

**Department of Defense
Manufacturing and Quality Body of Knowledge
(M&Q BoK)**

**Chapter 6
Operations and Support (O&S) Phase**



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Department of Defense Manufacturing and Quality Body of Knowledge (M&Q BoK)

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Manufacturing and Quality Body of Knowledge
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Introduction: How to Use the M&Q BoK

The Department of Defense (DoD) Manufacturing and Quality (M&Q) Body of Knowledge (BoK) is a compilation of best practices and lessons learned for completing M&Q activities across the DoD system acquisition life cycle. The office of the Deputy Director for Engineering (DD, ENG) prepared the BoK and will update the work periodically to reflect current policy, guidance, tools, and best practices. This document does not supersede DoD policy, guidance, or law.

The BoK details M&Q activities throughout the system life cycle but is not intended to be read from end to end. DoD Production, Quality, and Manufacturing (PQM) managers may refer to the BoK to find information relevant to the phase of the program they are working on. Within a specific phase, the user may focus on the section and tasks that apply (with appropriate tailoring) for the M&Q activities the program is conducting.

The BoK chapters cover recommended M&Q activities and tasks during each acquisition life cycle phase to meet DoD Instruction (DoDI) 5000.02, “Operation of the Adaptive Acquisition Framework.”

The BoK includes 6 chapters:

- Chapter 1: Pre-Materiel Development Decision (Pre-MDD)
- Chapter 2: Materiel Solution Analysis (MSA)
- Chapter 3: Technology Maturation and Risk Reduction (TMRR)
- Chapter 4: Engineering and Manufacturing Development (EMD)
- Chapter 5: Production and Deployment (P&D)
- Chapter 6: Operations and Support (O&S)

Each chapter focuses on the DoDI 5000.02 activities and program documentation required for that phase. Each chapter uses the following format:

- **Introduction:** Discusses the objectives of that phase to allow the user to understand the environment and requirements.
- **Manufacturing and Quality Objectives:** Discusses roles, goals, and objectives of program M&Q during this phase.
- **Threads:** Twelve threads or topic areas include discussions of major M&Q functions based on the “5 Ms” (Manpower, Machines, Materials, Methods, Measurement); Manufacturing Readiness Level (MRL) criteria; and DoD-unique M&Q-related functions not found in industry (i.e., DoD acquisition system, defense contracting system, and surveillance system). The 12 threads are labeled with letters A through L as follows:

- A. DoD Acquisition System
- B. Defense Contracting System
- C. Surveillance System
- D. Technology and Industrial Base
- E. Design

- F. Cost and Funding
- G. Materials Management
- H. Process Capability and Control
- I. Quality Management
- J. Manufacturing Workforce
- K. Facilities
- L. Manufacturing Management and Control

Each thread includes several **Activities** represented by gray boxes in the corresponding chapter figure (Figure 1). Activities are numbered A.1, A.2, A.3 . . . B.1, B.2, B.3, etc. The BoK includes the following for each activity:

- Activity overview description
- **Tasks** that M&Q personnel could be expected to support or lead.
- **Metrics** that should be developed, tracked, and managed during that phase.
- **Tools** such as checklists, templates, and samples available to M&Q personnel intended to help them to accomplish these tasks.
- **Resources** including guidance documents, handbooks, manuals, instructions, memos, etc., that provide direction to M&Q personnel for tasks identified in the gray box.

Example: Figure 1 shows Threads, Documents, Activities, and Reviews for the EMD Phase.

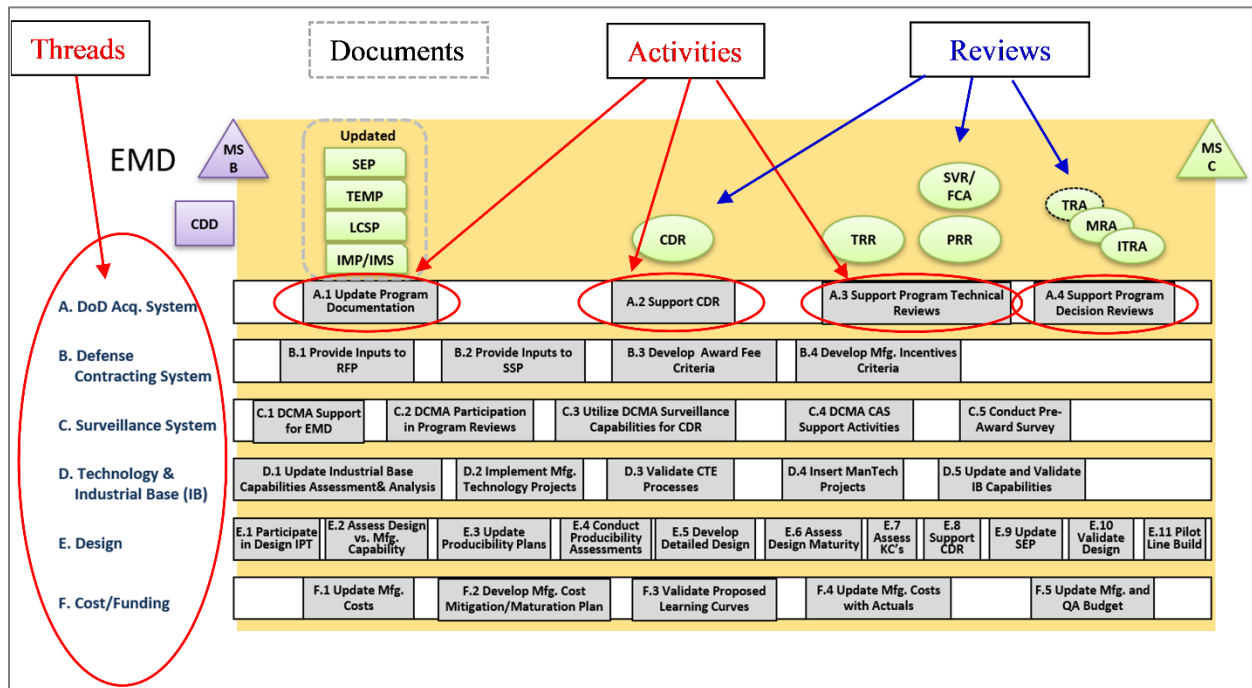
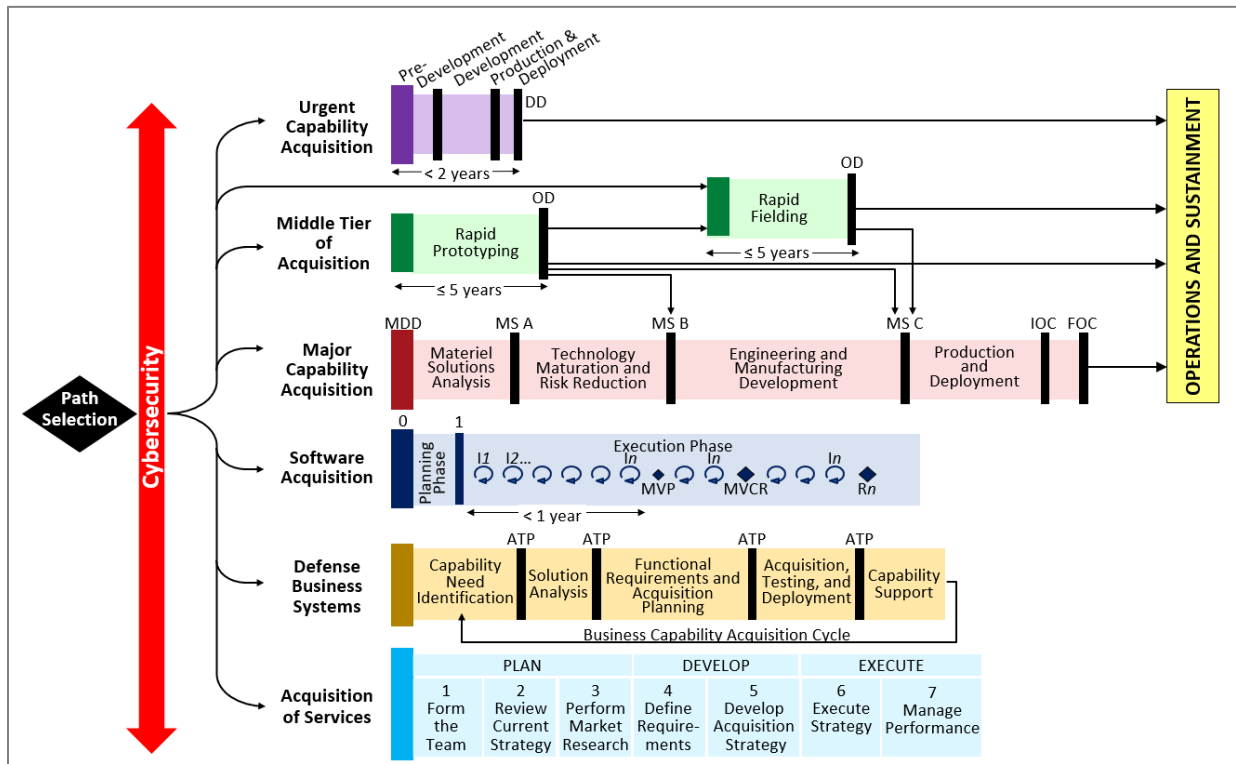


Figure 1. Sample Activity Chart

Adaptive Acquisition Framework (www.aaf.dau.edu)

This BoK follows DoDI 5000.02, Operation of the Adaptive Acquisition Framework (AAF), and for the most part will describe M&Q activities for the path labeled “Major Capability Acquisition.” This path includes a comprehensive and systematic approach for applying M&Q best practices; however, the M&Q BoK best practices are applicable to the alternative AAF acquisition paths as well. AAF paths are depicted in Figure 2.



Source: DoD Instruction 5000.02, Operation of the Adaptive Acquisition Framework, January 23, 2020

Figure 2. Adaptive Acquisition Framework Paths

For example, under the AAF, a program may have an Urgent Capability Acquisition and may have less than 2 years to provide a solution to the Warfighter, or the program may be involved in a Middle Tier of Acquisition (MTA) approach focused on rapid prototyping or rapid fielding. If so, users can see how these efforts are aligned with the Major Capability Acquisition process in Figure 2 and use those BoK chapters to identify and accomplish required tasks and activities.

In addition to DoDI 5000.02, the following associated policies provide information for the paths:

- DoD Instruction 5000.74, Defense Acquisition of Services
- DoD Instruction 5000.75, Business Systems Requirements and Acquisition
- DoD Instruction 5000.80, Operation of the Middle Tier of Acquisition (MTA)
- DoD Instruction 5000.81, Urgent Capability Acquisition
- DoD Instruction 5000.85, Major Capability Acquisition

- DoD Instruction 5000.88, Engineering of Defense Systems
- DoD Instruction 5000.89, Test and Evaluation

With any acquisition model, the program office should include M&Q personnel on the technical Integrated Product Team (IPT) and to support M&Q activities and tasks, many of which are support tasks for activities that control specific acquisition areas. For example, M&Q personnel do not have authority to sign contracts, but they should be involved in submitting M&Q input for consideration. This BoK serves as a framework for identifying and accomplishing the tasks and activities. It is up to the individual program office or acquisition organization to tailor this BoK for their application.

Manufacturing and Quality Planning

Manufacturing and Quality planning, control, and management activities represent an important and central effort that begins early in the life cycle (Pre-Materiel Development Decision and/or Materiel Solution Analysis phases) and continues throughout the life of a program through Operations and Support. Although planning is discussed in detail in each chapter, Figure 3 provides key elements M&Q planning activities in relation to overall program life cycle activities.

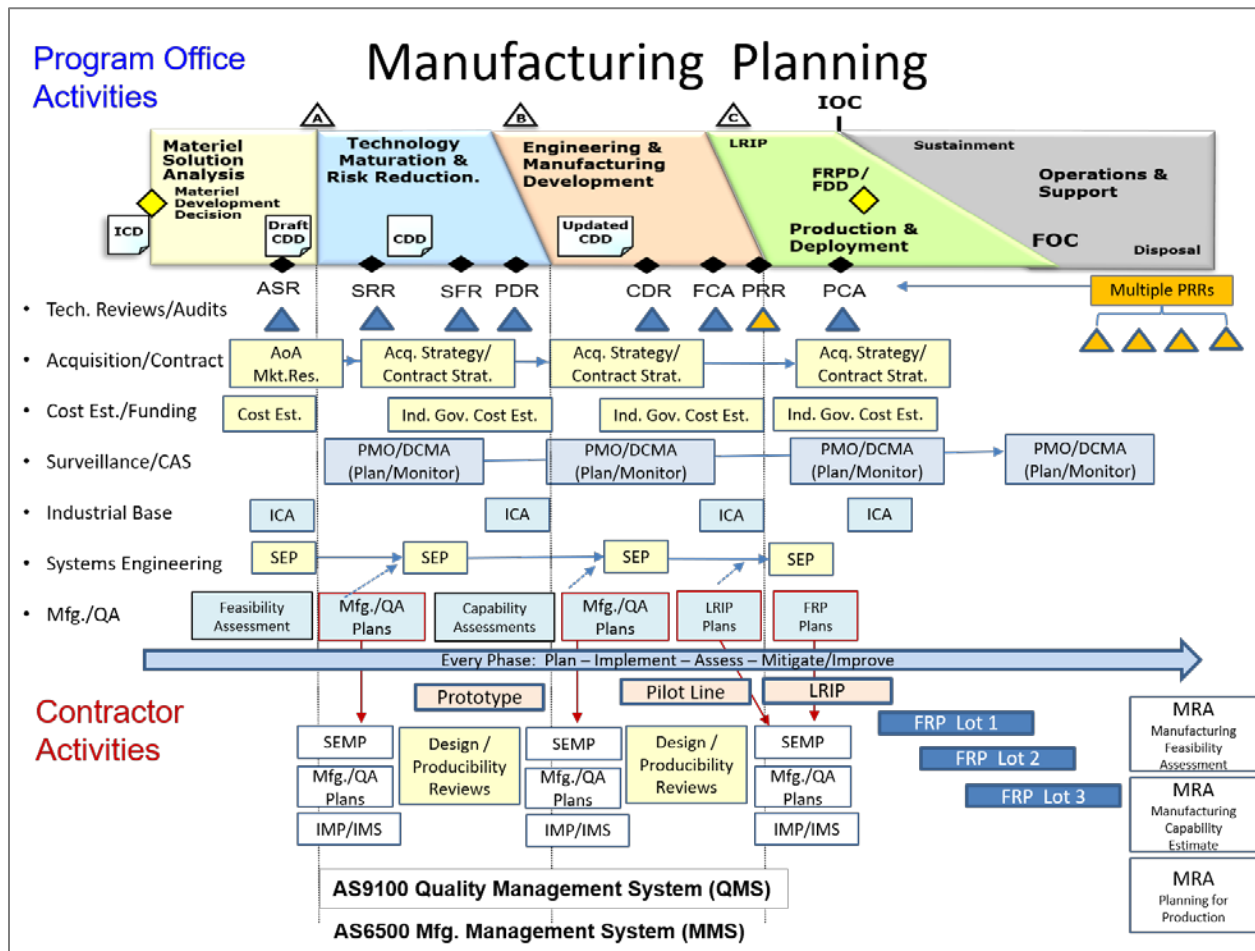


Figure 3. Typical Manufacturing and Quality Planning Activities

Most activities begin with the need to identify requirements, risks, and gaps, followed by planning activities. The top-most planning document is the Acquisition Strategy, and numerous documents feed into the Acquisition Strategy to include the Contracting Strategy and the Systems Engineering Plan (SEP). M&Q strategies should be a component of the SEP. Plans are then evaluated and updated on a recurring basis, usually just before a milestone decision.

Once the plans have been developed and the requirements handed off to the contractor in the form of a contract, then the detailed planning and execution occurs. The contractor is responsible for the execution of the program and in planning for success. The government Program Management Office (PMO), along with the Defense Contract Management Agency (DCMA), is responsible for oversight and management of the acquisition. Risk assessment and mitigation is an ongoing effort that should be conducted throughout the system life cycle. Key references for DoD M&Q planning and management approaches include: MIL-HNBK-896A, “Manufacturing Management Program Guide;” SAE Standard AS6500, “Manufacturing Management Program;” and Quality Management Systems standards ISO 9100 and/or AS9100. As a best practice, DoD PQM managers should become familiar with these fundamental planning and management approaches.

Tools and Resources

DoD tools and resources are available from many sources. Most should be available through open web-based links, but some may require a “.mil” address or a Common Access Card (CAC), or they may be available only to users in a specific community. Commercial tools and resources should be available to everyone, but may require the organization to purchase a user’s license/rights (e.g., ISO 9001 Quality Management System industry standard). In many cases, commercial resources and tools have been identified as a best practice. The M&Q BoK lists these tools for reference only; DoD does not necessarily endorse these resources or the publishing organizations. In addition, this document may reference a source for a specific tool (i.e., Pareto Chart), but there may be other widely available sources for this tool or for similar tools.

