDI 5000.02 modified by DTM 09-025 and is illustrated on the front of this chart.

The acquisition process begins with the identification of a capability need that requires a materiel solution. The process encompasses the activities of design, fabrication, test, manufacture, operations, and support. It may involve modifications, and it ends with disposal/recycling/demilitarization. Major upgrade or modification programs may also follow the acquisition life cycle process.

The policies and principles that govern the operation of the defense acquisition system are divided into five major categories as stated in DoDD 5000.01: 1.) Flexibility—tailoring program strategies and oversight; 2.) Responsiveness—rapid integration of advanced technologies through evolutionary acquisition; 3.) Innovation—adoption of practices that reduce cost and cycle time; 4.) Discipline—use of program baseline parameters as control objectives; and 5.) Effective management—decentralization to the extent practicable.

DoD components first try to satisfy capability needs through non-materiel solutions such as changes in doctrine or tactics. If existing U.S. military systems or other on-hand materiel cannot be economically used or modified to meet the warfighter's need, a materiel solution may be pursued according to the following hierarchy of alternatives:

- Procurement (including modification) of commercially available domestic or international technologies, systems or equipment, or allied systems or equipment
- Additional production or modification of previously developed U.S. and/or allied military systems or equipment
- Cooperative development program with one or more allied nations
- New joint, DoD component, or government agency development program
- New DoD component-unique development program.

A list of program information requirements to ensure informed decision making is found in DoDI 5000.02, enclosure 4. The Milestone Decision Authority (MDA) may tailor this information based on program needs, but normally may not omit documents required by statute or mandatory policy without a waiver (e.g., acquisition program baseline (APB) or initial capabilities document). Figure 1 is a simplified chart of information required at milestones and other decision reviews.

Other periodic reports:

Defense Acquisition Executive Summary (DAES) Report. ACAT I and IAM programs. Quarterly. Also upon Program Objectives Memorandum (POM) and Budget Estimate Submission (BES). For ACAT I only—upon UCR breach.

Selected Acquisition Report (SAR). ACAT I only. Submitted at program initiation for ships, MS B, and annually thereafter. Quarterly SARs may be required on an exception basis (see DAG, Chapter 10).

Unit Cost Report (UCR). ACAT I only. Quarterly as part of the DAES Report.

Electronic Warfare (EW) Test and Evaluation Report. Annually for all EW programs on the OSD T&E oversight list.

Earned Value Management System (EVMS) Reports. See DoDI 5000.02, Table 5, ANSI/EIA 748 and the DAG.

Contractor Cost Data Reports (CCDR). See DoDI 5000.02, Table 4.

Software Resources Data Report (SRDR). See DoDI 5000.02, Table 4.

Major Automated Information System (MAIS) Reports. See DoDI 5000.02, Table 2-1.

Figure 1. **Requirements for Milestone/Decision Reviews**
(See enclosure 4, DoDI 5000.02)

Requirement	MDD	A	Pre-EMD R	B	Post-CDR A	C	FRP
Acquisition Decision Memorandum[5]	X	X		X	X	X	X
Acquisition Information Assurance Strategy (all IT incl NSS)		X		X		X	X
Acquisition Program Baseline[5]			X[15]	X		X	X
Acquisition Strategy[5]			X	X		X	X
Affordability Assessment/Constraints/Targets[17]	X	X	X	X		X	X
Alternate LIve Fire T&E Plan (pgms w/waiver from full-up LFT&E)[2]			X[15]	X			
Analysis of Alternatives (AoA)[3&5]		X		X		X	X
AoA Study Guidance (DCAPE approved for MDAPs)	X						
AoA Study Plan (DCAPE Approved for MDAPs)	X						
Benefit Analysis & Determination[1&8] (bundled acquisitions)				X			
Beyond LRIP Report[2] (include MDAPs that are also MAIS)							X
Capability Development Document (CDD)			X	X			
Capability Production Document (CPD)						X	
Clinger-Cohen Act (CCA) Compliance[5]		X		X		X	X
Competition Analysis[1&8] (depot-level maintenance rule)				X			
Component CIO Confirmation of CCA Compliance (non-MAIS IT)[5]		X		X		X	X
Component Cost Estimate [5&9] (MAIS & MDAP)		X	X	X		X	X
Consideration of Technology Issues (MDAP & MAIS)		X		X		X	
Cooperative Opportunities[1]		X		X		X	
Core Logistics/Source of Repair Analysis[1&8]				X		X	
Corrosion Prevention Control Plan				X		X	
Cost Analysis Requirements Description[5&9] (MDAP & MAIS)			X	X		X	X
Data Management Strategy[1] (MDAP, MAIS & ACAT II)		X		X		X	X
Economic Analysis (MAIS)[7] (may be combined w/AoA at MS-A)		X		X			X
Exit Criteria[5]		X	X[15]	X		X	X
Independent Cost Estimate (ICE)[5&10] (MDAPs only)		X	X	X		X	X
Independent Logistics Assessment (ILA) (ACAT I & II)		X		X		X	X
Independent Technology Readiness Assessment[11]				X		X	
Industrial Base Capabilities[1] (MDAPs only)				X		X	
Information Support Plan[5]			X	X	X	X	
Initial Capabilities Document (ICD)[4&5]	X						
Initial Operational Test & Evaluation Completed (ACAT I & II)							X
Item Unique Identification (IUID) Plan (part of SEP)		X		X		X	
Joint Interoperability Test Certification (IT & NSS)							X
Life-Cycle Signature Support Plan[5]		X	X[15]	X		X	
Life-Cycle Sustainment Plan[1]			X[15]	X		X	X
Live Fire T&E Report[2] (covered systems) (n/a MAIS)							X
Live Fire T&E Waiver[2] (covered systems) (n/a MAIS)				X			
LRIP Quantities MDAP & ACAT II (n/a AIS)[1]				X			
Manpower Estimate (MDAPS only)[5]			X[15]	X		X	X
Market Research[1]		X		X			
Milestone Decision Authority Program Certification (MDAPs only)[4]		X		X			
Military Equipment Validation[1]						X	X
Net-Centric Data Strategy[5&12]		X		X		X	
Operational Test Agency Report of OT&E Results				X		X	X
Post-Critical Design Review (CDR) Report					X		
Post Implementation Review							X
Preliminary Design Review (PDR) Report[18]				X			
Program Manager's Report of DT&E Results				X		X	
Program Protection Plan (PPP)[1]		X	X	X		X	
Programmatic Environ, Safety & Occup Health Evaluation (PESHE)[5]				X		X	X
Replaced System Sustainment Plan[5] (MDAPs only)				X			
Request for Proposal (RFP) (ACAT ID)		X	X	X		X	X
Selected Acquisition Report (SAR)[4&13]							
Should-Cost Estimate		X		X		X	X
Spectrum Supportability Determination[8]				X		X	
System Threat Assessment (STA) (ACAT II)[5&14]				X		X	
System Threat Assessment Report (STAR) (ACAT I)[5&6]			X	X		X	
Systems Engineering Plan (SEP)		X	X[15]	X		X	
Technology Development Strategy (MDAP & MAIS)		X					
Technology Readiness Assessment (TRA)[5&16]			X	X			
Test & Evaluation Master Plan (TEMP)			X[15]	X		X	X
Test & Evaluation Strategy (TES)		X					

1. Part of TDS or Acquisition Strategy
2. OSD T&E Oversight Programs
3. MDAP: A,B,C; MAIS: A, B, FRP
4. MS B or C if Program Initiation
5. Program Initiation for Ships
6. Validated by DIA for ACAT ID; AIS use DIA validated capstone info/ops Threat Assessment Decision
7. MS C if equivalent to FRP
8. MS C if no MS B
9. MAIS whenever an economic analysis is required
10. May be CAIG Assessment at MS A
11. ACAT ID—Assessment of PM's TRA by ASD(R&E)
12. Summarized in TDS; details in ISP
13. SAR at program initiation; annually thereafter
14. Validated by Component; AIS use DIA validated capstone info/ops Threat Assessment Decision
15. Draft
16. Preliminary TRA at Pre-EMD Review; final at MS B
17. Affordability constraints at MDD. Affordability assessment at Pre-EMD Review, MS B, C and FRPDR. Affordability targets at A, B and C.
18. If PDR after MS B, MDA must conduct a Post-PDR Assessment

3. MANAGEMENT OF THE ACQUISITION PROCESS.

The person responsible for ensuring the acquisition management system activities result in fulfilling the warfighter's need is the program manager (PM). The PM is also the single point of accountability for accomplishing program objectives for total life cycle systems management, including sustainment. The PM is responsible for the entire system life cycle (design to disposal) (Total Life Cycle System Management [TLCSM] is required by DoDD 5000.01), and must consider supportability, life cycle costs, performance, and schedule in making program decisions. Each defense acquisition program is assigned a PM in accordance with DoD and component policy. The primary program management activities follow:

Planning. One of the first planning activities is the development of an acquisition strategy (see the DAG), an overarching plan that serves as a roadmap for program execution from program initiation through post-production support. It describes how the program will accomplish its objectives in terms of (among others) cost, schedule, performance, risk, and contracting activities.

- ACAT I and IA programs normally provide information on the strategy elements as noted in Figure 2. The PM may choose to develop the acquisition strategy as a standalone document or as part of a multipurpose document (e.g., Air Force Life Cycle Management Plan). Each program's acquisition strategy is tailored to meet the specific needs and circumstances of the program.
- There are two basic strategy approaches—evolutionary and single step to full capability. Evolutionary acquisition is the preferred DoD strategy for rapid acquisition of mature technology for the user. An evolutionary approach delivers capability in increments, anticipating the need for future capability improvements.