Sections labeled “Tools and Resources” are provided throughout the document chapters. In addition, following is a summary of key references and links by publisher or topic:

Key Manufacturing and Quality Body of Knowledge References and Resources

Department of Defense (DoD) Issuances, Directives Division <https://esd.whs.mil/DD/>

- DoD Directive 5000.01, The Defense Acquisition System
- DoD Instruction 5000.02, Operation of the Agile Acquisition Framework
- DoD Instruction 5000.80, Operation of the Middle Tier of Acquisition (MTA)
- DoD Instruction 5000.81, Urgent Capability Acquisition
- DoD Instruction 5000.84, Analysis of Alternatives
- DoD Instruction 5000.85, Major Capability Acquisition
- DoD Instruction 5000.88, Engineering of Defense Systems

- DoD Instruction 5000.89, Test and Evaluation
- DoD Instruction 5000.60, Defense Industrial Capabilities Assessments
- DoD Handbook 5000.60-H, Assessing Defense Industrial Capabilities
- DoD Instruction 5000.73, Cost Analysis Guidance and Procedures
- DoD Directive 5105.84, Director of Cost Assessment and Program Evaluation
- DoD Directive 4200.15, Manufacturing Technology (ManTech) Program
- DoD Directive 4400.01E, Defense Production Act Programs
- DoD Manual 4140.01, DoD Supply Chain Materiel Management Procedures

Defense Acquisition University (DAU) www.dau.edu

- Acquisition Notes (AcqNotes) www.acqnotes.com
- Defense Acquisition Guidebook (DAG) <https://www.dau.edu/tools/dag>
- Adaptive Acquisition Framework (AAF) <https://aaf.dau.edu>
- Analysis of Alternatives (AoA) www.acqnote/acquisitions/analysis-of-alternatives
- Market Research www.acqnotes/acqnote/acquisitions/market-research
- Acquisition Strategy (AS) Process/Guidance www.acqnote/acquisitions/acquisition-strategy
- System Engineering Plan (SEP) Outline and Preparation Guidance www.acqnotes.com/acqnote/acquisitions/systems-engineering-plan
- DoD Risk, Issue, and Opportunity (RIO) Management Guide for Defense Acquisition Programs <https://ac.cto.mil/wp-content/uploads/2019/06/2017-RIO.pdf>
- Logistics Assessment Guidebook www.dau.edu/tools/t/logistics-assessment-guidebook

Defense Contract Management Agency (DCMA) www.dcma.mil

- DCMA Policies <https://www.dcma.mil/Policy/>
- DCMA Instructions <https://www.dcma.mil/Policy/>
- DCMA-INST 204, Manufacturing and Production
- DMCA-INST 205, Program Support
- DMCA-INST 207, Engineering Surveillance
- DMCA-INST 309, Government Contract QA Surveillance Planning
- DCMA-INST 401, Industrial Analysis
- DCMA-INST 3401, Defense Industrial Base Mission Assistance

Defense Federal Acquisition Regulation (DFAR) Supplement <https://www.acquisition.gov/dfars>

- DFARS 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting
- DFARS 252.246-7007, Contractor Counterfeit Electronic Part Detection and Avoidance System
- DFARS 252.246-7008, Sources of Electronic Parts
- DFARS 252.242-7004, Material Management and Accounting System (MMAS)

- DFARS Subpart 242.7200, Contractor Material Management and Accounting

Defense Logistics Agency (DLA) Website www.dla.mil

- DMSMS Guidebook, SD-22 <https://www.dsp.dla.mil/Programs/DMSMS>
- ASSIST (Database of specifications and standards) <https://assist.dla.mil>
- ASSIST Quick search <https://quicksearch.dla.mil/qsSearch.aspx>
- DoD 4140.01, Supply Chain Materiel Management Regulation www.dla.mil

Manufacturing Readiness Levels (MRLs) www.dodmrl.org

- MRL Assessment Criteria Matrix www.dodmrl.org
- Interactive MRL Users Guide (MRL Assessment Criteria) www.dodmrl.org
- MRL Deskbook www.dodmrl.org
- MIL-HDBK-896A, Manufacturing Management Program Guide www.dodmrl.org

National Institute of Standards and Technology (NIST) www.nist.gov

- NIST 800-82, Guide to Industrial Control Systems (ICS) Security
- NIST 800-171, Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations

Office of the Secretary of Defense (OSD) Cost Assessment and Program Evaluation (CAPE) www.cape.osd.mil

Relevant Government Publications (Available via Web/Internet Search)

- DoD 4245.7-M Manual, Transition from Development to Production, 1985
- NAVSO P-3687, Producibility Systems Guidelines, 1999
- MIL-HDBK-766, Design to Cost
- MIL-HDBK-727, Design Guidance for Producibility, 1984

Standards, Specifications, and Standards Organizations

- ASSIST (Defense Logistics Agency Database of Specifications and standards) <https://assist.dla.mil>
- ASSIST Quick search <https://quicksearch.dla.mil/qsSearch.aspx>
- SAE International www.sae.org
- International Organization for Standards (ISO) www.iso.org
- Institute of Electrical and Electronics Engineers (IEEE) www.ieee.org
- *Note:* Many specifications and standards can be accessed at: <http://everyspec.com/>

Technology Readiness Levels (TRLs)

- Technology Readiness Assessment Deskbook www.acqnotes.com
- Technology Readiness Assessment Calculator www.acqnotes.com
- Technology Readiness Assessment Guide (Best Practices) (Report GAO-20-48G) www.gao.gov

6. Operations and Support (O&S) Phase

Introduction

During the Operations and Support (O&S) phase, the Department of Defense (DoD) Program Manager (PM) executes the Life Cycle Sustainment Plan (LCSP)/Product Support Strategy to satisfy materiel readiness and provide operational support. The O&S phase includes two major efforts: Sustainment (of operational systems) and Disposal. The LCSP, prepared by the PM and approved by the Milestone Decision Authority, is the basis for the activities conducted during this phase. Following the Production and Deployment (P&D) phase, production operations may shift from the prime contractor to government owned and operated facilities such as depots; arsenals; shipyards; maintenance, repair, and overhaul (MRO) facilities; or other industrial operations. In some cases, system sustainment may be accomplished at contractor facilities.

Many manufacturing and quality (M&Q) activities in this phase have a logistics focus such as supply, inventory, transportation, or maintenance and repair. This Body of Knowledge (BoK) focuses on DoD program office O&S activities such as management of system upgrades and modification as part of DoD Directive 5000.01, The Defense Acquisition System, as opposed to logistics “shop floor” functions such as Figure 6-1 illustrates typical program office M&Q activities of the O&S phase.

Sustainment

During this phase, the PM will deploy the product support package and monitor its performance according to the LCSP, which may include time-phased transitions between commercial, organic, and partnered product support providers. The PM will ensure the program has appropriate resources; will acquire the necessary intellectual property (IP) deliverables and associated license rights, tools, equipment, and facilities to support each level of maintenance; and will establish necessary organic depot maintenance capability in compliance with statute and the LCSP.

- A successful program meets the sustainment performance requirements, remains affordable, and continues to seek cost reductions by applying should-cost management and other techniques throughout this phase. Doing so requires close coordination with the warfighting sponsor (i.e., user), resource sponsors, and materiel enterprise stakeholders, along with effective management of support arrangements and contracts. During O&S, the PM will measure, assess, and report system readiness using sustainment metrics and will implement corrective actions for trends diverging from the required performance outcomes defined in the Acquisition Program Baseline (APB) and LCSP.
- Over the system life cycle, operational needs, technology advances, evolving threats, process improvements, fiscal constraints, plans for follow-on systems, or a combination of these influences and others may warrant revisions to the LCSP. When revising the LCSP, the PM will revalidate the supportability analyses and review the most current product support requirements, senior leader guidance, and fiscal assumptions to evaluate product support changes or alternatives and determine best value.

6. Operations and Support (O&S) Phase

Disposal/Demilitarization (DeMil)

- The O&S phase ends when the program is at the end of its useful life. The system will be demilitarized and disposed of in accordance with all legal and regulatory requirements and policy relating to safety (including explosives safety), security, and the environment.

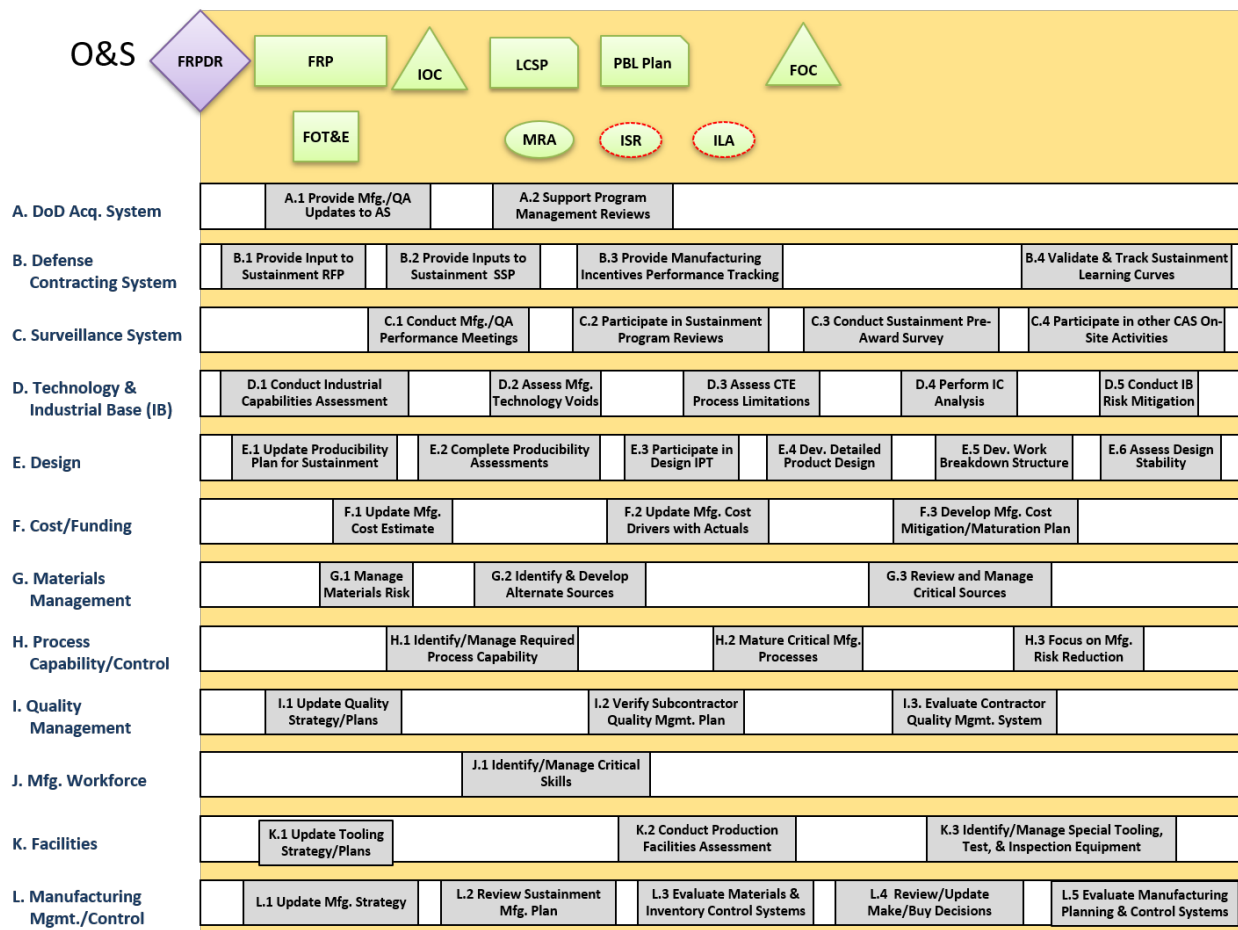


Figure 6-1. O&S Phase Manufacturing and Quality Activities

Key Program Phase Reviews, Documentation, and Activities

The O&S phase begins after the production or deployment decision and is based on a Life Cycle Sustainment Plan (LCSP) approved by the Milestone Decision Authority. The life cycle sustainment planning begins as early as the Materiel Solution Analysis (MSA) phase and is updated in every phase all the way through the O&S phase. The LCSP helps the PM to develop a complete and detailed product support package, resulting in product support arrangements. The package consists of product support elements needed to achieve sustainment requirements and the set of arrangements that programs establish with organic and commercial sustainment providers. The backbone of the product support package is the Integrated Product Support (IPS) Elements as detailed in the IPS Element Guidebook. These 12 elements can be grouped into three areas that cover the full range of life cycle functions:

6. Operations and Support (O&S) Phase

- Life cycle management
 - Product Support Management
 - Supply Support
 - Packing, Handling, Storage, and Transportation (PHST)
 - Maintenance Planning and Management
- Technical management
 - Design Interface
 - Sustaining Engineering
 - Technical Data
 - Computer Resources
- Infrastructure management
 - Support Equipment
 - Training and Training Support
 - Manpower and Personnel
 - Facilities and Infrastructure

A major focus during the sustainment effort of the O&S phase is identifying root causes and resolutions for safety and critical readiness degrading issues. These efforts include participating in trade studies and decision making relative to changes to the product support package, process improvements, modifications, upgrades, and future increments of the system. All these changes need to consider the operational needs and the remaining expected service life, interoperability or technology improvements, parts or manufacturing obsolescence, aging system issues, premature failures, changes in fuel or lubricants, and Joint or Service commonality.

- Key Program Documentation
 - System Safety Analysis (MIL-STD-882E)
 - Programmatic Environmental, Safety and Occupational Health Evaluation (PESHE)
 - National Environmental Policy Act (NEPA) and NEPA Compliance Schedule
 - Systems Engineering Plan (SEP)
 - Life Cycle Sustainment Plan (LCSP)
 - Reliability Centered Maintenance Analysis
 - Requests for Proposals (RFPs)
 - Source Selection Plans (SSPs)
- Key Program Reviews
 - Independent Logistics Assessment (ILA)
 - Manufacturing Readiness Assessment (MRA)
 - In-Service Review (ISR)

6. Operations and Support (O&S) Phase

Manufacturing and Quality O&S Objectives

During the O&S phase, program offices collect service use data, user feedback, failure reports, and discrepancy reports to assess sustainment performance. The program often will define and execute a series of improvements because of a Preplanned Product Improvement, a value engineering proposal, or modifications/upgrades to meet warfighter needs. When the product is competitive with similar products, these improvements are often driven by the action of competitors. The challenge in this phase is to integrate these changes into the production system with minimal disruption and cost. The changes introduced reflect both improvements in the ability of the product to meet the original design objective and extensions of capability to meet increased performance objectives.

Manufacturing considerations during the O&S phase should include the following:

- Continued production of units being fielded
- Updates/product improvements often tied to block upgrades
- Changes to the supply chain
- Items maturing (Diminishing Manufacturing Sources and Material Shortages (DMSMS)/Obsolescence/Counterfeit Parts)
- Changes to rate and quantity of items being produced; need to ensure a source of supply
- Items manufactured for spare parts (different configurations)
- Improvements to a contractor's Manufacturing Management System or Quality Management System
- Impacts of Continuous Process Improvement (CPI) due to Lean Six Sigma/total ownership cost or other improvement activities
- Environmental considerations (environment, safety, and occupational health (ESOH)/Occupational Safety and Health Administration (OSHA)/National Environmental Policy Act (NEPA) and Programmatic Environmental, Safety and Occupational Evaluation (PESHE)), requirements and risks
- Need to be able to maintain fielded items (data/technical information availability)
- Manage total life cycle costs/affordability (M&Q elements)
- End of life management (demil and disposal)

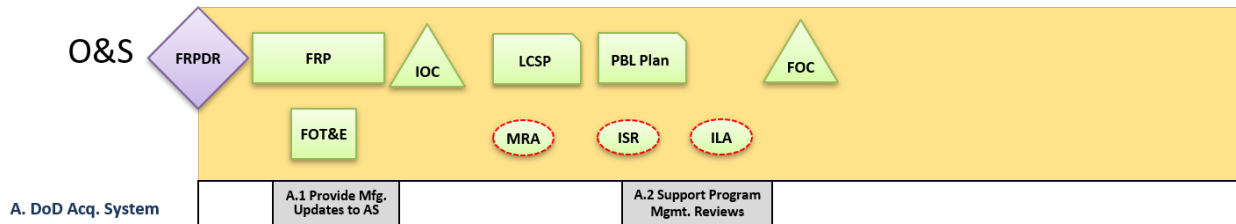
The O&S phase often overlaps with the P&D phase for many years, since O&S activities begin when the first system is fielded, and production can run for many years after Initial Operational Capability (IOC). O&S ends when a system is demilitarized and disposed of. Manufacturing and QA activities often change as production sometimes moves from a prime contractor to government owned and operated facilities, such as depots and MRO facilities. Key activities during this phase include:

- Continuation of Full-Rate Production (FRP)
- Performance-Based Logistics (PBL) implementation continues
- Updates to the Sustainment contract
- Updates to intelligence/counterintelligence products

6. Operations and Support (O&S) Phase

- Disposal and demil at the end of its useful life

A. DOD ACQUISITION SYSTEM



Sustainment planning, including the requirements in 10 U.S.C. 2337, must be an integral element of the capability requirements and acquisition process from inception. The PM, with the support of the Product Support Manager (PSM), will:

- Develop and implement an affordable and effective performance-based product support strategy. The product support strategy will be the basis for all sustainment efforts and will lead to a product support package to achieve and sustain warfighter requirements.
- Initiate system modifications, as necessary, to improve performance and reduce ownership costs, consistent with the limitations prescribed in 10 U.S.C. 2244a.
- Begin demilitarization and disposal planning, including demilitarization and controlled inventory item coding of system, subsystems, or components, as required by DoDM 4160.28, Defense Demilitarization: Program Administration, with sufficient lead time before the disposal or retirement of the first asset to reduce costs and risks and to ensure compliance with statutory and regulatory requirements.

The LCSP should be updated at each milestone and specified decision points to reflect the increased maturity of the product support strategy, any changes in the corresponding product support package, current risks, and any cost reduction activities.

The PM will integrate the product support design into the overall design process and will assess enablers that improve supportability, such as diagnostics and prognostics, for inclusion in the system performance specification. As the design matures, the PM will ensure that life cycle affordability is a factor in engineering and sustainment trades.

The following information sources provide important inputs to the O&S phase systems engineering process and should contain manufacturing considerations:

- Systems Engineering Plan (SEP)
- Programmatic Environmental, Safety and Occupational Evaluation (PESHE)
- Life Cycle Sustainment Plan (LCSP)

6. Operations and Support (O&S) Phase

Manufacturing and quality tasks during the O&S phase generally focus on producing spare parts/subsystems/systems to keep the production articles operating and initiating system modifications to improve performance and reduce ownership costs.

Manufacturing should help develop and implement an affordable and effective performance-based product support strategy. The product support strategy will be the basis for all sustainment efforts and leads to a product support package that will achieve and sustain warfighter requirements.

- Manufacturing should begin demilitarization and disposal planning, including demilitarization and controlled inventory item coding of system, subsystems, or components with enough lead time before the disposal or retirement of the first asset to reduce costs and risks and to ensure compliance with statutory and regulatory requirements.
- Manufacturing should initiate/support system modifications, as necessary, to improve performance and reduce ownership costs.
- Manufacturing will also be concerned with several related issues to include:
 - Diminishing Manufacturing Sources and Material Shortages (DMSMS)
 - Obsolescence
 - Counterfeit parts
 - Corrosion prevention and control
- Manufacturing should provide updates that reflect the increased maturity of the product support strategy, any changes in the corresponding product support package, current risks, and any cost reduction activities.

Several technical reviews could occur during this phase:

- Independent Logistics Assessment (ILA)
- Manufacturing Readiness Assessment (MRA)
- In-Service Review (ISR)

The Independent Logistics Assessment (ILA) is a multi-disciplined product and process assessment to ensure that the fielded system is operationally employed with well-understood and managed risk. This review is intended to characterize in-service technical and operational health of the fielded system by providing an assessment of risk, readiness, technical status, and trends in a measurable form that will substantiate in-service support budget priorities. Normally ISRs occur at numerous points in the O&S phase. They are typically initiated before, and in support of, the initiation of the following fiscal year(s) O&S budget requirements determination process.

During the sustainment effort of the O&S phase, systems engineering processes support ISRs including identifying root causes and resolutions for safety and critical readiness degrading issues. This effort includes participating in trade studies and decision making relative to the best resolution (e.g., changes to the product support package, manufacturing process improvements, modifications, upgrades, and

6. Operations and Support (O&S) Phase

future increments of the system), considering the operational needs and the remaining expected service life.

There may be a need to conduct a Manufacturing Readiness Assessment (MRA) to support ongoing risk assessment activities.

Interoperability or technology improvements, parts or manufacturing obsolescence, aging aircraft (or system) issues, premature failures, changes in fuel or lubricants, joint or Service commonality, etc., may all indicate the need for a system upgrade(s) or process improvements.

- The program should measure, assess, and report manufacturing readiness.
 - The major review during the O&S phase is the ISR
 - During O&S reviews, the manufacturing team should measure, assess, and report manufacturing readiness using metrics and should implement corrective actions for trends diverging from the required performance outcomes
 - The manufacturing team should provide information on quality, manufacturing/production, engineering, and software-related issues, deficiencies, or risks
- Manufacturing analysis supports the depot source of repair decision and must include detailed requirements for core depot-level maintenance and repair capabilities, and associated sustaining workloads required to support such requirements.

During O&S, the PM will measure, assess, and report system readiness using sustainment metrics and will implement corrective actions for trends diverging from the required performance outcomes defined in the Acquisition Program Baseline and LCSP.

The PM will ensure sustainment factors are fully considered at all key life cycle management decision points, and that appropriate measures are taken to reduce O&S costs by influencing system design early in development, developing sound product support strategies, and addressing key drivers of cost.

The PM should be aware of changing production capability as the transition from production to spare parts provisioning will severely reduce opportunities for future spares procurement if production facilities are changed to accommodate a new product line, material needs change, or new tooling for special purpose machines is installed. If extended production runs did not provide a spare parts inventory, the cost of parts produced later can be significantly higher than the original procurement. Conditions that drive up spare parts prices include:

- Smaller order quantity requirements
- Orders for earlier configuration units that require special documentation
- Parts requiring special purpose tooling
- Unique or scarce material requirements
- Lack of production capability due to several factors: Out of business, discontinued facilities, lack of available production capacity, etc.

6. Operations and Support (O&S) Phase

- Special handling, packaging, and shipping requirements

A.1 Provide Manufacturing and QA Updates to the Acquisition Strategy

Manufacturing and QA personnel need to be actively engaged in the development and update of numerous documents, to include:

- **Acquisition Strategy (AS)**
 - Manufacturing Strategy
 - Quality Strategy
- **Systems Engineering Plan (SEP)**
 - Manufacturing Plan
 - Quality Plan
- Test and Engineering Master Plan (TEMP)
- Integrated Master Plan/Integrated Master Schedule (IMP/IMS)
- Life Cycle Sustainment Plan (LCSP)
- Capability Development Document (CDD)
- Requests for Proposals (RFP)
- Source Selection Plan (SSP)

PMs should develop a Systems Engineering Plan (SEP) for Milestone Decision Authority approval in conjunction with each milestone review and integrated with the Acquisition Strategy. This plan should describe the program's overall technical approach, including processes, resources, metrics, and applicable performance incentives. It should also detail the timing, conduct, and success criteria of technical reviews.

Manufacturing and Quality Tasks

- Support updates to the Acquisition Strategy and other program documentation, as necessary.
- Ensure M&Q inputs for the O&S phase documents and activities evolve from the P&D phase to include:
 - Manufacturing Strategy and Plan
 - Quality Strategy and Plan
 - Test and Engineering Master Plan (TEMP)
 - Integrated Master Plan/Integrated Master Schedule (IMP/IMS)
 - Life Cycle Sustainment Plan (LCSP)
 - Capability Development Document (CDD)
 - Requests for Proposals (RFP)
 - Source Selection Plans (SSP)
- Sustainment requirements should be finalized to support sustainment contracts and the LCSP.

6. Operations and Support (O&S) Phase

- Support the development of the Product Support Package (PSP) to include the following 12 elements:
 - Product Support Management
 - Design Interface
 - Sustaining Engineering
 - Maintenance Planning and Management
 - Supply Support
 - Support Equipment
 - Technical Data
 - Training and Training Support
 - Manpower and Personnel
 - Facilities and Infrastructure
 - Packaging, Handling, Storage, and Transportation (PHS&T)
 - Computer Resources
- Support the development of the Product Support Strategy.
- Support the development of the Product Support Requirements.
- Prepare the M&Q inputs to the Product Support Strategy and Requirements:
 - Manufacturing support to system and product support package design trades
 - Manufacturing support to test and evaluation (T&E) planning
 - Manufacturing support in defining performance metrics for product support contracts and organic support requirements
 - Manufacturing support to logistics requirements, workload estimates, and logistics risk assessment
 - Manufacturing support to integrate the product support design into the overall design process, and assess enablers that improve supportability, such as diagnostics and prognostics, for inclusion in the system performance specification
 - Manufacturing support that helps ensure life cycle affordability is a factor in engineering and sustainment trades
 - Produce spare parts/subsystems/systems to keep the production articles operating and initiating system modifications, to improve performance and reduce ownership costs.
 - Manufacturing should initiate/support system modifications, as necessary, to improve performance and reduce ownership costs
 - Manufacturing should support cost estimating associated with system modifications
- Manufacturing should help develop and implement an affordable and effective performance-based product support strategy. The product support strategy will be the basis for all sustainment efforts and leads to a product support package that will achieve and sustain warfighter requirements

6. Operations and Support (O&S) Phase

- Manufacturing should help to assess field R&M data to evaluate the impact of M&Q activities on field failures. Assess using Failure Modes and Effects Analysis (FMEA) and Process Failure Modes and Effects Analysis (PFMEA)
- Manufacturing should begin demilitarization and disposal planning, including demilitarization and controlled inventory item coding of system, subsystems, or components with enough lead time before the disposal or retirement of the first asset to reduce costs and risks and to ensure compliance with statutory and regulatory requirements
- Monitor related issues including the following:
 - Diminishing Manufacturing Sources and Material Shortages
 - Obsolescence
 - Counterfeit Parts
 - Corrosion Prevention and Control
- Provide updates that reflect the increased maturity of the product support strategy, any changes in the corresponding product support package, current risks, and any cost reduction activities.

Metrics

- The Acquisition Strategy and all program documentation have been updated, as necessary.
- Manufacturing and QA personnel have provided inputs for the O&S phase documents and activities that evolve from the P&D phase to include:
 - Manufacturing Strategy and Plan
 - Quality Strategy and Plan
 - Test and Engineering Master Plan (TEMP)
 - Integrated Master Plan/Integrated Master Schedule (IMP/IMS)
 - Life Cycle Sustainment Plan (LCSP)
 - Capability Development Document (CDD)
 - Requests for Proposals (RFP)
 - Source Selection Plans (SSP)
- Sustainment requirements have been finalized to support sustainment contracts and the LCSP.
- Manufacturing and QA personnel have supported the development of the Product Support Package (PSP) to include the following 12 elements:
 - Product Support Management
 - Design Interface
 - Sustaining Engineering
 - Maintenance Planning and Management
 - Supply Support
 - Support Equipment

6. Operations and Support (O&S) Phase

- Technical Data
- Training and Training Support
- Manpower and Personnel
- Facilities and Infrastructure
- Packaging, Handling, Storage, and Transportation (PHS&T)
- Computer Resources
- Manufacturing and QA personnel have supported the development of the Product Support Strategy.
- Manufacturing and QA personnel have supported the development of the Product Support Requirements.
- Manufacturing and QA inputs have been made to the Product Support Strategy and Requirements and include:
 - Manufacturing support to system and product support package design trades
 - Manufacturing support to test and evaluation (T&E) planning
 - Manufacturing support in defining performance metrics for product support contracts and organic support requirements
 - Manufacturing support to logistics requirements, workload estimates, and logistics risk assessment
 - Manufacturing support to integrate the product support design into the overall design process, and assess enablers that improve supportability, such as diagnostics and prognostics, for inclusion in the system performance specification
 - Manufacturing support that helps ensure life cycle affordability is a factor in engineering and sustainment trades
 - Produce spare parts/subsystems/systems to keep the production articles operating and initiating system modifications, to improve performance and reduce ownership costs.
 - Manufacturing should initiate/support system modifications, as necessary, to improve performance and reduce ownership costs
 - Manufacturing should support cost estimating associated with system modifications
- Manufacturing and QA personnel have helped to develop and implement an affordable and effective performance-based product support strategy. The product support strategy will be the basis for all sustainment efforts and leads to a product support package that will achieve and sustain warfighter requirements
- Manufacturing and QA personnel have helped to assess field R&M data to evaluate the impact of M&Q activities on field failures. Assess using Failure Modes and Effects Analysis (FMEA) and Process Failure Modes and Effects Analysis (PFMEA)

6. Operations and Support (O&S) Phase

- Manufacturing and QA personnel have helped to begin demilitarization and disposal planning, including demilitarization and controlled inventory item coding of system, subsystems, or components with enough lead time before the disposal or retirement of the first asset to reduce costs and risks and to ensure compliance with statutory and regulatory requirements
- Manufacturing and QA personnel have helped to monitor related issues including the following:
 - Diminishing Manufacturing Sources and Material Shortages
 - Obsolescence
 - Counterfeit Parts
 - Corrosion Prevention and Control
- Provide updates that reflect the increased maturity of the product support strategy, any changes in the corresponding product support package, current risks, and any cost reduction activities.

Tools

- AS6500, Manufacturing Management System Checklist
- AS9100, Quality Management System Checklist
- Industrial Base Assessment Survey Form Defense Contract Management Agency (DCMA) Industrial Analysis Center
- Interactive MRL Users Guide (Checklist)
- ISO 9001, Quality Management System Checklist
- Life Cycle Sustainment Plan Outline
- Manufacturing Maturation Plan
- Product Support Strategy Development Tool, Defense Acquisition University (DAU)
- Technology Readiness Level (TRL) Assessment Checklist

Resources

- 10 USC 2337, Life-Cycle Management and Product Support
- AS6500, Manufacturing Management Program
- AS9100, Quality Systems–Aerospace
- CJS JCIDS 3170.01, JCIDS System
- Defense Manufacturing Management Guide for Program Managers, Chapter 12.5.14 In-Service Review
- DFARS 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting
- DoD 5000.60-H DoD Handbook: Assessing Defense Industrial Capabilities
- DoD HCI Style Guide, Human Computer Interaction (HCI)
- DoDI 5000.02, Operation of the Adaptive Acquisition Framework

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- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- DoDM 4160.28, Defense Demilitarization: Program Administration
- Guide to Environment, Safety, and Occupational Health (ESOH) in the Systems Engineering Plan (SEP)
- ISO 9001, Quality Management System
- ISO/IEC/IEEE 15288, Systems and Software Engineering–System Life Cycle Processes
- MIL-STD-1472, DoD Design Criteria Standard: Human Engineering
- NIST 800-171, Controls for Controlled Unclassified information
- Performance-Based Logistics (PBL) Guidance
- Product Support Manager Guidebook
- Technology Readiness Assessment Guidance

A.2 Support Program Management Reviews

Manufacturing and QA personnel should be actively engaged in the organization and execution of numerous formal reviews and audits during this phase to include:

- Manufacturing Readiness Assessments (MRAs)
- In-Service Reviews (ISRs)
- Independent Logistics Assessments (ILAs)
- Industrial Base Assessments

Program offices could request an informal review at any time and M&Q managers need to be prepared to support such reviews.

Sources of data used to assess and manage industrial and manufacturing readiness include technical reviews and audits, Program Status Reviews, pre-award surveys, Manufacturing Readiness Assessments, Industrial Base Assessments, trade-off studies, tooling plans, make-or-buy plans, manufacturing plans, and bills of material. An important output includes actions to reduce or address any remaining risks.

Manufacturing and Quality Tasks

- Provide M&Q assessments in support of the Independent Logistics Assessment (ILA) by assessing:
 - Product Support Management
 - Design Interface
 - Sustaining Engineering
 - Supply Support
 - Maintenance Planning and Management
 - Packaging, Handling, Storage, and Transportation (PHS&T)

6. Operations and Support (O&S) Phase

- Technical Data
- Support Equipment
- Training and Training Support
- Manpower and Personnel
- Facilities and Infrastructure
- Computer Resources
- Environment, Safety, and Occupational Health (ESOH)
- Provide M&Q assessments in support of the ISR:
 - System Hazard Risk Assessment
 - Operational Readiness assessment of system impacts from M&Q risks
 - Cost, schedule, and budget assessments from M&Q risks
 - Budget estimates in support of future M&Q activities
 - Current and Future Operational Risk and Systems Assessment of the impact of M&Q on reliability, maintainability, and operational readiness
- Support Follow-on Test and Evaluations (FOT&E) and review test reports
- Provide M&Q assessments in support of Manufacturing Readiness Assessments (MRA):
 - Assessments of the 12 threads
- Provide M&Q assessments in support of Industrial Base Assessments.

Metrics

- Manufacturing Readiness Assessments (MRAs) conducted.
- In-Service Reviews (ISRs) conducted.
- Independent Logistics Assessments (ILAs) conducted.
- Industrial Base Assessments conducted.

Tools

- Army Acquisition Logistician's Assessment Checklist
- DoD In-Service Review (Checklist)
- Independent Logistics Assessment Checklist (DLA)
- Interactive MRL Users Guide (Checklist)
- Manufacturing Maturation Plan
- MCSC Independent Logistics Assessment Checklist
- NAVSO P-3690, Acquisition Logistics: An Assessment Tool

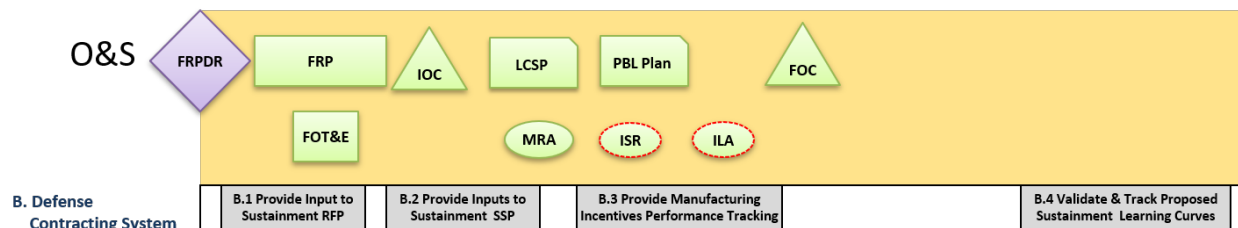
Resources

- AS6500, Manufacturing Management System
- AS9100, Quality Management System
- DoDI 5000.85, Major Capability Acquisition

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- DoDI 5000.88, Engineering of Defense Systems
- DoDI 5000.89, Test and Evaluation
- Independent Logistics Assessment Guidebook
- ISO 9001, Quality Management System
- Logistics Assessment Guidebook Tool

B. DEFENSE CONTRACTING SYSTEM



The Request for Proposal (RFP) is the primary opportunity for M&Q personnel to make inputs and should be based on M&Q risks, issues, and opportunities discovered during the O&S phase. Typical areas to be included in the proposal include industry best practices for manufacturing management, quality management, and systems engineering. Other areas to be addressed by M&Q include design and producibility, trade studies, M&Q technology investments, competition, materials (availability, counterfeit, and/or long-lead), data management, quality processes (capability studies), and M&Q reporting and control. This list and other details should be addressed in the Statement of Work (SOW) and/or the Statement of Objectives (SOO).