Figure 2. **Acquisition Strategy**
(*Defense Acquisition Guidebook*, Chapter 2)

1. Purpose
2. Capability Need
   - 2.1 Requirement Summary
   - 2.2 Operational Mission & CONOPS
   - 2.3 Threat Assessment
   - 2.4 Net-Centric Data Strategy (TDS only)
   - 2.5 Operational View (OV) – 1
   - 2.6 Reference Design Concept (MS B)
3. Acquisition Approach
   - 3.1 Cost, schedule, performance drives for current increment & plan to transition to later increments
   - 3.2 Unique program circumstances
   - 3.3 Indicate: Replacement or mod to existing system; or new Capability
   - 3.4 Indicate if new start
   - 3.5 Indicate if joint program
   - 3.6 Feasible technical approaches (TDS only)
   - 3.7 Total planned production & LRIP quantities (MS B & C only)
4. Tailoring
   - 4.1 Proposed tailoring and why
   - 4.2 Requests for policy waivers
5. Program Schedule
   - 5.1 Graphic illustration of key events
   - 5.2 Basis for delivery or performance-period requirements; justify urgency; justify if not full and open competition
   - 5.3 Analysis justifying schedule
   - 5.4 Activities planned for next phase
   - 5.5 Interdependencies
   - 5.6 Relationships between increments; criteria for moving forward
6. Risk and Risk Management
   - 6.1 Risk management approach
   - 6.2 Interdependency issues
   - 6.3 Key program technologies & TRL
   - 6.4 For TDS: alternative technologies and prototyping activities
   - 6.5 Principal programmatic risks
   - 6.6 Risks deferred to future increments
   - 6.7 Manufacturing risks (FRPDR only)
7. Business Strategy
   - 7.1. Competition Strategy
   - 7.2 Market Research
   - 7.3 Advance Procurement
   - 7.4 Sustainment Strategy
   - 7.5 Major Contracts Planned
   - 7.6. Technical Data Rights Strategy
   - 7.7 Contract Management
8. Cost and Funding
   - 8.1 Investment Program Funding and Quanities
   - 8.2 Cost
9. Resource Management
   - 9.1 Program Office Staffing and Organization
   - 9.2 Primary stakeholders
   - 9.3 Requirements community involvement
10. International Involvement
    - 10.1 Limitations on foreign contractors
    - 10.2 International Cooperation
    - 10.3 Foreign Military Sales
11. Industrial Capability and Manufacturing Readiness
    - 11.1 Industrial Capability
    - 11.2 Industrial and Manufacturing Readiness
    - 11.3 Sustaining Industrial Capabilities
    - 11.4 Planned or Completed MOAs
12. Life-Cycle Signature Support
    - 12.1 Table of life-cycle signature support requirements (TDS only)
    - 12.2 Life-cycle signature funding requirements (refer to part 8)
13. Military Equipment Valuation (MEV)
    - 13.1 Level 2 WBS for MEV accountability
    - 13.2 End items $100K or more
    - 13.3 GFP included in end items
    - 13.4 Other deliverables (manuals, tech data, etc.)
    - 13.5 Other types of deliverables that cannot be directly attributed to a specific end item (spares, support equipment, special tools & test equip, etc.)

Note: In addition to the TDS/AS there are five plans required: Acquisition Plan (FAR/DFARS), Program Protection Plan (PPP) and Test and Evaluation Master Plan (TEMP) (DoDI 5000.02), Information Support Plan (ISP) (CJCSI 6212.01_), and Systems Engineering Plan (SEP) (DoDI 5000.02).

Organizing and Staffing. The establishment, organization, and staffing of the program office should be a direct outgrowth of a task analysis that supports the program's acquisition strategy. As the program evolves, the program office organization and staffing should evolve to support the changing task requirements and acquisition environment.

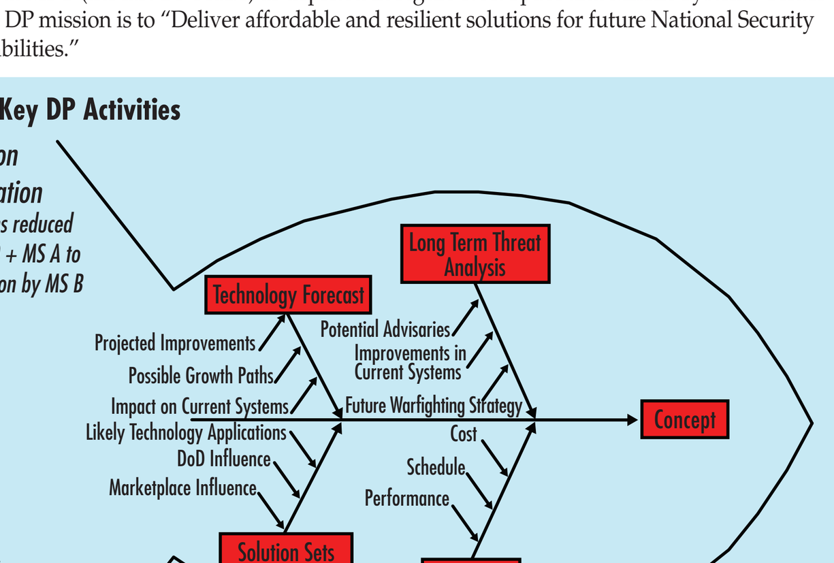
Controlling. The control system consists of standards against which progress can be measured, a feedback mechanism that provides information to a decision maker, and a means to make corrections either to the actions underway or to the standards. Examples of standards include the APB, exit criteria, program schedules, program budgets, specifications, plans, and test criteria. Examples of feedback mechanisms for program control, oversight, and risk management include the Joint Requirements Oversight Council, overarching integrated product team, Defense Acquisition Board, Information Technology Acquisition Board, integrated baseline review, technical reviews, and developmental and operational test and evaluation.

Leading. Effective leadership is the key to program success. It involves developing an organization's mission, vision, and goals, and clearly articulating a set of core values. Dominant leadership roles in program management include strategy setting, consensus/team building, systems integration, and change management. For successful teams, factors such as empowerment, clear purpose, open communication, adequate resources, and a team-oriented behavioral environment are critical.

4. PHASE DESCRIPTIONS AND SPACE POLICY IMPLICATIONS.

Development Planning Overview. Typically initiated by a capability shortfall, or simply a Development Planning (DP) request from MAJCOM, DP is a collaborative process bridging warfighter-identified capability needs to planning for acquisition of materiel solutions. It supports trade space evaluation of emerging capability needs, includes Systems of Systems (SoS) assessments, identifies and assesses technology maturity and risk drivers, and incorporates comprehensive life-cycle planning; all contributing to a high confidence acquisition program launch. DP begins with the Pre-Materiel Development Decision (pre-MDD) Phase where thousands of options are reduced to a final solution by the end at MS B (the last DP Phase) as depicted in Figure 3. At Space and Missile Systems Center (SMC), the DP mission is to "Deliver affordable and resilient solutions for future National Security Space capabilities."

Figure 3. **Key DP Activities**

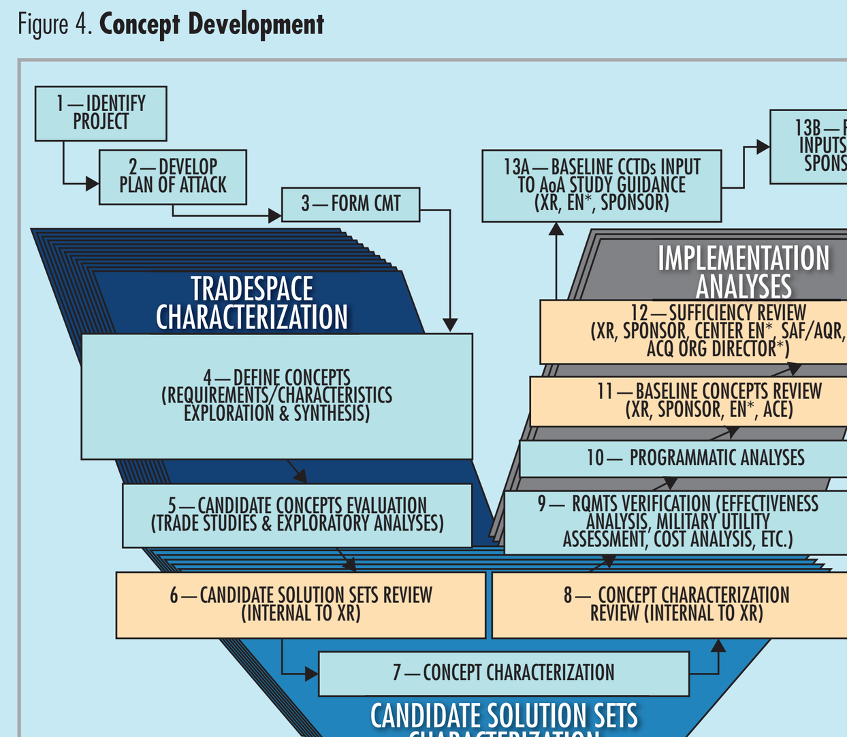


Pre-Materiel Development Decision Activities. This DP Phase uses focused SoS analysis and development of advanced systems concepts to support capability needs identified by the JCIDS. In this phase, early systems engineering produces Concept Characterization and Technical Descriptions (CCTDs) that capture the analytical basis of prospective materiel solutions (concepts), associated technologies and programmatic decisions. With the goal of achieving a timely and successful MDD, concepts are matured through three overarching phases of activity: Trade Space Characterization; Candidate Solution Sets Characterization; and Implementation Analysis. Each is depicted in Figure 4 and described in the paragraphs that follow.