A well-written RFP is critical to the success of the source selection. There should be consistency between the requirements documents, Source Selection Plan (SSP), and RFP. The acquisition team must ensure a clear linkage between the requirements and evaluation factors to maximize the accuracy and clarity of the RFP.

Manufacturing and quality personnel should support the PM in the development of an RFP based on the supportability analyses contained in the Life Cycle Sustainment Plan (LCSP) and review of the most current product support requirements, senior leader guidance, and fiscal assumptions to evaluate product support changes or alternatives and determine best value.

After the Full-Rate Production decision, the LCSP will focus on finalizing the sustainment metrics, integrating sustainment considerations with design and risk management activities, and refining the execution plan for the design, acquisition, fielding, and competition of sustainment activities.

The RFP needs to consider that at the end of a system's useful life, that system may need to be demilitarized and disposed of in accordance with all legal and regulatory requirements and policy relating to safety (including explosives safety), security, and the environment.

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Life cycle sustainment for information systems may be provided via multiple approaches, including Service-level agreements, support agreements, performance work statements, and enterprise services. Where feasible and as approved by the MDA, programs may employ portfolio-level documents to satisfy their LCSP requirements. COTS and GOTS products used as intended will normally be supported via standard warranties and support agreements. Effective life cycle sustainment requires continuous monitoring to ensure investments are maintained at the right size, cost, and condition, to include vulnerability management, to support warfighter and business missions and objectives.

The necessary intellectual property (IP) deliverables and associated license rights, consistent with and integrated with the program IP Strategy.

COTS and GOTS products used as intended will normally be supported via standard warranties and support agreements. Effective life cycle sustainment requires continuous monitoring to ensure investments are maintained at the right size, cost, and condition, to include vulnerability management, to support warfighter and business missions and objectives.

The relationship between government and contractor is a critical area. The Program Management Office (PMO) and M&Q managers should strive to create and maintain close teaming arrangements with their counterparts. This will enable better communications and enhanced respect between both parties.

Performance tracking within the SOO/SOW and RFP should focus on technical and business measures that will help to assure program success (cost, schedule, and performance). Cost performance measures should focus on affordability and total life cycle costs, schedule performance measures should focus on the Integrated Master Plan/Schedule. Adherence to both may be found in an Earned Value Management (EVM) if required. Technical performance should be assessed using technical measures that are derived from the Measures of Effectiveness (MOEs), Key Performance Parameters (KPPs), Measures of Performance, and Technical Performance Measures (TPMs). Manufacturing and QA-related TPMs should support the achievement of Sustainment Supportability Measures.

Manufacturing and quality personnel should support an integrated product support capability implementing the program's mix of government and industry providers supported by appropriate analyses as included in 10 U.S.C. 2337 – Life-cycle management that focuses on:

- Maximize competition to make the best possible use of available DoD and industry resources at the system, subsystem, and component levels; and
- Maximize value to the DoD by providing the best possible product support outcomes at the lowest operations and support cost.

Manufacturing and QA personnel should be working to identify cost, schedule, and TPMs. TPMs are often derived from mission needs or MOEs, KPPs, and Measures of Performance. These measures can

6. Operations and Support (O&S) Phase

then be related to and tracked by an Earned Value Management System (if applicable), and the Integrated Master Plan/Schedule.

A successful program meets the sustainment performance requirements, remains affordable, and continues to seek cost reductions by applying should-cost management and other techniques throughout the O&S phase. Doing so requires close coordination with the warfighting sponsor (i.e., user), resource sponsors, and materiel enterprise stake holders, along with effective management of support arrangements and contracts.

During Full-Rate Production, manufacturing should focus on how sustainment performance will be measured, managed, assessed, and reported; and the necessary actions to adjust the product support package to ensure continued competition and cost control while meeting warfighter mission requirements. After Initial Operational Capability (IOC), the LCSP is the principal document governing the system's sustainment. Programs will update the plan whenever there are changes to the product support strategy, or every 5 years, whichever occurs first, supported by appropriate analyses, sustainment metrics, sustainment costs, system components or configuration (hardware and software), environmental requirements, and disposal plans or costs.

Manufacturing and QA should support programs to update the plan whenever there are changes to the product support strategy, or every 5 years, whichever occurs first, supported by appropriate analyses, sustainment metrics, sustainment costs, system components or configuration (hardware and software), environmental requirements, and disposal plans or costs. Use performance-based payment events as effective Manufacturing /quality measures. This activity involves the assessment of how efficiently the contractor is producing products, primarily through the evaluation of work measurement data. It also includes the analysis of causes of variances, their root causes, and championing and motivating contractor improvements.

During production and into sustainment, manufacturing should support performance-based payment events such as award fees, manufacturing/production incentives, and learning curve analysis.

B.1 Provide Input to Sustainment Request for Proposal

M&Q managers typically support the development of the RFP by identifying M&Q considerations for inclusion in the REP and subsequent contract. M&Q should consider the warfighter requirements and evaluation factors and subfactors with an emphasis on Sustainment. Evaluation factors often include cost or price, and quality of product or service, which includes technical, past performance and others.

Manufacturing and Quality Tasks

- Ensure that M&Q personnel are included in the Sustainment RFP writing and review teams.
- Review the RFPs to ensure it contains the following item:
 - Content for SOW, SOO
 - Contract sections C, L, M, and H

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- System Performance Specification
- Top-level Schedule
- Preliminary Work Breakdown Structure (PWBS)
- Contract Data Requirements List (CDRLs) (M&Q)
- Contract Line Items (CLINs)
- Ensure Sustainment RFPs and contracts contain the following if appropriate:
 - Higher-Level Contract Quality Requirement per Federal Acquisition Regulation (FAR) Part 52
 - ISO 9001, AS9100, etc.
 - Manufacturing Management Program
 - AS6500, Manufacturing Management Systems
 - Identifies Sustainment requirements to include a Life Cycle Sustainment Plan and Product Support Strategy
 - Failure Modes, Effects, and Criticality Analysis (FMECA)
 - System Safety Military Standard (MIL-STD-882)
 - Material Management and Accounting System (MMAS)
 - Software QA Plan
 - Other (Parts Management Program, Counterfeit Management Program, Configuration Management Program, Integrated Product Support Plan, etc.)
- Ensure that a Failure Reporting, Analysis, and Corrective Action System (FRACAS) has been established and is operating effectively.
- Analyze the RFP Sustainment requirements and inputs from a M&Q perspective for the following:
 - Risk, Issue, and Opportunity Management System and processes
 - Design producibility, feasibility, and manufacturability studies and analyses
 - Tooling, facility, and workforce analyses
 - Prototype demonstrations and development tests
 - Materials analyses
 - Make/buy processes and analyses
 - Costs and budget analyses
 - Market research and analyses
 - Modeling and simulation analyses
 - Process Capability Studies
 - Environmental studies and risks (PESHE)
 - Manufacturing and quality processes and data
 - Work measurement/learning curve analyses
 - Industrial base studies
- Specify contractual M&Q requirements for:

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- Content for SOW/SOO and contract sections C, L, M, and H
- Review RFP and contract for Defense Priorities and Allocation System (DPAS) applicability in obtaining priority support from contractors and subcontractors.
- Review RFP and contract for eventual Demilitarization and Disposal.

Metrics

- Manufacturing and QA personnel were included in the Sustainment RFP writing and review teams.
- The contract has been evaluated for M&Q inputs in the following areas:
 - Content for SOW, SOO
 - Contract sections C, L, M, and H
 - System Performance Specification
 - Top-level Schedule
 - Preliminary Work Breakdown Structure (PWBS)
 - Contract Data Requirements List (CDRLs) (M&Q)
 - Contract Line Items (CLINs)
- Quality assurance requirements (AS9100, ISO 9001, etc.) have been identified in the RFP and Contract
- Manufacturing Management (AS6500) has been identified in the RFP and contract.
- Sustainment requirements to include a Life Cycle Sustainment Plan and Product Support Strategy have been identified in the RFP.
- The RFP/contract identifies the following requirements:
 - Failure Modes, Effects, and Criticality Analysis (FMECA)
 - Failure Reporting, Analysis, and Corrective Action System (FRACAS)
 - System Safety Military Standard (MIL-STD-882)
 - Material Management and Accounting System (MMAS)
 - Software QA Plan
 - Other (Parts Management Program, Counterfeit Management Program, Configuration Management Program, Integrated Product Support Plan, etc.)
- Manufacturing and QA contractual requirements for the content for SOW/SOO and contract sections C, L, M, and H have been identified.
- The RFP and contract contain requirements for a Defense Priorities and Allocation System (DPAS).
- The RFP and contract identify requirements for eventual Demilitarization and Disposal.

Tools

- AS6500, Manufacturing Management System Checklist
- AS9100, Quality Management System Checklist

6. Operations and Support (O&S) Phase

- IG5315.204-5(b) Section L Guide and Template
- IG5315.204-5(c) Section M Guide and Template
- Industrial Base Assessment Survey Form DCMA Industrial Analysis Center
- ISO 9001, Quality Management System Checklist
- ISO/IEC/IEEE 15288, Systems and Software Engineering–System Life Cycle Processes,

Resources

- Air Force Contract Sustainment Support Guide
- AS6500, Manufacturing Management System
- AS9100, Quality Management System
- DoD 5000.60-H, DoD Handbook: Assessing Defense Industrial Capabilities
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- IG5315.204-5(c) Section M Guide
- ISO 9000, Quality Management System
- ISO/IEC/IEEE 15288, System and Software Engineering IG5315.204-5(b) Section L Guide
- MIL-HDBK-29612-1A Guidance for Acquisition of Training Data Products and Services

B.2 Provide Inputs to Sustainment Source Selection Plan

FAR 15.101, in the Best Value section, states that an agency can obtain best value in negotiated acquisitions by using any one or a combination of source selection approaches. The Source Selection Plan (SSP) is a key document which specifies how the source selection activities will be organized, initiated, and conducted. The SSP serves as the guide for conducting the evaluation and analysis of proposals, and the selection of contractor(s) for the acquisition. SSP must clearly and succinctly express the government's minimum needs (evaluation factors) and their relative order of importance. M&Q managers, as members of the technical Integrated Product Team (IPT), should be involved in the development of the SSP and in the identification of evaluation factors for their respective functions.

Manufacturing and Quality Tasks

- Support the development of the Source Selection Plan. The Source Selection Authority should approve the SSP before the final solicitation is issued. The SSP should include the following as a minimum:
 - Introduction: Background and Objectives
 - Source Selection Process
 - Source Selection Organization (SS Team should include M&Q)
 - Security (Data, Communications and Personnel)
 - Pre-solicitation Activities
 - Major Source Selection Events including Visits
 - Evaluation Factors and Subfactors (should include some M&Q)

6. Operations and Support (O&S) Phase

- Evaluation Procedures
- Review the SSP against the Acquisition Strategy.
- Ensure manufacturing inputs to the Sustainment SSP include:
 - Manufacturing and QA evaluation criteria,
 - Technical Data Rights and Manufacturing Process Data Rights,
 - Intellectual property (IP) deliverables and associated license rights.
- Ensure the SSP describes the following data requirements:
 - The management approach to managing data acquired with other than unlimited rights.
 - The management approach for management data (i.e., data that is not software or technical data). It should include how contractor data needing protection will be identified, marked, and managed.
 - How the data deliverables will be reviewed for unjustified or non-conforming markings. It should include the process the program will follow to question or challenge contractor assertions or markings
 - The data deliverables specified in the RFP or contract, including the technical data, computer software documentation, and management data items.
 - The approach for maintaining the software and its documentation once software maintenance is transferred from the Original Equipment Manufacturer. It should include the contract provisions being put into place that will allow for a cost-effective migration.
 - The degree to which data will be acquired to support future competitions. It should include the logic by which these elements were selected; the alternative solutions considered; and the criteria by which the decision to procure technical data was made.
 - The extent to which priced options and associated source selection criteria will be used to acquire additional licenses.
 - The intended use of other mechanisms such as deferred ordering, deferred delivery, and the use of withholding or incentives specific to performance in data management.
 - How the use of an integrated digital environment and the repository system factors into the data strategy.
 - Any required interfaces to government data systems or repositories, and how those requirements will be satisfied.
 - The digital format standards to be used and why they were selected. The process (i.e., business case analysis, adherence to DoD Component policy, etc.) used to determine the deliverable form/format for all deliverables should be included.

Metrics

- Source Selection Plan has been developed, documented, and assessed.
- Source Selection Plan has been assessed against the Acquisition Strategy.
- Manufacturing and QA inputs have been included on all aspects of the SSP.
- Source Selection Plan data requirements have been assessed and validated.

6. Operations and Support (O&S) Phase

Tools

- AS6500, Manufacturing Management System Checklist
- AS9100, Quality Management System Checklist
- Industrial Base Assessment Survey Form DCMA Industrial Analysis Center
- ISO 9001, Quality Management System Checklist
- ISO/IEC/IEEE 15288, Systems and Software Engineering–System Life Cycle Processes
- Source Selection Plan Template

Resources

- Air Force Contract Sustainment Support Guide
- AS6500, Manufacturing Management System
- AS9100, Quality Management System
- DAU AcqNotes website
- DoD 5000.60-H DoD Handbook: Assessing Defense Industrial Capabilities
- DoD Source Selection Procedures
- FAR Subpart 15.3 Source Selection
- IG5315.303 Source Selection Plan Guide
- ISO 9000, Quality Management System

B.3 Provide Manufacturing Incentive Performance Tracking

FAR Subpart 16.4 notes that *“incentive contracts are designed to obtain specific acquisition objectives by establishing reasonable and attainable targets that are clearly communicated to the contractor; and include incentive arrangements designed to motivate the contractor to improve or discourage contractor inefficiency and waste.”*

Contracts should produce measurable performance outcomes that cumulatively contribute to the system KPP/Key Systems Attributes (KSAs), to their threshold or objective levels. To motivate the contractor to achieve the desired behavior, appropriate contract incentives (including award fee, incentive fee, award term, and cost sharing) need to be developed to promote and facilitate contractor performance.

Manufacturing and QA managers need to support the development of Award Fee/Incentive Fee criteria in their areas. These criteria may focus on manufacturing investments and outcomes, process capability and control, reduction of waste, producibility improvements, etc.

Manufacturing and Quality Tasks

- Support the development of the Acquisition Strategy, which promotes program stability and encourages industry to invest, plan, and bear their share of the risk.

6. Operations and Support (O&S) Phase

- Support the development of award fee, incentive fee language for performance tracking to include incentive clauses, incentive metrics and contractual strategies that promote competition, or the option of competition, at the prime and subcontract levels for large and small businesses, and system and subsystem levels.
 - Materiel Availability (Am)
 - Operational Availability (Ao)
 - Material Reliability
 - Mean Down Time
 - Ownership Cost
 - Customer Fulfillment Rate (on time/schedule)
 - Throughput Time
 - Manufacturing Cycle Time
 - Quality:
 - First Pass Yield/Scrap/Rework and Repair Rates
 - Supplier Quality Yield Rates
 - Field Data (Warranty/Mean Time Between Failure) (Technical performance)
 - Cost of Quality (affordability)
 - In-Plant:
 - OSHA Compliance
 - Inventory Reduction
 - Overall Equipment Effectiveness (OEE)

Metrics

- Technical Performance Measures identified and tracked.
- Schedule Performance Measures identified and tracked.
- Cost Performance Measures identified and tracked.
- Life Cycle Sustainment Plan (LCSP) developed and reviewed.
- Award Fee/Incentive Fee contract language provides for the following LCSP Metrics:
 - Materiel Availability (% of total inventory or a system operationally capable)
 - Operational Availability (% of time a system is operationally capable)
 - Material Reliability
 - Mean Down Time
 - Ownership Cost
 - Customer Fulfillment Rate (on time/schedule)
 - Throughput Time
 - Manufacturing Cycle Time
 - Quality:
 - First Pass Yield/Scrap/Rework and Repair Rates

6. Operations and Support (O&S) Phase

- Supplier Quality Yield Rates
- Field Data (Warranty/Mean Time Between Failure) (Technical performance)
- Cost of Quality (affordability)
- In-Plant:
 - OSHA Compliance
 - Inventory Reduction
 - Overall Equipment Effectiveness (OEE)
- Contract developed and reviewed especially for incentives and competition.
- Corrosion Prevention and Control Plan developed and reviewed.
- Acquisition Strategy has been developed and reviewed and includes Industry Investments.

Tools

- Award Fee Template, Annex B of the Air Force Award Fee Guide
- Life Cycle Sustainment Plan (LCSP) Outline
- Quality Function Deployment Excel template
- Requirements Roadmap worksheet

Resources

- Air Force Contract Sustainment Support Guide
- AS6500, Manufacturing Management System
- AS9100, Quality Management System
- Award Fee Guide, various Army, Navy, and Air Force
- Guidebook for the Acquisition of Services
- ISO 9000, Quality Management System
- Life Cycle Sustainment Plan Content Guide
- Quality Function Deployment Models
- Supply Chain Metrics Guide

B.4 Validate and Track Sustainment Learning Curves

During the O&S phase, the manufacturing cost estimate should be based upon application of detailed manufacturing standards and learning curves to the operations being performed and adjusted, as necessary, by realization factors or actual costs. By this phase learning should be flat and may even go up as rates and quantities may go down or as system updates are being made.

Cost reduction initiatives should be formally documented, and the documentation must include the baseline (“before” implementation) costs and projected (“after” implementation) costs, as well as the nonrecurring costs to implement the initiative.

6. Operations and Support (O&S) Phase

It is often difficult to distinguish initiatives that are “over and above” the historical learning curves that were already used to estimate the program costs. Historical learning curves usually include some amount of cost reduction initiatives, so the challenge in documenting and estimating the impacts of new cost reduction initiatives is to determine if they are truly over and above what has been done in the past. Generally, initiatives that reduce the scope of work can be considered over and above, but ones that improve the efficiency of the work must be more carefully evaluated.

Manufacturing and Quality Tasks

- Help develop sustainment performance requirements to include metrics such as:
 - Learning Curves
 - Work Measurement
 - Line of Balance
 - Manufacturing Cycle Times
- Cost/Schedule Control Systems Criteria (C/SCSC) or Earned Value Management (EVM). This includes the analysis of causes of variances, their root causes, and championing and motivating contractor improvements.
- Review and assess contractor performance where progress or performance-based payments are in effect.
 - During production and into sustainment, manufacturing should support performance-based payment events such as award fees, manufacturing/production incentives, and learning curve analysis.
- Encourage contractors to continually improve their processes and products during regular program meetings, formal Program Reviews, fact-finding activities, etc.

Metrics

- Sustainment Performance Metrics have been developed and validated and are being tracked, to include:
 - Learning Curves
 - Work Measurement
 - Line of Balance
 - Manufacturing Cycle Times
 - C/SCSC
- Progress-based or performance-based payment has been implemented if appropriate.
- Contractor performance and continuous improvement is being monitored.

Tools

- Application of Learning Curve Theory, DAU

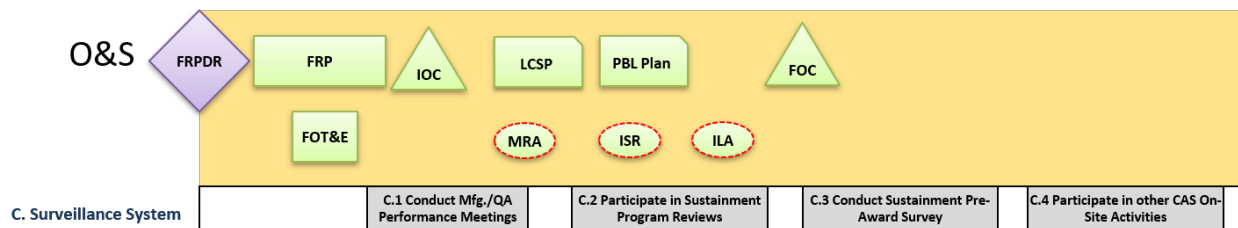
6. Operations and Support (O&S) Phase

- Cash Flow Tool for Evaluating Alternative Finance Arrangement
- DFAR Subpart 232.10, Performance-Based Payments
- DoD Progress-Based Payments Tool
- Learning Curve Calculator (Estimator)
- Performance Based Payments Guide
- Resources
- Work Measurement Time Study Worksheet

Resources

- 10 USC 2337 Life-cycle management and product support (b)(2)
- Application of Learning Curve Theory, DAU Teaching Note
- CJCSM 3170M, Manual for the Operation of the Joint Capabilities Integration and Development System
- DFAR Subpart 232.10 Performance-Based Payments
- DMMG for PMs, Chapter 9 – Work Measurement
- Life-Cycle Sustainment Plan Outline
- MIL-HDBK-502A Product Support Analysis
- Performance Based Payments Guide
- RA-C Report Manual

C. SURVEILLANCE SYSTEM



The PM and PMO should use to the extent possible available personnel from the Defense Contract Management Agency to provide onsite contract administration services (CAS) and functions in accordance with FAR 42.302(a) or DFAR subpart 242.3. Typical CAS functions involving engineering, M&Q can provide program offices with timely, value-added analysis, acquisition insight, and early confirmation of progress and risk reporting. CAS functions include but are not limited to:

- Pre- and Post-award contract actions
- Cost and financial surveillance
- Property administration
- Supply chain management
- Safety and Environmental Health

6. Operations and Support (O&S) Phase

- Engineering
- Production
- Quality

CAS functions can be delegated to the DCMA using a Memorandum of Agreement (MOA) or Letter of Delegation (LOD). DCMA-INST-205, Major Program Support and FAR 42.302(a) Contract Administration Functions outlines how DCMA personnel can be used to support program office request. Their support may be dependent upon manpower availability and funding.

Many M&Q functions may have moved from prime contractor facilities to government owned and operated facilities such as depots and MROs where CAS surveillance may not be available. This does not mean that oversight functions as outlined in the FAR/DFAR are not still appropriated.

Oversight of contracting actions will continue during the O&S phase. Sometimes contractors go out of business or for other reasons we change contractors. When we do, it is important that we gain a thorough understanding of their capability, capacity, and financial stability. This is when we will want to do a pre-award survey.

Major oversight functions include the need for regular status meetings, program reviews, the need for pre-award surveys (as appropriate) and other CAS oversight functions and activities. Manufacturing and QA oversight should be based on contract requirements (AS6500, AS9100, etc.).

Over the system life cycle, operational needs, technology advances, evolving threats, process improvements, fiscal constraints, plans for follow-on systems, or a combination of these influences and others may warrant revisions to the Life Cycle Sustainment Plan (LCSP).

Independent Logistics Assessments (ILAs) for all weapon system Major Defense Acquisition Programs (MDAPs) prior to Milestones B and C and the Full-Rate Production Decision to assess the adequacy of the product support strategy, and to identify features that are likely to drive future operating and support costs, changes to system design that could reduce costs, and effective strategies for managing such costs. The reviews will focus on sustainment planning and execution, to include the core logistics analyses and establishment of organic capabilities.

After IOC, the DoD Components will continue to conduct Independent Logistics Assessments (ILAs) at a minimum interval of every 5 years. Assessments will focus on the weapon system-level product support performance in satisfying warfighter needs, meeting sustainment metrics, and providing best-value outcomes. They must specifically assess O&S costs to identify and address factors resulting in growth in O&S costs and adapt strategies to reduce such costs. Results will inform LCSP and analyses updates.

Each DoD Component will establish its criteria for independence and will provide (1) guidance to ensure consistency within the respective Component and (2) the scope of the assessment for key

6. Operations and Support (O&S) Phase

acquisition decision points. At a minimum, these reviews will be chartered by the Component Acquisition Executive (CAE) and conducted by logistics, program management, and business experts from outside the program office. Each DoD Component will establish its criteria for independence and will provide guidance to ensure consistency within the respective Component and the scope of the assessment for key acquisition decision points. At a minimum, these reviews will be chartered by the CAE and conducted by logistics, program management, and business experts from outside the program office. M&Q experts should participate in this activity.

The In-Service Review (ISR) is a multi-disciplined product and process assessment to ensure that the fielded system is operationally employed with well-understood and managed risk. This review is intended to characterize in-service technical and operational health of the fielded system by providing an assessment of risk, readiness, technical status, and trends in a measurable form that will substantiate in-service support budget priorities.

C.1 Conduct Manufacturing and QA Performance Meetings

Compliance to a standard such as AS6500 Manufacturing Management Program, or ISO 9001 Quality Management System, or AS9100 Quality Systems, does not guarantee product or service quality. These standards are management system standards that identify requirements for processes within an organization, describe expected tasks and outcomes, and explain how the processes and tasks integrate to produce required inputs and outputs. Standards are meant to enable the organization to develop a set of processes that, if done by qualified persons using appropriate tools and methods with appropriate leadership involvement, will enable a capability for delivering high quality products or services. These standards can provide a basis for developing and managing a manufacturing or quality program and for assessing compliance to those standards.

Product or service quality is achieved through the implementation of a strategic plan to integrate all business and technical functions that result in the consistent application of proven, capable processes within an organization. Managers must ensure that all management systems are working toward the same goals and are not creating conflicting or dysfunctional behavior. Implementing a standard is of little use if the financial system rewards individuals for delivering non-conforming products/services. Because everything a contractor does should be related to the quality of its products or services, a contractor's quality management system should be the basis for integrating all other management systems within an enterprise.

Manufacturing and Quality Tasks

- Support the contractor's government/contractor status meetings to ensure the contractor is performing according to contract requirements:
 - At the prime contractor facility
 - At key/critical subcontractors and suppliers

6. Operations and Support (O&S) Phase

- Ensure that the contractor has established and implemented a Material Management and Audit System (MMAS).
- Ensure that the contractor has established and implemented a Government Property Control System.
- Support regular (weekly/monthly) contractor status meetings.
 - Manufacturing Management concerns per contract requirements (AS6500).
 - Quality concerns per contract requirements (AS9100, ISO 9001, etc.).

Metrics

- Status meetings/reviews held with M&Q personnel present:
 - Monthly/weekly program reviews
 - At prime contractors
 - At key/critical subcontractors and vendors
- Contractor has established and implemented a Material Management and Audit System (MMAS).
- Contractor has established and implemented a Government Property Control System.

Tools

- Army Acquisition Logistician Assessment Checklist
- DAU Logistics Assessment Guidebook, Appendix A: Integrated Product Support Element Assessment Criteria (checklist)
- Interactive MRL Users Guide (Checklist)
- Manufacturing Maturation Plan
- Material Management and Accounting System checklist
- Navy Government Property Compliance Checklist

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management Program
- ASA(ALT) Independent Logistics Assessments (ILA) Policy Memorandum
- DCMA-INST-204, Manufacturing and Production
- DCMA-INST-205, Major Program Support
- DCMA-INST-309 Government QA Surveillance Planning
- DFARS 245, Government-Furnished Property
- DoD Logistics Assessment Guidebook
- DoDI 4161.02, Accountability and Management of Government Contract Property
- FAR Part 46 Government Property
- Guidebook for Contract Property Administration,

6. Operations and Support (O&S) Phase

- Independent Logistics Assessment
- Independent Logistics Assessment Handbook (Navy)
- ISO 9001, Quality Management System
- Material Management and Accounting System (MMAS) Audit Program
- SECNAVINST4105.1C, Independent Logistics Assessment and Certification Requirements,

C.2 Participate in Sustainment Program Reviews

The technical reviews and audits are necessary systems engineering (SE) activities performed to assess technical progress within a program, relative to contractual requirements and developmental maturity. Technical reviews of program progress should be event-driven and conducted when the system under development meets the review entrance criteria as documented in the Systems Engineering Plan (SEP). The technical reviews and audits should include participation by subject matter experts who are independent of the program (i.e., peer review), unless specifically waived by the SEP approval authority as documented in the SEP. Acquisition milestones and SE technical reviews and audits serve as key points throughout the life cycle to evaluate significant achievements and assess technical maturity and risk. During the O&S phase the program will be faced with the need to conduct many program and technical reviews to include:

- Independent Logistics Assessment (ILA)
- In-Service Review (ISR)
- Manufacturing Readiness Assessment (MRA)

Manufacturing and Quality Tasks

- Support Independent Logistics Assessments (ILAs) at a minimum of every 5 years:
 - Assess O&S costs and address factors resulting in growth in O&S costs and adapt strategies to reduce such costs
 - Assess M&Q considerations that might impact sustainment activities
 - Assessments at prime and subcontractor levels
- Support the ISR to ensure the fielded system is operationally employed with well-understood and managed risk. The ISR should include the following considerations as appropriate:
 - Review quality, manufacturing, engineering and software related issues, deficiencies and/or risks during program reviews
 - Assess System Operational Risk and System Readiness have been quantified and related to current O&M and procurement budgets
 - Review any time-phased transitions between commercial, organic, and partnered product support providers
 - Ensure data rights and IP deliverables and associated license rights, tools, equipment, and facilities are acquired to support each of the levels of maintenance that will provide product support; and will help establish necessary organic depot maintenance capability

6. Operations and Support (O&S) Phase

- Identify features that are likely to drive future operating and support costs, changes to system design that could reduce costs, and effective strategies for managing such costs
- Assess sustainment planning and execution, to include the core logistics analyses and establishment of organic capabilities
- Review and assess Performance-Based Logistics (PBL) planning, development, implementation, and management during Sustainment
- Review and assess product obsolescence and the likelihood of future redesign to upgrade system capability to include Diminishing Manufacturing Sources and Material Shortages (DMSMS) and obsolescence
- Review and assess program office shutdown activities as needed
- DCMA should be used to support sustainment reviews
- Conduct a Manufacturing Readiness Assessment as appropriate.

Metrics

- Manufacturing and quality support the performance of Independent Logistics Assessments.
- Manufacturing and quality support the performance of the ISR.
- Manufacturing Readiness Assessment conducted.

Tools

- Army Acquisition Logistician's Assessment Checklist
- Interactive MRL Users Guide (Checklist)
- Manufacturing Maturation Plan
- MCSC Independent Logistics Assessment Checklist
- NAVSO P-3690, Acquisition Logistics: An Assessment Tool

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management System
- DoD Independent Logistics Assessment Guidebook
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- Independent Logistics Assessment Handbook
- ISO 9001, Quality Management System
- NAVSO P-3692, ILA Handbook

C.3 Conduct Sustainment Pre-Award Survey

A Pre-award Survey may be required per FAR 9.106 and is an evaluation of a prospective contractor's capability to perform under the terms of a proposed contract. During the O&S phase some subcontractors may leave the business and a new subcontractor may be validated, or there may be a

6. Operations and Support (O&S) Phase

significant system update that may require a pre-award survey and a first article inspection. It typically requires an on-site visit to the prospective contractor's facility and could be an assessment of their technical, production, quality, and financial capabilities. Manufacturing and QA managers need to support assessments at the contractors' facilities and should involve the support by DCMA personnel stationed at the facility.

Manufacturing and Quality Tasks

- Support the evaluation of a proposed contractor's capability and capacity by performing a pre-award survey.
- Support DCMA personnel on the following surveys:
 - Technical (SF 1404)
 - Production (SF 1405)
 - Quality (SF 1406)
 - Financial (SF 1407)
- Support the evaluation of Technical Capability; Production Capability; Quality; Packaging; Flight Operations/Safety; Technical documentation; Configuration Management; and Software Capability.
- Support revisions and system modifications over the system life cycle, as may be driven by operational needs, technology advances, evolving threats, process improvements, fiscal constraints, and plans for follow-on systems.
- Support taking appropriate measures to reduce operating and support costs by influencing system design early in development, developing sound product support strategies, and addressing key drivers of cost.
- Support independent logistics assessments to assess the adequacy of the product support strategy, and to identify features that are likely to drive future operating and support costs, changes to system design that could reduce costs, and effective strategies for managing such costs.
- Support sustainment planning and execution, to include the core logistics analyses and establishment of organic capabilities.

Metrics

- Pre-Award Survey(s) conducted with M&Q assistance

Tools

- Interactive MRL Users Guide (Checklist)
- Manufacturing Maturation Plan
- SF 1404 Pre-award Survey – Technical
- SF 1405 Pre-award Survey – Production
- SF 1406 Pre-award Survey – Quality Assurance

6. Operations and Support (O&S) Phase

- SF 1407 Pre-award Survey – Financial Capability

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management System
- DCMA Pre-award Survey Guide
- ISO 9001, Quality Management System

C.4 Participate in Other CAS On-Site Activities

The purpose of contract administration is to ensure that the contractor performs in accordance with the terms and conditions of the contractual agreement (surveillance). DFAR subpart 242.3 identifies seventy-one (71) Contract Administration Services (CAS) functions that need to be accomplished and managed. Contractor surveillance is defined by several FAR and DFAR clauses. Many CAS activities fall under the umbrella of production or quality surveillance activities. Manufacturing and QA managers play an integral and vital role in the total scope of contract administration. Most program offices delegate many CAS activities to the DCMA as a best practice.

Manufacturing and Quality Tasks

Manufacturing and QA personnel may be called out to perform some or all the following functions:

- Provide input to the development of a Memorandum of Agreement (MOA) between with program office and the government contract administration activity.
- Attend/participate in Post Award Orientation Conference (PAOC).
- Provide independent program status of cost, schedule, and technical performance.
- Conduct Flight Operations, if applicable.
- Support Requests for Variation (RFVs) Material Review Board (MRB) proposals for Use-As-Is (UAI) and repair non-conformances.
- Verify supplier complies with contractual Special Packaging Instructions (SPIs) for end item systems and spares.
- Perform Government Contract Quality Assurance (GCQA), to include Inspection and Acceptance, of production quantities.
- Verify Surveillance Critical Designator (SCD) (FAR 42.11) applied to the contract is the correct designator.
- Perform government surveillance of the supplier's Material Management and Accounting System (MMAS).
- Verify Beyond Economical Repair (BER) requests.
- Perform evaluation of Over and Above (O&A) requests.
- Perform Physical Progress Reviews (PPRs) to support Progress Payments.
- Perform Estimates to Completion (EAC) when requested.