During Trade Space Characterization, capability needs are decomposed to determine requirements, ground rules and assumptions. Concepts are defined and candidates are evaluated. An initial Work Breakdown Structure (WBS) is developed, applicable technologies are researched, and initial assessments are made for critical technology elements, technology readiness, manufacturing readiness, user considerations, risk, cost estimates, intelligence and logistics support. Candidate concepts are evaluated to determine the evaluation methodology, score and rank candidate concepts, develop a Department of Defense Architecture Framework (DoDAF) OV-1 and create a Level 2 WBS.

During Candidate Solution Sets Characterization, focus is placed on concepts with a reasonable chance of timely maturation. Concern is given to areas that have historically led to significant program issues when not given sufficient or timely consideration, such as key interfaces, intelligence inputs, configuration management at the SoS level, support infrastructure and human operations. Ground rules and assumptions are re-examined, cost estimates are updated, DoDAF views (OV-2, OV-3, OV-4, OV-5, SV-1, SV-3, SV-4, SV-7, SV-9) are created, a Level 3 WBS is started, preliminary trade studies (between concepts) are conducted, and Modeling and Simulation (M&S) is used to characterize concept capabilities. Relevant data is captured in CCTDs.

Figure 4. **Concept Development**



During Implementation Analysis, acquisition resources, schedules and costs are defined for each candidate solution. Programmatic analyses are performed, sufficiency of life cycle cost estimates are assessed, and manpower costs are projected based on anticipated fielded maintenance, support and operational capabilities. Prior to the release of the baseline CCTDs, a sufficiency review is held for the overall programmatic assessment that includes cost, schedule, estimated performance, technology readiness, manufacturing readiness, integration readiness and risk; as captured in the CCTDs. Those concepts that are mature receive an initial Military Utility Assessment (MUA) which is later refined and included in the Analysis of Alternatives (AoA).

For MDD requirements refer to Figure 1. MDD criteria is as follows:

1. The candidate materiel solution approaches have the potential to effectively address the capability gap(s), operational attributes, and associated dependencies.
   - Common understanding of the root cause of the gap between the operational, analytical, and acquisition communities
   - Problem is defined with adequate specificity while maintaining solution independence
   - Associated dependencies, to include other gaps, legacy systems, SoS baseline considerations and DOT_LPF (Doctrine, Organization, Training, Leadership and Education, Personnel, Facilities) implications
   - Candidate materiel solution approaches have the potential to effectively address the gap
   - The urgency/priority of the gap, including the operational community's requirements on schedule for deployment
2. There exists a range of technically feasible solutions generated from across the entire solution space, as demonstrated through early prototypes, models, or data.
   - Initial set of solutions have been drawn from the entire solution space
   - A broad range of solutions is proposed for consideration to ensure the highest likelihood of success
   - Evidence that demonstrates technical feasibility of proposed alternative solutions is presented, including prototypes, models, or data
   - Technical feasibility considers technical issues of new developments, updates to existing systems, and the changes needed given the dependencies of the proposed system
3. Consideration has been given to near-term opportunities to provide a more rapid interim response to the capability need.–
   - Provide evidence that consideration was given to interim, more rapid solution to mitigate the impact of the capability gap while a system acquisition is underway
   - Ensure that incremental acquisition has been considered to quickly deliver the solution to the warfighter and deliver added capability with follow-on increments
4. The plan to staff and fund analytic, engineering, and programmatic activities supports the proposed milestone entry requirements.
   - Current DoDI 5000.02 policies mandate full funding of the AoA at the MDD
   - Proposed Development Planning policy directs ASD(R&E) participation in oversight of the AoA to support greater analysis of technical risk of proposed solutions
   - Recent changes to DoDI 5000.02 require greater pre-MS A engineering and programmatic planning for the Technology Development Phase in support of MS A requirements
   - Requires evidence of planning, funding, and staffing to adequately perform additional analysis and planning in the Materiel Solution Analysis Phase

Materiel Solution Analysis Phase. The Materiel Solution Analysis Phase begins with the MDD review, the formal entry point into the acquisition process; however, note that the MDA's decision to begin Materiel Solution Analysis does not mean that a new acquisition program has been initiated. Guided by the Initial Capabilities Document (ICD) and the AoA Study Guidance, this phase assesses critical technology elements (CTEs) associated with each proposed materiel solution, including technology maturity, integration risk, manufacturing feasibility, and, where necessary, technology maturation and demonstration needs.

In this phase, the AoA is generated based on the AoA study plan and AoA study guidance that were prepared by the OSD Director of Cost Assessment and Program Evaluation (CAPE), and approved prior to MDD. The purpose of the AoA is to assess the potential materiel solutions to satisfy the capability need documented in the approved ICD. An AoA study plan is prepared to assess preliminary materiel solutions, identify key technologies, and estimate life cycle costs. The AoA focuses on identification and analysis of alternatives, measures of effectiveness, cost, schedule, concepts of operations, and overall risk. To achieve the best possible system solution, emphasis is placed on innovation and competition. Existing commercial-off-the-shelf (COTS) functionality and solutions drawn from a diversified range of large and small businesses is to be considered.

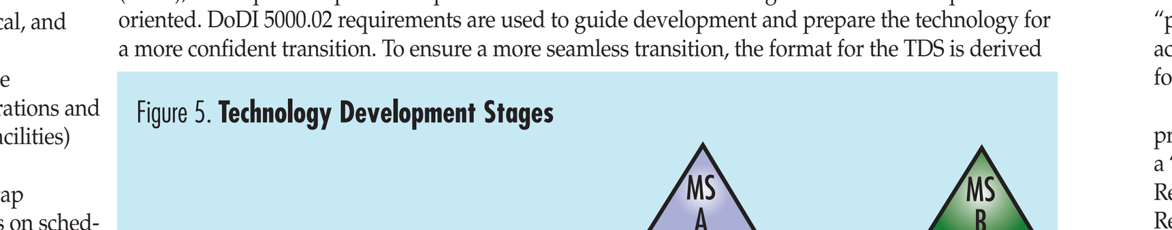
A strategy is developed for technology maturation and transition planning. The resulting product is the Technology Development Strategy (TDS) which captures the roadmap to mature a specific technology for warfighter application. The TDS reflects the current state of a technology maturation effort (relative to its transition to an acquisition program) and drives the activities of the Technology Development Phase. It documents the coordinated Air Force strategy on how to best transition a technology with respect to its follow-on acquisition program by capturing the current readiness level, the desired readiness level for transition, and the incremental stages necessary for it to be achieved.

Materiel Solution Analysis Phase Space Policy. The TDS for space systems shall detail acquisition strategy and contracting approach for development of pertinent technologies for each phase of the program life cycle. Due to the small number of articles procured, space systems commit to the acquisition approach early in the acquisition life cycle. The TDS is used in support of MS A. The TDS is the foundation from which the formal Acquisition Strategy (AS) is built (AS used in later phases). For MS A requirements refer to Figure 1.

Technology Development Phase. This phase determines and matures the appropriate set of technologies, reduces technology risk, and demonstrates CTEs using prototypes. The goal is an efficient planning process that leads to increased confidence in innovative technologies and the successful transition of those technologies into acquisition programs. Technology Development is a continuous technology discovery and development process reflecting close collaboration between the S&T community, the user, and the system developer. It assesses the viability of innovative technologies while simultaneously refining user requirements.

The TDS developed in the previous phase is the foundation from which the formal AS is built for later phases. Technology maturation requires an effective means to manage, direct, and control technology development to meet the criteria required to move a technology through the stages depicted in Figure 5. As a technology matures and gets closer to transitioning into a program of record (MS B), the acquisition process requirements become more demanding and thus more acquisition oriented. DoDI 5000.02 requirements are used to guide development and prepare the technology for a more confident transition. To ensure a more seamless transition, the format for the TDS is derived from the Life Cycle Management Plan (LCMP) which includes the Life Cycle Sustainment Plan (LCSP) required at MS B. For MS B requirements refer to Figure 1.

Figure 5. **Technology Development Stages**



Technology Development Phase Space Policy. PMs shall conduct a System Design Review (SDR) during Technology Development Phase to 1) Ensure system's functional baseline is established, and 2) Ensure system has reasonable expectation of satisfying ICD requirement within allocated budget and schedule. The SDR 1) Completes process of defining items or elements below system level, 2) Assesses decomposition of system specification to system functional specifications, 3) Determines whether system's functional definition is fully decomposed, and 4) Determines that program is prepared for preliminary design. PMs shall provide a Post-SDR report to the MDA to include 1) Assessment of design maturity and summary of system-level SDR results, and 2) Independent vulnerability assessment and Space Debris Assessment Report (SDAR). The SDAR will include an assessment of debris generation risk during launch, on-orbit operations, and end-of-life disposal, and shall assess compliance with the U.S. Government Orbital Debris Mitigation Standard Practices, in collaboration with the NASA Orbital Debris Program Office. The MDA shall review the post-SDR report and the PM's resolution and/or mitigation plans, and determine whether additional action is necessary to achieve technology development phase objectives and satisfy the capability need specified in the ICD. The results of the MDA's post-SDR assessment shall be documented in an Acquisition Decision Memorandum (ADM) and include the MDA's determination to proceed with technology development (or not). The post-SDR assessment will be supported by an Independent Program Assessment (IPA).