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- Provide delivery delay notices to the customer.
- Validate/verify Performance Base Payment requests.
- Provide support to customer priority delivery requests.
- Support of Failure Reporting, Analysis and Corrective Action System (FRACAS).
- Support assessment of field failures.

Metrics

- The following CAS activities were supported by M&Q personnel:
 - Input into the development of a Memorandum of Agreement (MOA) between with program office and the government contract administration activity
 - Attend/participate in Post Award Orientation Conference (PAOC)
 - Provided independent program status of cost, schedule, and technical performance
 - Flight Operations, if applicable were conducted
 - Supported Requests for Variation (RFVs) Material Review Board (MRB) proposals for Use-As-Is (UAI) and repair non-conformances
 - Verified supplier complies with contractual Special Packaging Instructions (SPIs) for end item systems and spares, as defined in the contract
 - Performed Government Contract Quality Assurance (GCQA), to include Inspection and Acceptance, of production quantities
 - Verified Surveillance Critical Designator (SCD) (FAR 42.11) applied to the contract
 - Performed government surveillance of the supplier's compliance to DFARS 252.242-7004, Material Management and Accounting System (MMAS), when invoked in the contract
 - Verified Beyond Economical Repair (BER) requests
 - Performed evaluation of Over and Above (O&A) requests
 - Performed Physical Progress Reviews (PPRs) to support Progress Payments
 - Performed Estimates to Completion (EAC) when requested
 - Provided delivery delay notices to the customer
 - Validated/verified Performance Base Payment requests
 - Provided support to customer priority delivery requests
 - Supported of Failure Reporting, Analysis and Corrective Action System (FRACAS)
 - Supported the assessment of field failures

Tools

- DCMA Manufacturing and Production Surveillance Plan
- DMCA Engineering Surveillance Plan
- DMCA Program Support Plan
- DMCA QA Surveillance Plan
- Interactive MRL Users Guide (Checklist)

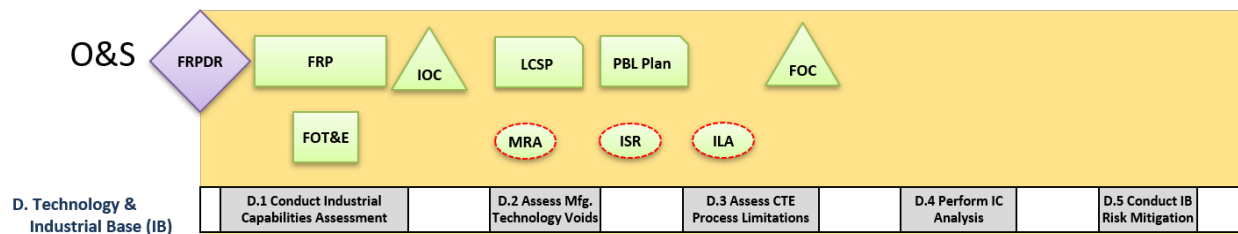
6. Operations and Support (O&S) Phase

- Manufacturing Maturation Plan

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management System
- DCMA-INST-204, Manufacturing and Production
- DMCA-INST-205, Program Support
- DMCA-INST-207, Engineering Surveillance
- DMCA-INST-309, Government Contract QA Surveillance Planning
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- ISO 9001, Quality Management System

D. TECHNOLOGY AND INDUSTRIAL BASE



The O&S phase is characterized by ongoing production and sustainment operations. The PM should evaluate the industrial base to ensure there will be a source of material for future development, production, and sustainment. The potential loss of design or manufacturing capabilities at planned cost and schedule is the major program risk during the O&S phase.

Industrial Base Assessments are required by law:

- 10 USC 2440: Technology and Industrial Base
- 10 USC 2503: Analysis of the Technology and Industrial Base
- 10 USC 2504: Annual Report to Congress
- 10 USC 2525: Periodic Defense Capabilities Assessments

When there is an indication that industrial capabilities needed by DoD are endangered, an additional analysis is required as the basis for determining what if any DoD action is required to preserve an industrial capability (*see* DoDD 5000.60 and DoD 5000.60H). Along with this analysis come the identification of risks and the development and implementation of risk mitigation activities.

The risk of industry being unable to provide program design or manufacturing capabilities at planned cost and schedule is a major risk during this phase.

6. Operations and Support (O&S) Phase

- Manufacturing and QA personnel should consider industrial surge requirements and capability for operationally expendable items such as munitions, spares, and troop support items. These are likely surge candidates and should receive close attention and specific planning, to include use of contract options.
- Manufacturing and QA personnel should identify production bottlenecks at both the prime and sub tier supplier levels for high use/high volume programs in an asymmetric warfare construct. Consider surge capability in evaluation criteria for contract award.
- If M&Q analysis indicates that industrial capabilities are in danger of being lost to include DMSMS and Obsolescence, the DoD Components should determine whether government action is required to preserve the industrial capability.
- Conduct industrial base risk handling.

During the O&S phase the industrial base may include depots, MROs, and other organic activities. There are several manufacturing concerns for the PM during the O&S phase to include:

- Diminishing Manufacturing Sources and Material Shortages (DMSMS)
- Obsolescence
- Counterfeit parts
- Insertion of new technology
- Smart shutdown
- Demilitarization and disposal

Typically, the program is very mature in the O&S phase but may still require research and development of new technologies to keep weapon systems current with new threats. As a result, the program is constantly looking at emerging threats and emerging capabilities. If there is a gap between requirements and capabilities, then the program may initiate a manufacturing technology (ManTech) development effort to close that gap.

DoD investments may be needed to create and maintain access to competitive suppliers for critical areas at the system, subsystem, and component level. When the analysis indicates that industrial capabilities needed by DoD are in danger of being lost, the components should determine whether government action is required to preserve the industrial capability. Address product technology obsolescence, replacement of limited-life items, regeneration options for unique manufacturing processes, and conversion to performance specifications at the subsystem, component, and spares levels.

D.1 Conduct Industrial Capabilities Assessment

10 U.S.C. 2440 and DFAR Subpart 207.1 require assessments of the capability of the U.S. industrial base to support the development, production, and sustainment of weapon systems used by our defense forces. As a member of the IPT, the program office should lead and support assessments of the impact

6. Operations and Support (O&S) Phase

of programmatic decisions on the national and international NTIB supporting U.S. weapon system programs. These assessments should include DCMA and program office personnel.

Manufacturing and Quality Tasks

- Support assessments of the capabilities of the industrial base to support the development, production and sustainment of weapon systems used by our defense forces.
- Support industrial base assessments, which could include the following concerns:
 - Capability to develop, produce, and sustain a capability
 - Capacity to develop, produce, and sustain a capability
 - Financial stability to develop, produce, and sustain a capability
- Support assessments of the ability to meet post-production operational needs (spares, etc.).
- Support assessments related to:
 - Technology obsolescence
 - Diminishing manufacturing sources and material shortages
 - Counterfeit parts
 - Replacement of limited-life items
 - Regeneration options for unique manufacturing processes
 - Conversion to performance specifications at the subsystems, component, and spares levels

Metrics

- Program Industrial Base Assessment has been conducted, which included:
 - Capability to develop, produce, and sustain a capability
 - Capacity to develop, produce, and sustain a capability
 - Financial stability to develop, produce, and sustain a capability
- Post-production operational needs (spares, etc.) were assessed.
- ICAs included the following items:
 - Technology obsolescence
 - Diminishing manufacturing sources and material shortages
 - Counterfeit parts
 - Replacement of limited-life items
 - Regeneration options for unique manufacturing processes
 - Conversion to performance specifications at the subsystems, component, and spares levels
- DCMA provided inputs to ICA.

6. Operations and Support (O&S) Phase

Tools

- Industrial Base Assessment Survey Form DCMA Industrial Analysis Center
- Interactive MRL Users Guide (Checklist), Technology and Industrial Base thread
- Manufacturing Maturation Plan

Resources

- 10 USC 2440, Technology and Industrial Base
- 10 USC 2501, National Security Objectives Concerning National Technology and Industrial Base
- 10 USC 2503, Analysis of the Technology and Industrial Base
- DCMA Industrial Analysis (DCMA-INST 401)
- DCMA Instruction 3401, Defense Industrial Base Mission Assistance
- DoDI 5-000.60, Defense Industrial Base Assessments
- DoDI 5000.60H, Defense Industrial Capabilities Assessments
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- MRL Deskbook

D.2 Assess Manufacturing Technology Voids

The objective of the ManTech program is to improve performance while reducing acquisition cost by developing, maturing, and transitioning advanced manufacturing technologies. During the O&S phase, programs may be working on additional capabilities and block upgrades to programs. Manufacturing assessments should identify high-risk manufacturing process areas that represent technology voids and may require investments in ManTech or other programs. ManTech program investments should be directed toward areas of greatest need and potential benefit. These investments must be identified early so that these manufacturing capabilities will be matured on time to support rate production.

Manufacturing and Quality Tasks

- Support the identification and assessment of technology voids:
 - Update assessments of emerging technologies needed to upgrade existing weapon systems
- Perform manufacturing trade studies on potential technologies to solve the requirements gap.
- Identify costs and risks associated with these new technologies.
- Update current ManTech and other technology development plans and roadmaps.
- Ensure ManTech programs and other technology programs target the risk of industry being unable to provide program design or manufacturing capabilities at planned cost and schedule following production.

6. Operations and Support (O&S) Phase

- Ensure manufacturing analysis addresses product technology obsolescence, replacement of limited-life items, regeneration options for unique manufacturing processes, and conversion to performance specifications at the subsystem, component, and spares levels.
- Assess lab resources that could be used to help contractors solve technical problems.

Metrics

- Technology voids assessed.

Tools

- Interactive MRL Users Guide (Checklist), Technology and Industrial Base thread
- ManTech or other Technology Roadmap
- Manufacturing Maturation Plan
- Producibility Assessment Worksheet
- Pugh Matrix
- Technology Readiness Assessment

Resources

- Defense Production Act, Title III
- DoDD 4200.15, ManTech Program
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- MRL Deskbook
- NAVSO P-3687 Producibility Systems Guidelines
- Technology Readiness Assessment Guide (Best Practices) (Report GAO-20-48G)
- Technology Transition Managers Guide
- TRA Deskbook

D.3 Assess CTE Product and Process Limitations

The ManTech program focuses on advancing state-of-the-art manufacturing technologies and processes from the research and development environment (laboratory) to the production and shop floor environment. These technologies are often immature and have process limitations that need to be assessed. Manufacturing and quality managers need to be on the IPT assessing these product and process limitations.

Manufacturing and Quality Tasks

- Assess critical processes that may be difficult to provide on a limited production basis.
- Manufacturing and QA personnel should assess Critical Technology Element (CTE) Process Limitations.
- Assess CTE for impacts to feasibility, affordability, producibility, and supportability.

6. Operations and Support (O&S) Phase

- Assess maturity of the technology and manufacturing processes.
- Participate in product and process assessments.

Metrics

- CTEs identified.
- Product limitations identified.
- Critical processes identified.
- Process limitations identified.

Tools

- Interactive MRL Users Guide (Checklist), Technology and Industrial Base thread
- Manufacturing Maturation Plan
- Producibility Assessment Worksheet
- Technology Readiness Assessment
- TRL Calculator

Resources

- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- MRL Deskbook
- NAVSO P-3687, Producibility Systems Guidelines
- Technology Readiness Assessment Deskbook
- Technology Readiness Assessment Guide (Best Practices) (Report GAO-20-48G)

D.4 Perform Industrial Capability Analysis

An Industrial Base Assessment is an assessment of an industry to evaluate the skills and knowledge, processes, facilities, and equipment needed to design, develop, manufacture, repair, and support DoD products. ICAs can be performed in many ways. One way is to send a standardized questionnaire to companies. After they complete the survey a small team could visit the company to follow up on the questions and tour of the facilities. The purpose of the assessment is to identify potential industrial base/program risks.

Manufacturing and Quality Tasks

- Conduct industrial base assessments as needed, or when they are in danger of being lost.
- Address product and process technology obsolescence, replacement of limited-life items, regeneration options for unique manufacturing processes, and conversion to performance specifications at the subsystem, component, and spares levels.
- Determine whether government alternative action is required to preserve the industrial capability per DoD Handbook 5000.60H, which could include:

6. Operations and Support (O&S) Phase

- Take no action
- Buy from a foreign source
- Find/develop an alternative source
- Lifetime buy
- Smart Shutdown
- Maintain the current capability
- Identify DoD investments needed to create and maintain access to competitive suppliers for critical areas at the system, subsystem, and component level.
 - Identify ManTech projects
 - Initiate ManTech projects

Metrics

- Industrial Base Capability assessment conducted.
- Industrial base alternative action identified.
- Industrial base investments identified.
- ManTech projects identified and initiated.

Tools

- Industrial Base Assessment Survey Form DCMA Industrial Analysis Center
- Interactive MRL Users Guide (Checklist), Technology and Industrial Base thread
- Manufacturing Maturation Plan
- TRL Assessment Checklist

Resources

- DoD 5000.60H, Defense Industrial Capabilities Assessments
- DoDI 5-000.60, Defense Industrial Base Assessments
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- MRL Deskbook

D.5 Conduct Industrial Base Risk Mitigation

Industrial base risk mitigation activities may be a result of a formal study or analysis or may be a result of routine oversight that identifies a risk or an issue. Manufacturing and QA managers need to assist in the development and management of risk management strategies and implementation plans.

Manufacturing and Quality Tasks

- Develop and implement Industrial Base risk mitigation activities per DoD 5000.60H, Chapter 5, Identify and Evaluate Alternative Actions. These risk mitigation plans should address the following:
 - Identify which M&Q capabilities should be maintained throughout the life of the program.
 - Mitigate product or process technology obsolescence, lifetime replacement, or regeneration of items projected to go out of production.
 - Address the approach to making production rate and quantity changes that support a response to contingency and support requirements including surges.
 - Mitigate the vulnerability of the supply chain (to include sole, single, fragile, foreign sources, cyber exploitation, and foreign acquisition of domestic sources).
 - Address the availability of essential raw materials, special alloys, composite materials, components, tooling, and production test equipment (required to include the availability of alternatives for obtaining such items from within the National Technology Industrial Base (NTIB)).
 - Address the risks introduced by new and unique capabilities and processes.
- Support the development of Acquisition Strategies that consider industrial surge requirements and capability for operationally expendable items such as munitions, spares, and troop support items.

Metrics

- Industrial Base Risk Mitigation plans developed.
 - Manufacturing capabilities that should be maintained have been identified
 - Product and process technology obsolescence has been addressed
 - Supply chain vulnerabilities have been mitigated
 - Availability of essential materials has been addressed
 - Risks to unique capabilities and processes have been addressed
- Industrial surge requirement have been addressed in the Acquisition Strategy.

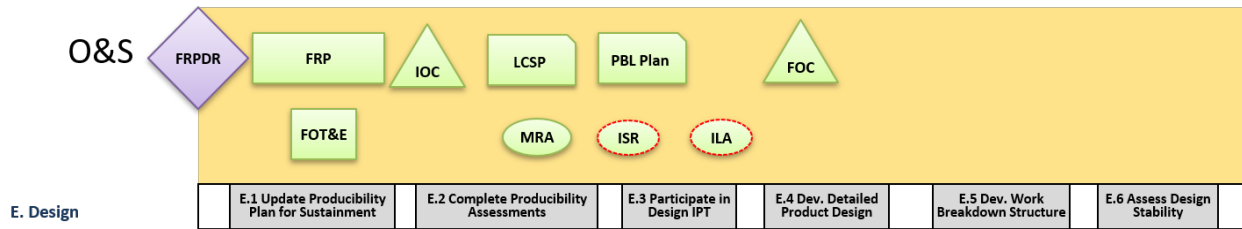
Tools

- Industrial Base Assessment Survey Form DCMA Industrial Analysis Center
- Interactive MRL Users Guide (Checklist), Technology and Industrial Base thread
- Manufacturing and QA Risk Mitigation Plan (no Template available)
- Manufacturing Maturation Plan

Resources

- DoD Handbook 5000.60H, Assessing Defense Industrial Capabilities, Part II, Chapter 5 Identify and Evaluate Alternative Actions
- DoDI 5-000.60, Defense Industrial Base Assessments
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- MRL Deskbook, Chapter 5.2 Development of a Manufacturing Maturation Plan

E. DESIGN



Manufacturing and quality personnel participation in the program’s systems engineering process as a part of the IPTs is critical to succeeding in producing a manufacturable and affordable system with acceptable risks. Manufacturing and quality industry best practices are integral to design and development efforts in both Manufacturing Management System (MMS) and Quality Management System (QMS) requirements (e.g., AS6500, ISO 9001, AS9100, etc.). The program should integrate M&Q into the product design and development process and engage M&Q expertise throughout the entire life cycle of a system to include the O&S phase. Analyses of design alternatives through trade studies, producibility analyses, and manufacturing feasibility based on program requirements needs to be conducted, with results incorporated into the design. To accomplish program objectives, producibility planning and analysis along with M&Q planning and analysis need to be performed throughout the supply chain to enable visibility and accountability through collection, recording, and communication of technical and programmatic data.

The purpose of Producibility Engineering and Planning (PEP) is to ensure that product designs reflect good producibility considerations prior to release for manufacturing. Incorporating PEP early in production system requirements planning process will help the program achieve cost, schedule, and performance objectives by identifying design risks early.

PMs should reduce manufacturing risk and demonstrate producibility prior to Full-Rate Production. Manufacturing and QA personnel should provide input into producibility/design reviews, systems engineering, and trade studies.

The PEP program should be defined contractually and contain specific tasks and measurable performance that will support an orderly transition. PEP progress should be tracked by means of production readiness reviews required before initial or full production decisions. The objective of a transition plan is to provide visibility of how well each activity is being executed. Progress should be regularly compared against the transition plan.

6. Operations and Support (O&S) Phase

PEP is a qualification process that will confirm the adequacy of the design and production planning, tool design, manufacturing process, and procedures before rate production begins. Manufacturing and Quality managers should look at producibility assessments as a vehicle for encouraging the contractors to continually improve their processes and products. Also note this is not confined to contractors. PMs should encourage internal improvements at depots and within the support facilities.

- The producibility engineering review is conducted in addition to normal and necessary design reviews. These reviews during the O&S phase are conducted by the engineering IPT and should be used to assess progress against specific goals and metrics for the product. Producibility engineering should naturally support any requirements for “design for supportability.”
- Producibility assessments are required to develop and manufacture products that will satisfy the warfighter. NAVSO P-3687, Producibility Systems Guidelines, outlines a five-step process for ensuring that producibility planning and execution are integrated into the systems engineering process and into the Life Cycle Sustainment Plan. One of the major steps in that process is to “determine the process capability” and that means to assess the producibility of the item.
- The current JCIDS Manual identifies four mandatory KPPs (Energy, System Survivability, Force Protection, and Sustainment). The updated Sustainment KPP consists of several mandatory components: Materiel Availability (Am) and Operational Availability (Ao), and three mandatory attributes: Reliability, Maintainability, and the O&S cost. Respectively, they provide fleet-level availability and operational availability. System design and manufacturing variability, especially of key characteristics can have a significant impact on the ability of the user to achieve their mandatory KPPs and other Measures of Performance.
- Metrics should be derived from the mission requirements and first expressed as MOEs, and then as KPPs. The KPPs then are expressed as Measures of Performance and then as Technical Performance Measures. Manufacturing and quality personnel need to understand their role in achieving the MOEs/KPPs/TPMs and develop systems and processes that will help the program to achieve these measures. The identification and management of Key Characteristics (KCs) is an important function if the program expects to achieve any of these metrics.

One of the roles of M&Q personnel is to “influence the design.” It must be noted that M&Q personnel are not design engineers and thus their role is a supporting role. They need to assess the design to ensure that the design is manufacturable and inspectable/testable. The existing factory floor is a “capability,” and a design that cannot be produced on the existing factory floor either requires a design change to match the existing factory floor capability or M&Q personnel must develop new processes that will ensure that the design can be build that results in uniform, defect-free products that are affordable.

6. Operations and Support (O&S) Phase

Manufacturing must assess the detailed production designs, processes, WBS, and schedules must be transitioned from Full-Rate Production to a schedule and rate that can be used to produce spares during sustainment. In addition:

- Manufacturing and QA personnel must assess new analytical methods, tools, and processes for analyzing production schedules against spare parts manufacturing.
- Manufacturing should support developing an overarching WBS framework to identify “smart shutdown” tasks. This would stop Full-Rate Production efforts and change over to a limited spares production capability.
- The planning, execution, and control of the production phase activities require that the work be divided into manageable tasks that are compatible with the existing manufacturing and performance measurement systems. Often, the WBS used during the development phases will not be appropriate for the production phase or for sustainment. Consequently, the contractor should, as a basis for production planning, identify and develop the WBS to be used. While this may differ from the EMD structure, the two should be such that production phase costs can be related to the development WBS, and the sustainment costs can be related to the production costs. This is critical for those programs that have used a design-to-unit production cost management approach during development.
- The objective of the O&S phase is the execution of a support program that meets operational support performance requirements and sustains the system in the most cost-effective manner over its total life cycle. When the system reaches the end of its useful life, the department should dispose of it.
- During the sustainment effort of the O&S phase, systems engineering processes support In-Service Reviews including identifying root causes and resolutions for safety and critical readiness degrading issues. This effort includes participating in trade studies and decision making relative to the best resolution (e.g., changes to the product support package, manufacturing process improvements, modifications, upgrades, and future increments of the system), considering the operational needs and the remaining expected service life. Interoperability or technology improvements, parts or manufacturing obsolescence, aging aircraft (or system) issues, premature failures, changes in fuel or lubricants, Joint or Service commonality, etc. may all indicate the need for a system upgrade(s) or process improvements.
- The last activity associated with the operations and support acquisition phase is disposal. Early systems engineering processes should include and inject disposal requirements and considerations into the design processes that ultimately facilitate disposal.

During the O&S phase, M&Q should be assessed to support all sustainment activities and concerns. This includes continued production and design activities associated with value engineering activities, Preplanned Product Improvements, and capability enhancements. It should be noted that during the O&S phase design, M&Q activities can be taking place at contractor facilities or at government depots, MRO facilities, or other forms of government facilities.

6. Operations and Support (O&S) Phase

Designs should be stable and mature prior to going into production, with design changes limited to those required for continuous improvement. All Key Characteristics should be stable and under control per appropriate quality standards. Any significant design changes should be assessed for maturity prior to release to production.

Contractors and production organizations during the O&S phase may be experiencing the following:

- Ongoing production (no design impact)
- Ramp up or ramp down in production (no design impact)
- Production of spares (no design impact)
- Design changes to meet changing requirements or for continuous improvement
- Changing requirement could indicate a significant design change
- Continuous improvement may involve “tweaking” of the design or manufacturing processes

Manufacturing and QA personnel should advocate Continuous Improvement. This activity involves the use of the “bully pulpit” of the SPO and the role we have in encouraging the contractors to continually improve their processes and products. The M&Q assurance managers have numerous opportunities to do this, such as during teleconferences, Program Management Reviews, fact findings, etc. Also note this is not confined to contractors, we can encourage internal improvements at depots and within the program office.

E.1 Update Producibility Plan for Sustainment

Producibility engineering and planning should be directed toward generating a robust design that is compatible with the current capability of the factory floor. Producibility is a major driver of product affordability because of the effect on both production and sustainment costs. The producibility plan should guide the design effort and describe activities that will be accomplished, the responsible organization, and the management controls that will be established to ensure successful accomplishment. Manufacturing and QA managers should review and update the plan with a focus on the realism, completeness, and clarity of the planning accomplished by the contractor.

Manufacturing and Quality Tasks

- Provide input into the Life Cycle Sustainment Plan (LCSP).
 - The LCSP should contain requirements for a Producibility Plan.
- Provide input into producibility/design reviews, systems engineering, and trade studies for Sustainment planning.
- Review contractor/governments plans for producibility planning.
- Ensure the producibility plan describes how the design engineers will apply producibility principles.

6. Operations and Support (O&S) Phase

- Identify specific producibility engineering techniques (Design for Manufacturing and Assembly (DFMA), Design for Reliability and Maintainability, Design for Six Sigma (DFSS), DfX, etc.) that the contractor could use to enhance producibility outcomes.
- Support the identification and management of key characteristics (KCs).
- Support the identification of producibility risks and issues.

Metrics

- Life Cycle Sustainment Plan has been updated.
 - Life Cycle Sustainment Plan includes requirements for Producibility Planning.
- Sustainment planning includes inputs for producibility during design reviews, systems engineering processes and trade studies.
- Manufacturing and QA personnel reviewed contractor/governments plans for producibility planning.
- Manufacturing and QA personnel ensured the producibility plan describes how the design engineers will apply producibility principles.
- The contractor used specific producibility engineering techniques to enhance producibility outcomes.
- Key characteristics (KCs) were identified and managed.
- Manufacturing and QA personnel supported the identification of producibility risks and issues.

Tools

- Interactive MRL Users Guide (Checklist) for the Design thread
- Manufacturing Maturation Plan
- Producibility Engineering and Planning Data Item Description

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management Program
- AS9103, Variation Management of Key Characteristics
- DCMA-INST-204 Manufacturing and Production
- Defense Manufacturing Management Guide for Program Managers, Chapter 7.6 Producibility Engineering and Planning
- DoDI 5000.88, Engineering of Defense Systems
- IEEE15288.2, System and Software Engineering, Standard for Technical Reviews and Audits on Defense Program
- MRL Deskbook
- NAVSO P-3687 Producibility System Guidelines

6. Operations and Support (O&S) Phase

- Producibility System Guidelines, Missile Defense Agency

E.2 Complete Producibility Assessments

Producibility engineering and producibility assessments should be a part of the ongoing systems engineering process. Producibility is directly connected to the complexity of a system. As complexity increases, so does the acquisition cost. Therefore, producibility programs are necessary as a management means to minimize the cost increases associated with the growing complexity of systems. Producibility analysis accomplished by the PMO must be performed by a team of specialists assembled from the program office and supporting organizations. Manufacturing and QA managers are key to the successful implementation of a producibility program.

Manufacturing and Quality Tasks

- Complete producibility assessments.

Metrics

- Producibility Assessment completed.
- Producibility Rating established.

Tools

- Producibility Assessment Worksheet
- Interactive MRL Users Guide (Checklist), Design thread
- Manufacturing Maturation Plan

Resources

- DoDI 5000.88, Engineering of Defense Systems
- NAVSO P-3687, Producibility System Guidelines
- AS6500, Manufacturing Management Program
- DCMA-INST-204, Manufacturing and Production
- AS9100, Quality Management Program
- AS9103, Variation Management of Key Characteristics
- MRL Deskbook

E.3 Participate in Design Integrated Product Team

Major design updates can occur during the O&S phase as programs bring on new capabilities and technologies. Programs are organized around a core design team, usually composed of 20-50 engineers. This core design team makes 90-95 percent of all critical decisions with most design decision made prior to production. If M&Q are not one of their primary concerns, these considerations will be

6. Operations and Support (O&S) Phase

delegated to secondary teams or not accomplished until late in the program, causing serious problems with cost, schedule, and performance.

The PM and technical team need to ask M&Q questions and ask them often. The contractor will follow the government's lead. If the government shows concern for these areas in the development of the design and integration with M&Q, then the contractor receives the message and will show like concern. Manufacturing and QA personnel must participate with the Design IPT in the development and review of the design and design documentation.

Manufacturing and Quality Tasks

- Participate in the Systems Engineering process along with other members of the Design Integrated Product Team (IPT).
- Ensure adherence to appropriate M&Q requirements and best practices.
- Provide inputs to any design trade studies.
- Provide inputs to any engineering trouble analysis on factory floor problems (FMEA, etc.) or on field failures (FRACAS, etc.).

Metrics

- Manufacturing and QA personnel participate in the Systems Engineering process.
- Manufacturing and QA requirements and best practices are being adhered to.
- Manufacturing and QA personnel provided inputs into all design trade studies.
- Manufacturing and QA personnel provided inputs into engineering trouble analysis on factory floor problems.

Tools

- Interactive MRL Users Guide (Checklist) for the Design thread
- Life Cycle Sustainment Plan outline
- Manufacturing Maturation Plan
- Systems Engineering Plan (SEP) Outline

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management Program
- AS9103, Variation Management of Key Characteristics
- DCMA-INST-204, Manufacturing and Production
- Defense Acquisition Guidebook, Chapter 3 – Systems Engineering
- Defense Acquisition Guidebook, Chapter 4 – Life Cycle Sustainment
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems

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- LCSP memo, Sep 2011, and DAG Chapter 4-3.1
- MRL Deskbook
- Systems Engineering Plan (SEP) Outline

E.4 Develop Detailed Product Design

Detailed product design includes the realization (build) effort down to the lowest level system elements and includes the fabrication/production processes required to complete the build effort. As a best practice, the systems engineer should develop an implementation plan that includes implementation procedures, fabrication processes, tools and equipment, implementation tolerances, and verification uncertainties. Manufacturing and QA managers/engineers need to be a part of the development and assessment of detailed design efforts.

Manufacturing and Quality Tasks

- Support the detailed design process with M&Q inputs.
- Assess proposed design changes for producibility and manufacturability.
- Assess proposed design changes for inspectability and high levels of quality (yields).

Metrics

- Manufacturing and QA personnel supported the detail design process.
- Producibility and manufacturability were assessed by M&Q personnel.
- Design changes were assessed for inspectability and yield by M&Q personnel.

Tools

- Design for Performance
- Design for Manufacturing and Assembly (DFMA)
- Design for Six Sigma
- Design for Producibility
- Design for Affordability
- Interactive MRL Users Guide (Checklist), Design thread
- Manufacturing Maturation Plan

Resources

- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- Defense Acquisition Guidebook, Chapter 3 – Systems Engineering
- IEEE15288.2, Systems and Software Engineering, Standard for Technical Reviews and Audits on Defense Programs
- AS6500, Manufacturing Management Program
- DCMA-INST-204, Manufacturing and Production

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- AS9100, Quality Management Program
- AS9103, Variation Management of Key Characteristics
- MRL Deskbook

E.5 Develop Work Breakdown Structure

The Work Breakdown Structure (WBS) is a government-approved framework that includes all program elements for which the contractor is responsible and for which they must report. The WBS is defined, developed, and maintained throughout the system life cycle based on a disciplined application of the systems engineering process. The goal is to develop a WBS that defines the logical relationship among all program elements to a specific level (typically Level 3 or 4) of indenture that does not constrain the contractor's ability to define or manage the program and resources.

Manufacturing and Quality Tasks

- Support the development and/or review of the WBS:
 - Program WBS (government owned usually)
 - Contract WBS (contractor owned usually)

Metrics

- Manufacturing and QA personnel supported the development and review of the WBS.
 - Program WBS was developed and reviewed.
 - Contract WBS was developed and reviewed.

Tools

- Interactive MRL Users Guide (Checklist), Design thread
- Manufacturing Maturation Plan
- WBS Template

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management Program
- DCMA-INST-204, Manufacturing and Production
- DoDI 5000.88, Engineering of Defense Systems
- MIL-STD-881 – Work Breakdown Structure for Defense Materiel Items
- MRL Deskbook

E.6 Assess Design Stability

The design should be stable and mature as the product moves into the O&S phase and may be considered mature when the number and type (Class I and Class II) of engineering change traffic is

6. Operations and Support (O&S) Phase

tapering off and when the drawing packages have been released to manufacturing. Configuration of the item should be stable as should be the requirements.

Manufacturing and Quality Tasks

- Support the assessment of the design's stability.
- Encourage contractors to continually improve their processes and products and change from rate production to limited production of spares.
- Monitor field failures and the potential for design changes due to a variety of problems (Field Failure Reports, etc.).

Metrics

- Design stability was assessed.
- Design maturity was assessed.
- Product and processes were monitored and continually improved.
- Production was monitored as product moved from rate production to limited production of spares.
- Field failures and potential for design changes was monitored.

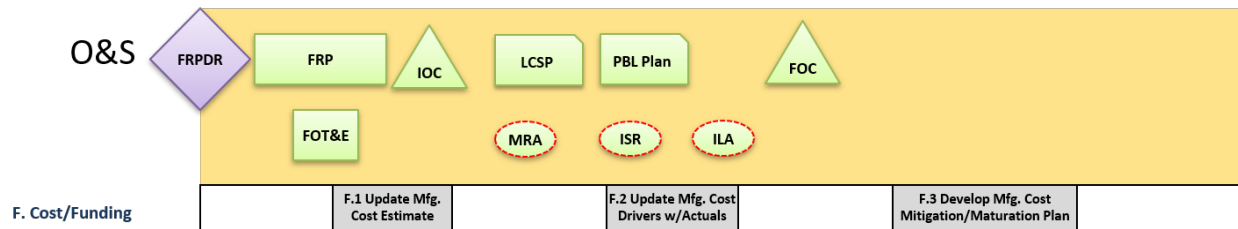
Tools

- Design for Performance
- Design for Six Sigma
- Design for Producibility
- Design for Affordability
- Interactive MRL Users Guide (Checklist) for the Design thread
- Manufacturing Maturation Plan

Resources

- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- Defense Acquisition Guidebook, Chapter 3 – Systems Engineering
- AS6500, Manufacturing Management Program
- DCMA-INST-204, Manufacturing and Production
- AS9100, Quality Management Program
- AS9103, Variation Management of Key Characteristics
- MRL Deskbook

F. COST AND FUNDING



Cost and funding are mainly concerned with having cost models to initially estimate costs, then validating the cost models by collecting and analyzing actual cost against cost targets or budget goals, and finally, establishing a budget to support future M&Q efforts.

Manufacturing cost estimates for the production phase are normally based on the assumption that the design is complete, that the manufacturing processes are known, stable and in control, and manufacturing operations will be accomplished as planned. The same hold true for the O&S phase. However, the O&S phase may see several changes to the P&D model.

- Full-Rate Production may not continue, and if it stops and the contractor is only producing spares, then the unit cost may go up.
- Work may be done at a public or private

Typically, in any industry, materials and labor are the two biggest manufacturing cost drives. Another major factor is rate and quantity. During the O&S phase several changes often take place that impact costs, such as changes to rate and quantity as the contractor’s original rate from Full-Rate Production goes down, and most of their production is in support of spares. There may also be changes to the supply chain as contractors either move in and out of a business or contractors look for lower prices and higher quality.