Engineering and Manufacturing Development (EMD) Phase. The purpose of the EMD Phase is to develop a system or an increment of capability; complete full system integration; develop an affordable and executable manufacturing process; ensure operational supportability with particular attention to minimizing the logistics footprint; implement human systems integration (HSI); design for producibility; ensure affordability; protect CPI by implementing appropriate techniques such as anti-tamper; and demonstrate system integration, interoperability, safety, and utility. The CDD, AS, SEP, and Test and Evaluation Master Plan (TEMP) shall guide this effort. Entrance into this phase depends on technology maturity (including software), approved requirements, and full funding. Unless some other factor is overriding in its impact, the maturity of the technology shall determine the path to be followed.

Engineering and Manufacturing Development Phase Space Policy. The Initial Production Decision is at MS C, so it is appropriate that approval for procurement of long-lead items to support initial production of space systems occur much earlier, at MS B. In addition to DoDI 5000.02 requirements, MS B shall normally include authorization for procurement of long-lead items necessary for authorized number of initial production articles.

Production and Deployment Phase. The purpose of the Production and Deployment Phase is to achieve an operational capability that satisfies mission needs. Operational Test and Evaluation (OT&E) shall determine the effectiveness and suitability of the system. The MDA shall make the decision to commit the DoD to production at MS C and shall document the decision in an ADM.

Production and Deployment Phase Space Policy. For space systems the MDA will conduct a Follow-On Production Decision Review in lieu of a Full Rate Production Decision Review (FRPDR). If only one space system is being acquired a follow-on production decision is not necessary.

In lieu of the DoDI 5000.02 requirements to have acceptable performance in Developmental Test and Evaluation (DT&E) and operational assessment; and no significant manufacturing risks, space systems shall be required to have acceptable performance in developmental test activities and acceptable manufacturing risks.

The design of the EMD Phase is not consistent with the needs of space systems acquisitions. The location of MS C needs adjusting to authorize space systems to enter the Production and Deployment Phase. Space systems commit to "Low Rate Production" at the Critical Design Review (CDR). For that reason, MS C for space systems shall be described as the initial production review and shall be conducted as soon as feasible after program CDR. At MS C, the MDA authorizes acquisition-related activities associated with fabrication, integrated T&E, to include DT&E and OT&E, deployment (e.g. launch), and support of new space system. The MDA shall review post-CDR report, determine whether additional action is necessary to satisfy EMD Phase exit criteria, address and resolve orbital debris compliance issues, and approve entry into Production and Deployment Phase for initial number of production articles.

The MDA will approve subsequent article production at a Follow-On Production Decision. The MDA may direct an In-Progress Review (IPR) after MS C, but prior to Follow-On Production Decision Review, to assess progress and determine if any additional actions are necessary to support a Follow-On Production Decision.

Moving CDR to just before MS C and having the MDA review the post-CDR report at MS C is a major difference from the DoDI 5000.02 process for non-space programs. For space programs there will be no significant production and testing of "production representative articles" after CDR and prior to MS C. Those activities will take place after MS C during what is commonly called "LRIP" for non-space systems.

The FRPDR does not properly describe the efforts associated with the procurement of additional space system articles. Space systems do not achieve a "full rate production" as implied by the "Full Rate Production Decision" Review in DoDI 5000.02. For that reason, a "Follow-on Production Decision" Review shall take the place of the FRPDR. The MDA shall conduct a Follow-On Production Decision Review in lieu of a full-rate production and deployment decision to authorize procurement of additional space system articles beyond those authorized at MS C. Statutory and regulatory information requirements outlined DoDI 5000.02 for full-rate production and deployment reviews shall also apply to the follow-on decision review for space systems. An OSD independent cost estimate is required for a follow-on production decision.

Operations and Support Phase. The purpose of the Operations and Support Phase is to execute a support program that meets materiel readiness and operational support performance requirements, and sustains the system in the most cost-effective manner over its total life cycle. Planning for this phase shall begin prior to program initiation and shall be documented in the LCSP. Operations and Support has two major efforts, Life-Cycle Sustainment and Disposal.

Operations and Support Phase Space Policy. In addition to DoDI 5000.02 requirements, space systems shall be required to have acceptable performance in integrated T&E, to include DT&E, OT&E, and user acceptance of the system. A follow-on production decision review may not be required as an entrance criteria if, for example, only one space system article is being acquired.

Other Space Policy

Independent Program Assessment (IPA): An independent, comprehensive, and systematic review, preferably led by one of more qualified U.S. Government employees, of major space system managerial and technical progress. IPAs are designed to identify program cost, schedule, and performance risks; formulate risk mitigation plans; and provide feedback both to the PM and the MDA. An IPA will be conducted 1) Before each milestone, 2) Prior to post-SDR assessment, and 3) Whenever directed by the MDA. The IPAT's findings and recommendations are either presented to the OIPT prior to the DAB, the MDA at the DAB, or both. In preparation for the IPA, the PM should produce a consolidated set of program documentation to facilitate the IPAT review.

The **Systems Engineering Plan (SEP)** as defined in DoDI 5000.02 does not include sufficient information to effectively manage the engineering of space systems. The space systems SEP requires additional details in two areas.

1. Emphasize the space system's integration with other existing and approved future architectures and capabilities.
2. Include mission assurance (MA) planning. MA is a description of those activities undertaken to ensure that space systems operate properly once launched into orbit, since retrieval for repair is impractical.

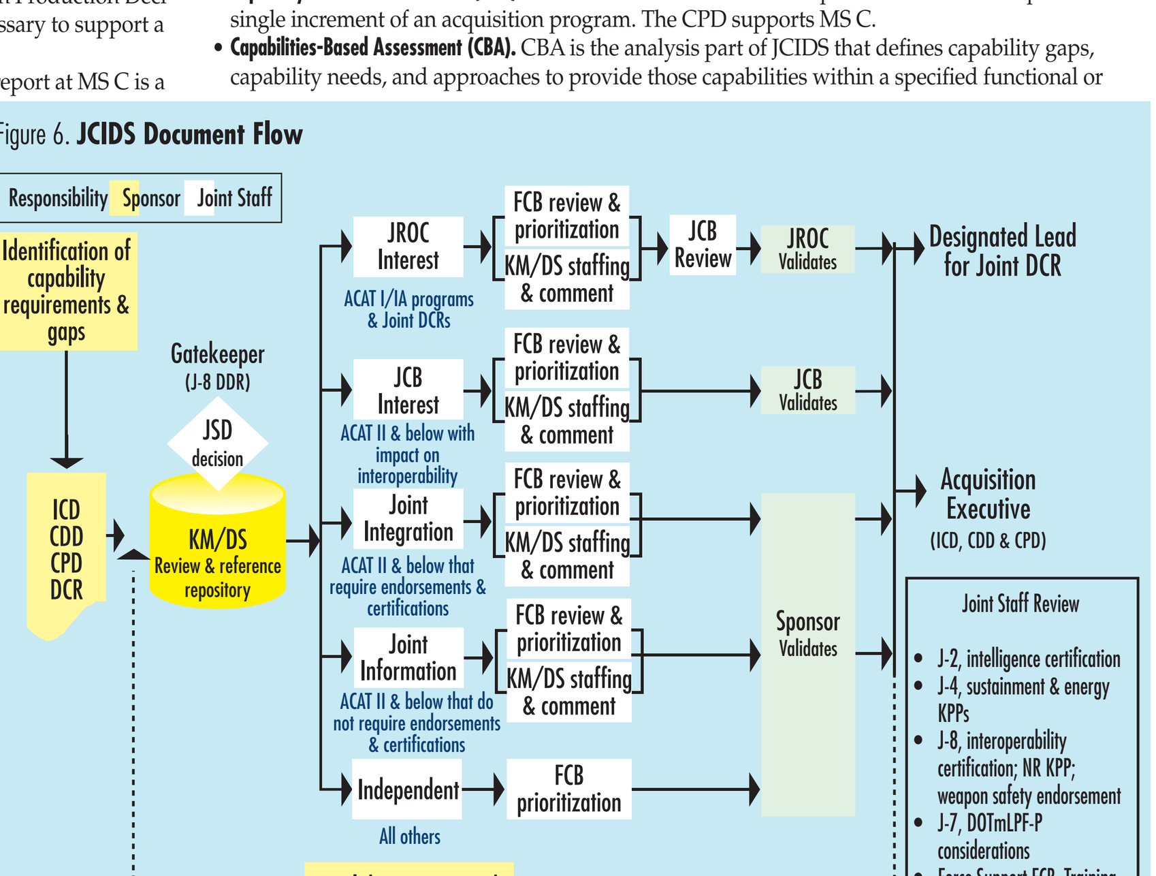
The description of the Material Development Decision (MDD) does not fully address its application to evolving on-going space systems acquisition programs. It is necessary to specify that all follow-on increments for space systems shall be preceded by a MDD. All follow-on increments shall be preceded by a MDD to 1) Assess prior increment's progress, 2) Consider additional requirements for that increment, and 3) Determine proper phase of entry for next increment.

5. JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM (JCIDS).

The procedures established in the JCIDS support the Chairman of the Joint Chiefs of Staff and the Joint Requirements Oversight Council in identifying, assessing, and prioritizing joint military capability needs. These needs are reflected in a series of documents that support the acquisition process (see Figure 6):

- **Initial Capabilities Document (ICD) (includes the Information Systems (IS variant)).** A document that describes the need for a materiel approach to a specific capability gap derived from an initial analysis of materiel approaches. The ICD defines the capability gap in terms of the functional area, the relevant range of military operations, desired effects, and time. It summarizes the results of the Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) analysis and describes why non-materiel changes alone are not adequate to fully provide the capability. The ICD supports the MDD and MS A.
- **Capability Development Document (CDD).** A document that captures the information necessary to develop a proposed program, normally using an evolutionary acquisition strategy. The CDD outlines an affordable increment of militarily useful, logistically supportable, and technically mature capability. A draft CDD supports MS A, and the validated CDD supports the Pre-EMD review and program initiation at MS B.
- **Capability Production Document (CPD)**. A document that addresses the production elements specific to a single increment of an acquisition program. The CPD supports MS C.
- **Capabilities-Based Assessment (CBA).** CBA is the analysis part of JCIDS that defines capability gaps, capability needs, and approaches to provide those capabilities within a specified functional or operational area. Based on national defense policy and centered on a common joint warfighting construct, the analyses initiate the development of integrated, joint capabilities from a common understanding of existing joint force operations, and DOTMLPF capabilities and deficiencies. See upper left front of chart.

Figure 6. **JCIDS Document Flow**



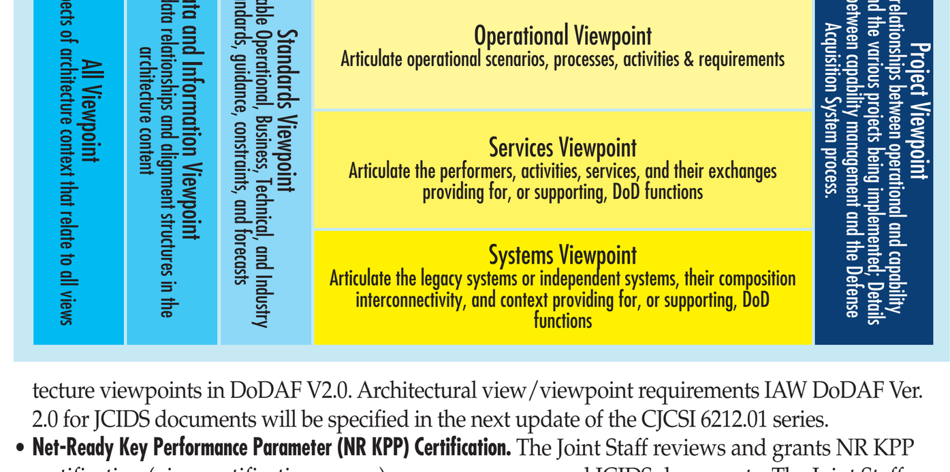
DOTMLPF Change Recommendation (DCR). A document focusing on changes that are primarily non-materiel in nature, although there may be some associated materiel changes (additional numbers of existing commercial or non-developmental) required. DCRs are normally referred to as "non-materiel" solutions, while acquisition programs are referred to as "materiel" solutions.

Military Utility Assessment (MUA). Replaces the ICD for Joint Capability Technology Demonstrations (JCTD) or other approved prototype projects, and guides development of CDD and CPD for these efforts.

Interoperability. The policies for interoperability are found in CJCSI 3170.01 series, *JCIDS*, and CJCSI 6212.01 series, *Interoerability of Information Technology (IT)* and *National Security Systems (NSS)*. The following are key aspects of this policy:

- **Global Information Grid (GIG).** The globally interconnected, set of information capabilities, associated processes and personnel for collecting, processing, storing, disseminating, and managing information on demand to warfighters, policy makers, and support personnel. The GIG includes all owned and leased communications and computing systems and services, software (including applications), data, security services, and other associated services necessary to achieve information superiority.
- **GIG Technical Guidance (GTG)**. GTG is an evolving web-enabled capability providing the technical guidance necessary for an interoperable and supportable GIG built on net-centric principles.
- **Architecture Viewpoints and DoDAF-Described Models**. An architecture viewpoint is a selected set of architectural data that has been organized to facilitate visualization in an understandable way. An Architectural Description can be visualized in a number of formats, such as dashboard, fusion, textual, composite, or graphics, which present data and derived information collected in the course of the development of an Architectural Description. A view is only a presentation of a portion of the architectural data, in the sense that a photograph provides only one view of the object within the picture, not the entire representation of that object. Figure 7 provides a graphical representation of the architecture viewpoints in DoDAF V2.0. Architectural view/viewpoint requirements IAW DoDAF Ver. 2.0 for JCIDS documents will be specified in the next update of the CJCSI 6212.01 series.

Figure 7. **Architecture Viewpoints in DoDAF Ver. 2.0**



- **Net-Ready Key Performance Parameter (NR KPP) Certification.** The Joint Staff reviews and grants NR KPP certification (via a certification memo) on sponsor approved JCIDS documents. The Joint Staff certifies the NR KPP, using the DoDAF architecture data or the optional NR KPP Architecture Data Assessment Template, and spectrum requirements compliance. The Joint Staff reviews and comments on the ISP NR KPP, DoDAF architecture data, or the optional NR KPP Architecture Data Assessment Template, and spectrum requirements compliance. The architecture data identified in table B-1, CJCSI 6212.01F, is required to support the various JCIDS documents for systems that have joint interfaces or joint information exchanges. BCL documents comply with the BEA.
- **Joint Interoperability Test Certification.** Provided by the Joint Interoperability Test Command upon completion of testing, valid for four years from the date of the certification or when subsequent program modifications change components of the NR KPP or supportability aspects of the system (when materiel changes [e.g., hardware or software modifications, including firmware] and similar changes to interfacing systems affect interoperability; upon revocation of joint interoperability test certifications; non-materiel changes [i.e., DOTLPF] occur that may affect interoperability).
- **Net-Ready Key Performance Parameter (NR-KPP).** The NR KPP documents sponsor identified and JROC validated verifiable performance measures and metrics for interoperability engineering, design, and testing. To meet NR KPP attributes, IT must be able to support military operations, to be entered and managed on the network, and to effectively exchange information. The NR KPP development process will help verify operationally effective provider to consumer, end-to-end information exchanges according to the sponsor's stated capability requirements and applicable reference models and reference architectures. It informs the solution architecture according to the DoD Information Enterprise Architecture (IEA).

6. INFORMATION TECHNOLOGY (IT) & NATIONAL SECURITY SYSTEMS (NSS).

Software components of defense systems should be tightly linked to and managed as an inherent part of the overall systems engineering processes. Software-specific considerations are:

- Ensuring that software technologies and complex algorithms are matured prior to MS B.
- Careful consideration of COTS capabilities and licensing. For COTS IT solutions, specific plans by phase are required. Additionally, use of the DoD Enterprise Software Initiative and "SmartBUY" is required for commercial software purchases whenever appropriate.
- Exploiting software reuse wherever feasible.
- Selecting contractors with systems domain experience, successful past-performance, and mature development capabilities and processes.
- Use of DoD standard data IAW DoDD 8320.02 and compliance with the DoD Net-Centric Data Strategy.
- Early planning for transition to software support.
- Designing extensible and modular software so as to better support incremental life cycle product upgrades.
- Evaluating programming languages used in the context of their life cycle costs, support risks, and interoperability.
- Assessing information operations risks (see DoDD 3600.01) using techniques such as Program Support Reviews.
- Emphasis on software security and assurance considerations throughout the life cycle, including certification of foreign nationals who work on key defense system software. Other detailed mandatory IA considerations required by life cycle phase include development of an IA strategy. Details of the DoD Information Assurance Certification and Accreditation Process (DIACAP), required to authorize operation of DoD information systems IAW statutory, federal, and DoD requirements can be found in DoDI 8510.01

Other IT & NSS Management Considerations. Defense systems must be inherently joint and network-centric; as such, IT is an inherent enabler of net-centricity. Additionally, a number of legal and regulatory considerations apply to IT and NSS systems. These considerations include:

- The GIG (mentioned earlier) (DoDD 8100.01) is the organizing and transforming construct for managing IT throughout the DoD.
- The GTG contains a program questionnaire and compliance matrices/declaration tables that point to applicable GIG Enterprise Service Profiles (GESPS) for use in the interoperability and supportability certification process.
- Enterprise and domain-specific architectures are key to achieving scalable and interoperable IT systems. Use of the DoDAF, which requires programs to document their architectures in a series of specially tailored "viewpoints" that are produced at varying levels of detail at various points in a program's life cycle is mandatory.
- Collections of standards that the DoD has selected as key to facilitating system interoperability have been collected into an online tool, the DoD IT Standards Registry (DISR). https://disronline.disa.mil
- The Clinger-Cohen Act (CCA) applies to all federal IT and NSS acquisitions. CIO confirmation of compliance is required at MS A, B, C, and FRPDR for all programs.
- Management of Defense Business Systems. A defense business system is an information system, other than a NSS, operated by, for, or on behalf of the DoD, including financial systems, mixed systems, financial data feeder systems, and IT and IA infrastructure. Review and certification of defense business systems modernizations with total modernization or development funding exceeding $1 million is overseen by the Defense Business Systems Management Committee and is described by enclosure 11 to DoDI 5000.02.

7. EARNED VALUE MANAGEMENT (EVM).

A program management tool that integrates the work scope, schedule, and cost parameters of a program in a manner providing objective performance measurement and management. As work is performed, the corresponding budget value is "earned." EVM directly supports nine management processes: organizing, scheduling, work authorization, accounting, indirect management, management analysis, change incorporation, material management, and subcontract management.

Processes Associated with EVM

- **ANSI/EIA-748 EVMS Standard.** Thirty-two management guidelines published in the American National Standards Institute/Electronic Industries Alliance Standard 748, Earned Value Management Systems (ANSI/EIA-748). The DoD formally adopted the guidelines in ANSI/EIA-748 in August 1999 for application to defense acquisition programs.
- **Integrated Baseline Reviews (IBR).** Joint government/contractor reviews to assess the realism and accuracy of the integrated performance measurement baseline (work, schedule, and budget) and gain a mutual understanding of inherent risks.
- **EVMS Compliance.** The continuing operation of the contractor's EVMS in accordance with the guidelines in ANSI/EIA-748.
- **EVMS Validation.** A formal determination by an independent party, normally DCMA, that a contractor's EVMS meets the guidelines in ANSI/EIA-748.
- **EVMS Surveillance.** A recurring process by an independent party, normally DCMA, assessing the continuing compliance of the contractor's EVMS with ANSI/EIA-748 and the contractor's written system documentation.

EVM Independent Variables

- **Actual Cost of Work Performed (ACWP or Actual Cost).** The costs actually incurred and recorded in accomplishing work performed.
- **Budget at Completion (BAC or Authorized Work).** The total authorized budget for accomplishing the program scope of work. BAC is a term that may also be applied to lower level budgets.
- **Budgeted Cost for Work Performed (BCWP or Earned Value).** The value of completed work expressed in terms of the budget assigned to that work.
- **Budgeted Cost for Work Scheduled (BCWS or Planned Value).** The time-phased budget plan for work currently scheduled.
- **EVM Reporting**—A common WBS that follows the *DoD WBS Handbook* (MIL-HDBK-881) is required for all EVM-related reporting.
- **Contract Performance Report (CPR)**. A report, prepared by the contractor, containing contract cost and schedule performance information to identify problems early and forecast future performance. (DI-MGMT-81466A)
- **Integrated Master Schedule (IMS).** A time-based schedule containing the networked, detailed tasks necessary to ensure successful program execution. (DI-MGMT-81650)
- **Contract Funds Status Report (CFSR).** A report containing contract funding data. (DI-MGMT-81468)

8. CONTRACTING.

Acquisition Plan. A formal written document reflecting the specific actions necessary to execute the approach established in the approved acquisition strategy and guiding contractual implementation. (FAR Subpart 7.1 and DFARS Subpart 207.1) There is no DoD-level rule that precludes the PM from preparing a single document to satisfy both the requirement for an Acquisition Plan and an Acquisition Strategy (see DAG, part 2.4).

Source Selection Plan (SSP). Explains the source selection process for a particular acquisition. Typically, the SSP consists of two parts. The first part describes the organization and responsibilities of the source selection team. The second part identifies the evaluation criteria and detailed procedures for proposal evaluation.

A Draft Request for Proposals (RFP) and Presolicitation Conferences. Used to ensure that the requirements are understood by industry. Open and honest feedback is essential.

Request for Proposals (RFP). Used in negotiated acquisitions to communicate the government's requirements and to solicit proposals.

Requests for Information (RFI). May be used when the government does not presently intend to award a contract, but wants to obtain price, delivery, and other market information or capabilities for planning purposes. Responses to these notices are not offers and cannot be accepted by the government to form a binding contract. There is no required format for RFIs.

Contract Management is the process of systematically planning, organizing, executing, and controlling the mutually binding legal relationship obligating the seller to furnish supplies and/or services and the buyer to pay for them.

Contract. The formal written agreement between the government and industry. See Figure 8 for the characteristics of the most common contract types. Figure 9 illustrates the most likely contract type for each phase of the acquisition process.

Figure 8. **Characteristics of Contract Categories**

	Cost-Reimbursement	Fixed Price
Promise	Best effort	Shall deliver
Risk to contractor	Low	High
Risk to gov't	High	Low
Cash flow	As incurred	On delivery
Financing	None	Progress/performance payments
Administration	Max gov't control	Min gov't surveillance
Fee/profit	CPFF max 15/10%	No limit

Performance-Based Acquisition (PBA). An acquisition structured around the results to be achieved as opposed to the manner by which the work is to be performed.

Statement of Work; Statement of Objectives; Performance Work Statement; System Specification; Contract Data Requirement List. Documents contained in the solicitation to industry (RFP) that define contractual requirements:

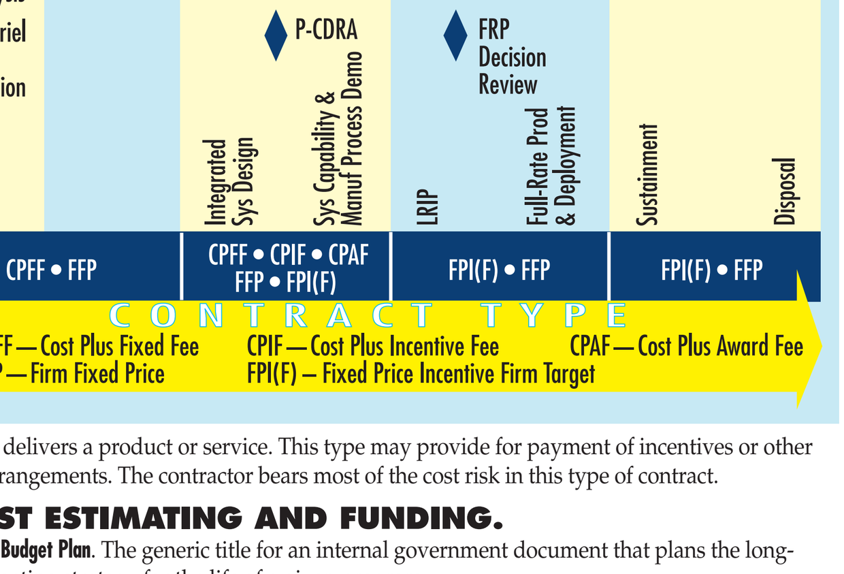
- **Statement of Work (SOW)** details the work the contractor will perform and, when necessary, specifies how the work is to be performed.
- **Statement of Objective (SOO).** Performance-based broad objectives of the product/service. The SOO contains top-level objectives of the program and is usually 1 to 2 pages. The contractor is tasked in the RFP to provide a Performance Work Statement (PWS) or a SOW in response to the SOO.
- **Performance Work Statement (PWS)** A statement of work for performance-based acquisitions that describes the required results in clear, specific, and objective terms with measurable outcomes.
- **System Specification** sets forth the technical performance requirements the system must achieve (what the system will do).
- **Contract Data Requirement List (CDRL)**, DD Form 1423 is a requirement identified in the solicitation and imposed in a contract that lists contract data requirements that are specified for a specific acquisition.

Cost-Reimbursement Contracts. A category of contracts in which the government pays the cost (subject to specified limitations) and the contractor provides "best efforts." This type may provide for payment of a fee that may consist of an award fee, incentive fee, or fixed fee, or combinations of the three fee types. The government assumes most of the cost risk in this type of contract.

Engineering Change Proposal (ECP). A formal document used to make engineering changes to configuration management baselines. ECPs are implemented by contract modification(s).

Fixed-Price Contracts: A category of contracts (e.g., Firm-Fixed-Price, Fixed-Price Incentive-Firm Target) in which the government pays a price that is subject to specified terms and conditions and the contractor delivers a product or service. This type may provide for payment of incentives or other sharing arrangements. The contractor bears most of the cost risk in this type of contract.

Figure 9. **Contract Type by Phase of the Acquisition Process**



9. COST ESTIMATING AND FUNDING.

Government Budget Plan. The generic title for an internal government document that plans the long-range budgeting strategy for the life of a given program.

Planning, Programming, Budgeting, and Execution (PPBE) Process. The PPBE Process is a time-driven resource allocation process to request funding for all operations, including weapon system development and acquisition. It is essential to convert each program's event-driven acquisition strategy and phasing into the PPBE Process calendar-driven funding profiles to assure the appropriate amount and type of funds are available to execute the desired program.

Planning. The first phase of PPBE, planning, produces the Defense Planning and Programming Guidance (DPPG). The DPPG is based on guidance from the National Security Strategy, the National Defense Strategy, and the National Military Strategy, along with other top-level guidance appropriate for each annual program budget cycle. The DPPG guides the Programming Phase of PPBE.

Programming. The second phase of PPBE, Programming, produces a 5-year POM from each military department, defense agency, and other selected DoD components. The POM is submitted to the Office of the Secretary of Defense (OSD) IAW a schedule published by OSD early each calendar year. A POM review is conducted at OSD and decisions are made by the Deputy Secretary of Defense as to funding priorities over the 5-year timeframe.

Budgeting. The third phase of PPBE, Budgeting, runs concurrent with Programming and produces the DoD portion of the president's annual budget for submission to Congress. A Budget Estimate Submission (BES) is submitted by each department/agency that submits a POM. The BES is submitted concurrent with the POM and reflects a budget for the first year of the POM. The BES is reviewed by analysts from the Office of the Under Secretary of Defense (Comptroller) and from the Office of Management and Budget (OMB). Funding changes as a result of the review are documented in decision memoranda approved by the Deputy Secretary of Defense.

Execution Review. Concurrent with the preparation of the POM/BES, "execution" reviews take place in which DoD evaluates actual output against planned performance and adjusts resources as appropriate.

Enactment. The process that the Congress uses to develop and pass the Authorization and Appropriations Bills. In the enactment process, DoD has an opportunity to work with Congress and defend the president's budget.

Future Years Defense Program. A massive DoD database and internal accounting system that summarizes forces and resources associated with programs approved by the Secretary of Defense.

Funding Appropriation Types:

- **RDT&E Budget Activities:**
  1. **Basic Research** includes all efforts and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.
  2. **Applied Research** translates promising basic research into solutions for broadly defined military needs, short of development projects. This type of effort may vary from systematic mission-directed research, which is beyond that in Budget Activity 1, to sophisticated breadboard hardware, study, programming, and planning efforts that establish the initial feasibility and practicality of proposed solutions to technological challenges. These funds are normally applied during concept refinement.
  3. **Advanced Technology Development** includes all efforts that have moved into the development and integration of hardware for field experiments and tests. The results of this type of effort are proof of technological feasibility and assessment of operability and producibility rather than the development of hardware for service use. These funds are normally applied during technology development.
  4. **Advanced Component Development & Prototypes** includes all efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology. These funds are normally applied during technology development but could be applied throughout the life cycle.
  5. **System Development & Demonstration** includes those projects in system EMD but not yet approved for low-rate initial production at MS C. These funds are normally applied during the EMD Phase of the life cycle.
  6. **RDT&E Management Support** includes test and other types of R&D support. These funds are used to support development efforts throughout the life cycle.
  7. **Operational Systems Development** includes modifications and upgrades to operational systems.
- **Procurement** is used to finance investment items and should cover all costs integral and necessary to deliver a useful end item intended for operational use or inventory.
- **Military Construction (MILCON)** funds the cost of major construction projects such as facilities. Project costs include architecture and engineering services, construction design, real property acquisition costs, and land acquisition costs necessary to complete the construction project.
- **Military Personnel (MILPERS)** funds the costs of salaries and compensation for active military and National Guard personnel as well as personnel-related expenses such as costs associated with permanent change of duty station (PCS), training in conjunction with PCS moves, subsistence, temporary lodging, bonuses, and retired pay accrual.
- **Operations and Maintenance (O&M)** finances those things that derive benefits for a limited period of time, i.e., expenses, rather than investments. Examples are headquarters operations, civilian salaries, travel, fuel, minor construction projects at dollar threshold determined by Congress, expenses of operational military forces, training and education, recruiting, depot maintenance, purchases from Defense Working Capital Funds, and base operations support.

Cost Estimating is a realistic appraisal of the level of cost most likely to be realized. Types of cost estimating are analogy, parametric, engineering, and extrapolation from actual costs.

- **Analogy** is used early in the acquisition life cycle. A one-to-one comparison of an existing system similar to the system you are designing.
- **Parametric** uses statistical analysis from a number of similar systems and their relationship to your system.
- **Engineering.** A bottoms-up estimate using the detailed WBS structure to price out discrete components, such as material, design hours, labor, etc.
- **Extrapolation from actual costs.** Method used late in the acquisition life cycle after actual cost data are available from the same system at an earlier time.

Life Cycle Cost (LCC) is the total cost to the government of acquisition and ownership of the system over its full life time. It includes the cost of development, acquisition, support, and (where applicable) disposal.

10. TECHNICAL ACTIVITIES.

Systems Engineering. Systems Engineering transforms needed operational capabilities into an integrated system design through concurrent consideration of all life cycle needs. Systems Engineering is a structured, disciplined, and documented technical effort that simultaneously designs and develops systems products and processes to satisfy the needs of the customer. In the DoD, Systems Engineering activities are based around eight technical management processes (technical planning, requirements management, interface management, risk management, configuration management, technical data management, technical assessment, and decision analysis). These eight technical management processes receive input from different systems acquisition specialty disciplines including environment, safety and occupational health (ESOH), reliability, maintainability, etc.

Important Design Considerations. A number of key areas, some of which are mandated by statute, are called out for special consideration and emphasis during the design solution process. They form the basis for trade-offs in seeking an optimal, life cycle balanced technical solution. These design considerations are described in Chapter 4 of the DAG.

Configuration Management (CM) Baselines:

- **Functional Baseline.** The technical portion of the program requirements (system performance specification) that provides the basis for contracting and controlling the system design. It is normally established by the government at the system functional review (SFR).
- **Allocated Baseline** defines the performance requirements for each configuration item of the system (item performance specifications). The contractor normally establishes this early in the process (not later than the preliminary design review [PDR]). Government control is typically deferred until the system verification review (SVR).
- **Product Baseline** is established by the detailed design documentation for the system. It includes the process and materials baseline. Government control of the initial product baseline occurs after Critical Design Review (CDR) and final product baseline is approved and validated at the Physical Configuration Audit (PCA).

Technical Management Plans:

- **Systems Engineering Plan (SEP)** (required at each milestone) is a comprehensive, living document that defines the program's systems engineering activities, addressing both government and contractor technical activities and responsibilities.
- **Integrated Master Plan (IMP)** is an event-driven plan that defines a program's major tasks and activities and lays out the necessary conditions to complete them.
- **Integrated Master Schedule (IMS)** is a time-based planning tool that uses a calendar or detailed schedule to demonstrate how work efforts will support tasks and events, often integrated with an IMP.

Reviews and Audits. (These are tailored to the program's acquisition strategy.)

- **Initial Technical Review (ITR).** A multi-disciplined technical review to support a program's initial POM submission.
- **Assessment of Operational Test Readiness (AOTR).** An independent assessment by the office of the USD(AT&L) of operational test readiness for all ACAT ID programs and special interest programs.
- **Alternative Systems Review (ASR).** A technical review that demonstrates the preferred concept is cost effective, affordable, operationally effective and suitable, and can be developed to provide a timely solution to a need at an acceptable level of risk.
- **System Functional Review (SFR).** A formal review of the conceptual design of the system to establish its capability to satisfy requirements. It establishes the functional baseline.
- **System Requirements Review (SRR).** A formal, system-level review conducted to ensure that system requirements have been completely and properly identified and that a mutual understanding between the government and contractor exists.
- **Software Specification Review (SSR).** A subsystem formal review of requirements and interface specifications for computer software configuration items.
- **Preliminary Design Review (PDR) Draft Space Debris Assessment Report.** Due 30 days prior to program PDR for the spacecraft or equivalent program/project milestone. This draft is submitted to the PM, who will make distribution to the Chief Engineer and Safety Office, and any other offices as needed.
- **Preliminary Design Review (PDR).** A formal review that confirms the preliminary design logically follows the SFR findings and meets the requirements. It normally results in approval to begin detailed design.
- **Critical Design Review (CDR).** A formal review conducted to evaluate the completeness of the design and its interfaces.
- **Test Readiness Review (TRR).** A formal review of contractors' readiness to begin testing on both hardware and software configuration items.
- **Functional Configuration Audit (FCA).** A formal review conducted to verify that all subsystems can perform all of their required design functions in accordance with their functional and allocated configuration baselines.
- **System Verification Review (SVR).** A formal review conducted to verify that the actual item (which represents the production configuration) complies with the performance specification.
- **Physical Configuration Audit (PCA).** A formal audit that establishes the product baseline as reflected in an early production configuration item.
- **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.
- **In-Service Review (ISR).** A formal technical review that is to characterize in-Service technical and operational health of the deployed system by providing an assessment of risk, readiness, technical status, and trends in a measurable form that will substantiate in-Service support and budget priorities.

Test and Evaluation (T&E) is a verification and validation process by which a system or components are compared against capability needs and specifications through testing. The results are evaluated to assess progress of design, performance, supportability, etc.

- **Beyond Low-Rate Initial Production (BLRIP) Report.** Completed by the Director, Operational Test and Evaluation (DOT&E) to assess the IOT&E for MDAPs prior to the FRPDR (or, before proceeding beyond LRIP—hence the name of the report). A copy is provided to the USD(AT&L) and to the congressional defense committees.
- **Combined Developmental and Operational Testing (DT/OT).** Combining DT and OT is encouraged to achieve time and cost savings. The combined approach must not compromise either DT or OT objectives. A final independent phase of IOT&E is required for ACAT I and II and other programs on the OSD T&E oversight list prior to the FRP decision.
- **Developmental Test and Evaluation (DT&E).** A technical test conducted to provide data on the achievability of critical system performance parameters. This verification testing is performed on components, subsystems, and system-level configurations of hardware and software.
- **Evaluation Strategy.** A description of how the capabilities in the ICD will be evaluated once the system is developed. The evaluation strategy will evolve into the TEMP, which is first due at MS B.
- **Follow-On Operational Test & Evaluation (FOT&E).** OT&E needed during and after the production phase to refine estimates from the IOT&E, to evaluate system changes, and to re-evaluate the system as it continues to mature in the field. FOT&E may evaluate system performance against new threats or in new environments.
- **IOT&E.** All OT&E that is conducted on production or production representative articles to support a FRP decision. It is conducted to provide a valid estimate of expected system operational effectiveness and suitability for ACAT I and II programs and other programs on the OSD T&E oversight list.
- **Live Fire T&E (LFT&E).** A test process to evaluate the vulnerability and/or lethality aspects of conventional missiles, munitions, or weapon systems. LFT&E is required by law (Title 10 U.S.C. 2366) for covered systems, major munitions programs, missile programs, or product improvements to covered systems major munitions programs, or missile programs, before they can proceed beyond LRIP. A covered system is a system that DOT&E has determined to be ACAT I or ACAT II program, user occupied and designed to provide protection to occupants; or a conventional munitions or missile program; or, a mod to a covered system that is likely to significantly affect the survivability or lethality of the system.
- **LFT&E Report.** Completed by DOT&E for covered systems that have been subjected to a full-up live fire test prior to FRPDR. Usually included in DOT&E report of IOT&E (BLRIP report) when sent to Congress.
- **Modification T&E.** Testing done after FRPDR to evaluate modifications/upgrades/improvements to an in-production or fielded system.
- **Operational Assessment (OA).** An evaluation of operational effectiveness and suitability made by an independent operational test agency, with user support as required, on other-than-production systems. An OA conducted during integrated system integration is often called an early operational assessment (EOA).
- **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 and validating the effectiveness and suitability of the weapons, equipment, or munitions for use in combat by typical military users.
- **Production Acceptance T&E (PAT&E).** T&E of production items to demonstrate that items procured fulfill the requirements and specifications of the procuring contract or agreements.
- **Production Qualification T&E (PQT&E).** A technical test conducted to ensure the effectiveness of the manufacturing process, equipment, and procedures. These tests are conducted on a number of samples taken at random from the first production lot and are repeated if the design or process is changed significantly.
- **Qualification Testing.** Testing that verifies the contractor's design and manufacturing process and provides a performance parameter baseline for subsequent tests. (Best Practice)
- **Test and Evaluation Master Plan (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 documents schedule and resource implications associated with the T&E program. The TEMP identifies the necessary DT&E, OT&E, and LFT&E activities. It should be closely aligned with the SEP.
- **Test and Evaluation Strategy (TES).** An early test and evaluation planning document that describes the overall approach for integrating DT&E, OT&E, and LFT&E and addresses test resource planning. Over time, the scope of this document will expand and evolve into the TEMP.
- **Vulnerability T&E.** Testing a system or component to determine if it suffers definite degradation as a result of having been subjected to a certain level of effects in an unnatural, hostile environment. A subset of survivability.

Manufacturing (also called Production) is the conversion of raw materials into products and/or components through a series of manufacturing procedures and processes. Manufacturing management is the technique of planning, organizing, directing, controlling, and integrating the use of people, money, materials, equipment, and facilities to accomplish the manufacturing task economically.

An AS outlines the approach to obtaining a certain amount of a product or system, within a planned timeframe and funding. The desired product or system has to be manufactured/produced to a quality level that provides confidence the system will perform as advertised. The production strategy is the approach to obtaining the total quantity of the system, at some rate, for some cost, and must match up with the acquisition strategy.

The role of manufacturing during the pre-production period is to influence the design of the subsystems and systems and to prepare for production. Once production has been authorized, the role of manufacturing is to execute the manufacturing plan. The overall objective of manufacturing is to provide a uniform, defect-free product with consistent performance and a lower cost in terms of both time and money.

- **Design Producibility.** A measure of the relative ease of manufacturing a product design. Emphasis is on simplicity of design and reduction in opportunities for variation during fabrication, assembly, integration and testing of components, processes, and procedures.
- **The Manufacturing Plan** is a formal description of a method for employing the facilities, tooling, and personnel resources to produce the design. The manufacturing plan must ensure that the items produced reflect the design intent, the processes are repeatable, and process improvements are constantly pursued.
- **Industrial Capability Assessment (ICA).** A legal requirement (10 U.S.C. 2440) at each milestone to analyze the industrial capability to design, develop, produce, support, and (if appropriate) restart the program.
- **The "5Ms" are Manpower, Materials, Machinery, Methods, and Measurement.** These are five major elements of all manufacturing and production efforts, and are referred to during resource requirements risk identification and management.
- **Variation Control.** Identification of key process and product characteristics, and reduction/elimination of significant differences from the nominal values of those characteristics so that those differences would not cause unacceptable degradation in product cost, quality, delivery schedule, or performance.
- **Process Proofing.** Demonstration of the required manufacturing capability in a realistic, production-representative facility.
- **Lean.** A fundamental way of thinking, intended to enable flexibility and waste reduction in order to reduce costs, cycle time, and defective products by focusing on those actions that will provide value to the end-item customer.
- **Engineering and Manufacturing Readiness Levels.** A means of communicating the degree to which a technology is producible, reliable, and affordable. Their use is consistent with efforts to include the consideration of engineering, manufacturing, and sustainment issues early in a program.

11. LIFE CYCLE LOGISTICS (LCL)

is the planning, development, implementation, and management of a comprehensive, affordable, and effective systems support strategy within TLCSM. Life cycle logistics encompasses the entire system's life cycle including acquisition (design, develop, test, produce, and deploy), sustainment (operations and support), and disposal. The principal goals/objectives of acquisition logisticians are to:

1. Influence product design for affordable system operational effectiveness (SOE).
2. Design and develop the support system utilizing performance-based logistics (PBL).
3. Acquire and concurrently deploy the supportable system, including support infrastructure.
4. Maintain/improve readiness, improve affordability, and minimize logistics footprint.

- **Acquisition Logistics**. DoD decision makers must integrate acquisition and logistics to ensure a superior product support process by focusing on affordable system operational effectiveness as a key design and performance factor, and emphasizing life cycle logistics considerations in the systems engineering process.
- **Business Case Analysis (BCA)** - A PBL BCA provides a best-value analysis, considering not only cost, but other quantifiable and non-quantifiable factors supporting an investment decision. This can include, but is not limited to, performance, producibility, reliability, maintainability, and supportability enhancements.
- **Life Cycle Sustainment Plan (LCSP)** - DoDD 5000.01 requires programs to "implement performance-based logistics strategies that optimize total system availability while minimizing cost and logistics footprint". These strategies are articulated in the LCSP, documenting the plan for implementing these strategies throughout the life of the program. The LCSP is an evolutionary document that provides the strategic framework for optimal sustainment at minimal LCC. It evolves into an execution plan for how sustainment is applied, measured, managed, assessed, and reported after system fielding. By MS C, the LCSP describes details on how the program will field and sustain the product support package necessary to meet readiness and performance objectives, lower total ownership cost, reduce risks, and avoid harm to the environment and human health.
- **Performance-Based Life Cycle Product Support (PBL)** is the purchase of support as an integrated, affordable, performance package designed to optimize system readiness and meet performance goals for a weapon system through long-term support arrangements with clear lines of authority and responsibility. PBL is DoD's preferred approach for product support implementation.
- **The Product Support Strategy (PSS)** is part of the AS, and addresses life cycle sustainment and continuous improvement of product affordability, reliability, and supportability, all while sustaining readiness. It ensures that system support and life cycle affordability considerations are addressed and documented.
- **Product Support Manager (PSM)** - The day-to-day oversight and management of the product support functions are delegated to a product support manager who leads the development and implementation of the performance-based product support strategy and ensures achievement of desired support outcomes. The PSM, while remaining accountable for system performance, can delegate responsibility for delivering specific outcomes. In doing so, the PM and PSM may employ any number of sub system PSMs or product support integrators to integrate support from all support sources to achieve the performance outcomes specified in a PBA. The PSM is responsible for accomplishing the overall integration of product support either directly through government activities or via a contract when commercial organizations are involved.
- **The Product Support Integrator (PSI)** is an organic or private sector organization that is selected to serve as the single point of accountability for integrating all sources of support necessary to meet the agreed-to support/performance metrics.
- **Performance-Based Agreements (PBAs)** establish a negotiated baseline of performance, and corresponding support necessary to achieve that performance, whether provided by commercial or organic support providers. PBAs with users specify the level of operational support and performance required by users.
- **Supportability Analyses** are a set of analytical tools used as an integral part of the systems engineering process. These tools help determine how to most cost effectively support the system throughout the life cycle and form the basis for design requirements stated in the system performance specification and the product support management plan.
- **Reliability, Maintainability, and Supportability (RMS)** are key components of system operational effectiveness.
- **The Product Support Package** identifies support requirements based upon the inherent reliability and maintainability of the system. This total system product support package identifies the support elements that make up the PBL package. Continuous assessment of in-Service system performance will identify needs for system improvements to enhance reliability, slow obsolescence, and reduce/minimize corrosion or other LCL characteristics. This package details requirements for the following elements:
  - Supply Support (spare/repair parts)
  - Maintenance Planning & Management
  - Test/Support Equipment
  - Technical Data Management/IETM
  - Manpower & Personnel
  - Training & Training Support
  - Facilities & Infrastructure
  - Packaging, Handling, Storage & Transportation (PHS&T)
  - Design Interface
  - Computer Resources & Software Support
  - Product Support Management
- **Pre-Deployment Evaluations** of the system must demonstrate supportability and life cycle affordability as entrance criteria for the Production and Deployment Phase.
- **Post Deployment Evaluations** of the system beginning with the Pre-IOC SR verify whether the fielded system meets thresholds and objectives for cost, performance, and support parameters, and support continuous improvement.
- **Key Acquisition Documents** that reflect support inputs include the ICD, AoA, CDD, CPD, TEMP, APB, and the contract.