During this phase should-cost management and other techniques will be used continuously to control and reduce cost. Employ a should-cost management and analysis approach to identify and implement system and enterprise sustainment cost reduction initiatives. Should-cost targets will be established and reviewed periodically based on analysis of acquisition sustainment costs and O&S cost element drivers. PMs will capture product support metrics and cost data in DoD Component- and DoD-level information systems, and track performance against should-cost targets.

Any deviation from these assumptions could cause a growth in cost. As such, time and conformance measures can give some indication of potential or real cost aberrations since there is normally a direct correlation between late delivery or conformance problems and cost.

Support Earned Value Management System analysis, or its predecessor Cost/Schedule Control System Criteria (C/SCSC). This will help in updating manufacturing costs using production phase actuals when developing cost estimates for the O&S phase to ensure that the government receives the full benefit of the contractor’s production learning curve.

6. Operations and Support (O&S) Phase

Manufacturing and QA cost estimates for the O&S phase are normally often based on actual costs that were experienced during the Production and Operations phase, the costs associated with Full-Rate Production (FRP). Cost associated with FRP should be well known, however, during the O&S phase, the contractor may not be producing product or spares at the same rate and the contractor may not be in Full-Rate Production, so the cost may be higher. Or the O&S costs are now associated to depot-level work, and because the throughput is lower and thus the cost per unit to remanufacture may be higher.

Detailed cost estimates need to be established or updated. Costs could be related to contractor or depot/MRO activities and products. Historical cost estimates based on Full-Rate Production quantities may not be appropriate for the O&S phase.

In addition, DoD's Sustainability Analysis Guidance: Integrating Sustainability into Acquisition Using Life Cycle Assessment, provides weapon system and product support managers with guidance for conducting sustainability cost estimates. Sustainability analysis combines Life Cycle Cost (LCC) estimating and Life Cycle Assessments (LCAs). The LCA quantifies resource requirements, environmental releases, and waste through each life cycle stage of a system, and estimates the associated impacts on the following:

- **Resource Availability:** Includes natural resource use (e.g., land, water, mineral, and fossil resources), potential impacts on resource quality and availability, and the associated marginal cost increases.
- **Climate Change:** Includes greenhouse gas emissions, their contribution to global warming, and the associated impacts, including changes in net agricultural productivity, human health, property damages from increased flood risk, and ecosystem services.
- **Human Health:** Includes environmental releases, water use, and noise emissions, and the associated impacts on human health and productivity.
- **Ecosystem Quality:** Includes environmental releases, land use, and water use, and the associated impacts on biodiversity and ecosystem services.

Together LCC estimating and LCA are employed to reveal and estimate three types of sustainability related costs:

- Internal Cost
- External Cost
- Contingent Cost

F.1 Update Manufacturing Cost Estimate

DoDI 5000.02, Operation of the Adaptive Acquisition Framework, Enclosure 10 identifies Cost Estimating and Reporting requirements. M&Q managers need to support the development and update of government cost estimates and the assessment of contractor cost estimates.

Manufacturing and Quality Tasks

- Establish cost models for the O&S phase based on the planned rates and quantities.
 - Should Cost, Will Cost
 - Total Ownership Costs (TOC) or Life-Cycle Cost Estimate (LCCE)
 - Program Office Estimate (POE)
 - Independent Cost Estimate (ICE)
 - Cost Analysis Requirements Description (CARD)
- Review and assess the work allocation by a contractor or the government, and at a production facility or at an organic activity (depot, arsenal, shipyard, fleet readiness center, or MRO).
- Assess whether DoD investments are going to be needed to create or enhance certain critical industrial capabilities.
- Track expenditures and estimate to complete using approved techniques such as Earned Value Management System analysis, or its predecessor Cost/Schedule Control System (C/SCS) during sustainment operations.

Metrics

- Cost models have been developed and assessed.
 - Should Cost, Will Cost
 - Total Ownership Costs (TOC) or Life-Cycle Cost Estimate (LCCE)
 - Program Office Estimate (POE)
 - Independent Cost Estimate (ICE)
 - Cost Analysis Requirements Description (CARD)
- Workload allocations between government and contractor facilities have been assessed.
- DoD investment requirements have been assessed.
- Estimate-to-complete has been established and is being monitored.

Tools

- Cost Analysis Requirements Description (CARD) template
- Cost, Schedule Control Systems Criteria (C/SCSC)
- Earned Value Management (EVM)
- Design to Cost Estimates
- Interactive MRL Users Guide (Checklist), Cost thread
- Manufacturing Cost Estimating Spreadsheet
- Manufacturing Maturation Plan
- *See* CAPE website for tools

Resources

- C/SCSC Reference Guide

6. Operations and Support (O&S) Phase

- CAIG website and processes
- DCAPE website and processes
- Defense Acquisition Guidebook, Section 3.4.4 Cost Assessment Reporting Requirements
- DoDD 5000.04, DoD Cost Analysis Improvement Group (CAIG)
- DoDI 5000.73 Cost Analysis Guidance and Procedures
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- Earned Value Management Guide
- GAO Cost Estimating and Assessment Guide
- Manufacturing Cost Estimating (*see* Defense Manufacturing Management Guide for Program Managers, Chapter 9)
- MIL-HDBK-766, Design to Cost
- MRL Deskbook
- OSD O&S Cost Estimating Guide
- Should-cost and affordability memo
- Sustainability Analysis Guidance: Integrating Sustainability into Acquisition Life Cycle Assessment

F.2 Update Manufacturing Cost Drivers with Actuals

During the O&S phase, most manufacturing costs should be based on actual cost data provided by the contractor. Cost drivers could be high-cost items, or items that have high manufacturing costs due to several factors (long processing times, low yield rates, etc.). These cost drivers need to be updated.

Manufacturing and Quality Tasks

- Identify manufacturing cost and cost drivers, and then continuously control and reduce cost.
- Use the actuals generated to update Sustainment costs to determine new cost drivers and to validate funding estimates.
- Assess risks and the costs associated with those risks.
- Employ should-cost management and analysis approach to identify and implement system and enterprise sustainment cost reduction initiatives.
 - Employ other cost reduction initiatives (Lean/Six Sigma, etc.)
- Periodically establish, and review cost targets based on analysis of acquisition sustainment costs and O&S cost element drivers.
- Support the PM to capture product support metrics and cost data and track performance against should-cost targets.
- Conduct cost analysis and cost reduction programs on subcontractors and vendors.

6. Operations and Support (O&S) Phase

Metrics

- Manufacturing cost drivers have been identified and regularly updated with actuals.
- Continuous improvement activities to reduce manufacturing costs have been identified.
- Risks and costs associated with those risks have been identified.
- Cost management and reduction initiatives have been identified and implemented.
 - Prime contractor, subcontractors, and vendors
- Cost targets have been reviewed based on the analysis of acquisition and sustainment cost.

Tools

- Cost Analysis Requirements Description template
- Cost, Schedule Control Systems Criteria (C/SCSC)
- Earned Value Management (EVM)
- Design to Cost Estimates
- Interactive MRL Users Guide (Checklist), Cost thread
- Manufacturing Cost Estimating Spreadsheet
- Manufacturing Maturation Plan
- *See* CAPE website for tools

Resources

- DoDI 5000.73 Cost Analysis Guidance and Procedures
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- Manufacturing Cost Estimating (*see* Defense Manufacturing Management Guide for Program Managers, Chapter 9)
- MIL-HDBK-766, Design to Cost
- MRL Deskbook
- O&S Cost Estimating Guide, CAPE
- O&S Cost Management Guide
- Should-cost and Affordability Memo

F.3 Develop Manufacturing Cost Mitigation/Maturation Plan

Affordability is always a concern for the DoD. Manufacturing and quality managers need to support the development and implementation of cost mitigation plans. These plans often focus on manufacturing cost drivers and continuous improvement opportunities.

Manufacturing and Quality Tasks

- Manufacturing and QA personnel should be engaged in the development of a Cost Mitigation/Maturation Plan.
 - Prime Contractor
 - Key and critical subcontractors and vendors.
- Support the development of the Cost Mitigation/Maturation Plan (refer to the Independent Logistics Assessment).
- Track cost and cost trends using Earned Value Management (EVM) or Cost, Schedule Control Systems Criteria (C/SCSC).
- Assess if DoD investments will be needed to create or enhance certain critical industrial capabilities.
- Monitor product support performance and correct trends that could negatively impact availability and cost.
- Develop Manufacturing Cost Risk Handling/Maturation Plans:
 - Prime Contractor
 - Key and critical subcontractors and vendors.
- Use field data and failure reports to update cost models and help ensure that Sustainability targets are being met.
- Identify and account for demil. and disposal cost.
- Review reliability and maintainability data from operational testing and fielding in developing the Cost Mitigation/Maturation Plan.

Metrics

- Manufacturing and QA personnel have supported the development of Cost Mitigation/Maturation Plans:
 - Prime Contractor
 - Key and critical subcontractors and vendors.
- Cost Mitigation Plans developed.
- Cost are track and manage cost using EVM, C/SCSC or other method.
- Investment requirements have been analyzed.
- Product support performance and trends have been assessed.
- Manufacturing Cost Risk Handling/Maturation Plans have been developed.
- Field failure reports and other field data have been reviewed and assessed for cost impacts.
- Demil. and Disposal costs have been identified and accounted for in the program budget.
- R&M data from operational testing has been used to update the Cost Mitigation/Maturation plan.

6. Operations and Support (O&S) Phase

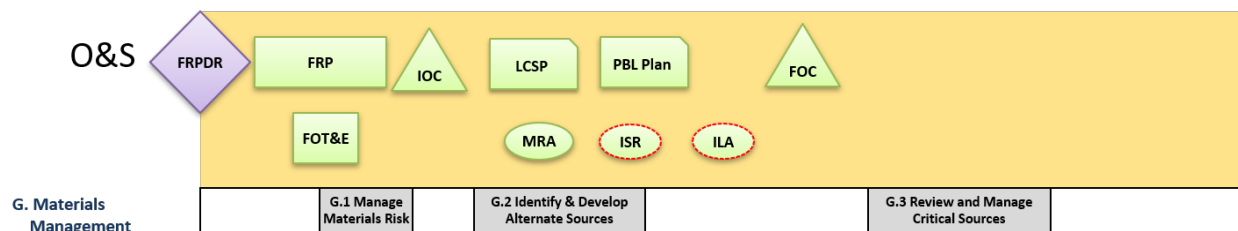
Tools

- EVM and C/SCSC software tools or in excel
- Interactive MRL Users Guide (Checklist) for the Cost thread
- Manufacturing Maturation Plan
- Manufacturing Readiness Assessment Cost and Funding thread

Resources

- 10 USC 2334, Independent Cost Estimation and Cost Analysis
- Cost Analysis Requirements Description (CARD) Template (*see* CAPE website for guidance)
- Cost/Schedule Control Systems Criteria Reference Guide
- DoDI 5000.73, Cost Analysis Guidance and Procedures
- DoDI 5000.73, Cost Analysis Guidance and Procedures
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- MRL Deskbook
- O&S Cost Estimating Guide, CAPE
- O&S Cost Management Guide
- Public Law 114-328, §807, Cost, Schedule, and performance of major defense acquisition programs
- Risk, Issue, and Opportunity Management Guide for Defense Acquisition Process

G. MATERIALS MANAGEMENT



The acquisition community generally refers to Material Management as being concerned with the identification and management of materials required for manufacturing or production during operations and sustainment. Materiel management is different. The logistics or sustainment community refers to materiel management as being concerned with management activities involved in developing, operating, implementing, and analyzing manual and automated integrated logistics systems to support various weapons systems, while simultaneously providing customer service to combat support. This section is about managing materials and includes concerns about:

- Availability (is readily available to support production)
- Maturity (has been characterized for manufacturability)

6. Operations and Support (O&S) Phase

- Supply chain (for the buy items in the Bill of Materials)
- Special handling requirements (toxic materials or chemicals used in the product or production process, or special handling from a perspective of moving the item around the production facility)

Material management is concerned with the entire supply chain and is driven by several specifications and standards to include:

- DoDM 4140.01, DoD Supply Chain Materiel Management Procedures
- DoDM 4140.01, Volumes 1-11, DoD SCM Management Procedures
- Supply Chain Operations Reference (SCOR) Model
- MIL-STD-3018 Parts Management
- SD-22, Diminishing Manufacturing Sources and Material Shortages
- DoDM 4160.21, Volumes 1-4, Defense Materiel Disposition: Disposal Guidance and Procedures

During the sustainment phase, programs face unique challenges as they attempt to manage their military supply chains, especially during wartime.

At the strategic level, military and private organizations must address the logistics issues of acquisition, distribution, sustainment, and disposition and disposal. As the program matures and moves from production to spares production, and ongoing maintenance and sustainment activities, the nature of the business arrangement often changes as DoD contractors get out of the business and DoD MRO activities take on increasingly more responsibilities.

As the program matures and transitions to the O&S phase, Sustainment managers should be concerned about:

- Material availability and in particularly DMSMS, obsolescence, and counterfeit parts
- Material maturity
- Supply chain management
- Special handling

The objective of this phase is the execution of a support program that meets operational support performance requirements and sustains the system in the most cost-effective manner over its total life cycle. When the system reaches the end of its useful life, the department should dispose of it.

During sustainment, M&Q managers should support in-service reviews to identify material risks including identifying root causes of risks, corrective action, and continuous improvement. Sustainment activities include participating in trade studies and decision making that may impact the product support package, manufacturing process improvements, modifications, upgrades, and future increments of the system while considering the operational needs and expected service life.

DoD Supply Chain Material Management Regulation directs DoD Components to use the supply chain operational reference processes of Plan, Source, Make/Maintain, Deliver, and Return as a framework

6. Operations and Support (O&S) Phase

for developing, improving, and conducting material management activities. Most of the DoD supply chain focus is on operations and logistics.

Sustainment Material Risks often include such concerns as:

- Diminishing Manufacturing Sources and Material Shortages (DMSMS) and Obsolescence
- Corrosion Control
- Counterfeit Parts

Diminishing Manufacturing Sources and Material Shortages (DMSMS), the loss of sources of items or material, surfaces when a source announces the actual or impending discontinuation of a product, or when procurements fail because of product unavailability. DMSMS may endanger the life cycle support and viability of the weapon system or equipment.

Counterfeiting of parts and materials, especially in the electronic business segment, is growing at an alarming rate. In addition, there are unique conditions that make aerospace and defense products susceptible to counterfeiting, including a long-life cycle and Diminishing Manufacturing Sources and Material Shortages issues. Therefore, supporting aerospace and defense products throughout their life cycle sometimes requires the use of parts that may no longer be available from the Original Equipment Manufacturer, authorized aftermarket manufacturer or through franchised or authorized distributors or resellers.

There are several ways the DoD can address material needs and shortages. One is through the Defense Production Act of 1950 and the implementation of the Defense Priorities and Allocation System (DPAS) in which the government can designate programs as “high priority” and put them at the front of the contractor’s production queue. Another is the Defense Industrial Capabilities Handbook, DoD 5000.60H, which identifies alternative actions the government can take when facing material shortages to include:

- Finding foreign sources of supply
- Finding alternative or substitute parts
- Making a Lifetime buy to meet all planned future needs
- Maintaining a current capability
- Developing an Alternative solution

Many DoD systems require maintenance long beyond the useful life initially anticipated. Extending the service life of military systems increases the costs of ownership. One way to reduce O&S costs is to take advantage of the commercial sector's technological innovations by inserting commercial technology into fielded weapon systems.

One of the major challenges facing DoD is modernizing legacy systems using state-of-the-art technology. Therefore, from the start of an acquisition program, DoD must consider not only how to field a useful military capability quickly, but also how it can upgrade a system later. Considerations include the latest technology, increasing mission performance, reducing O&S costs, and enhancing supportability. Modernizing legacy systems requires the identification of potential replacement parts, components, and even subsystems requiring the validation and acceptance of alternative materials.

6. Operations and Support (O&S) Phase

Where and how the contractor gets sources of material can be a vital concern for PMs. Having just one sole source, single source or foreign source in supply chain could be a showstopper, especially if that item is a critical item that significantly impacts the capability of the system to perform its mission.

- A sole source is one in which there is only one source for that item. There are no other alternatives.
- A single source is one in which there is only one “qualified” source. Qualification can be an expensive and time-consuming process.
- A foreign source is one that is outside of the U.S. industrial base

If the contractor is in a sole source, single source, or a foreign source situation, it may want to consider an investment strategy to qualify a second source. Now the contractor has competition in addition to a second source.

Foreign sources carry with them many problems. The transfer of some intellectual information to companies outside of the U.S. can be restricted by International Traffic in Arms Regulations (ITAR), making it difficult to do business outside of the United States. In addition, some countries restrict the types of items their companies can sell to the United States. For example, items that go into nuclear programs are often restricted by countries with strong nuclear concerns. Sometimes politics can play a role and an item that is available this week may not be available next week due to political pressures. If the contractor has a foreign sources item that is critical to the program, they might want to consider funding a second source, a U.S. source.

G.1 Manage Materials Risk

Risk can be described as anything that has the potential to impact negatively on cost, schedule, or performance. Material risks have been known to slow or delay a program, add additional costs to a program, or create field failures because of poor material reliability. Material risks could include availability of the material, maturity of the material, or need for special handling and control. Material risks can occur anywhere in the supply chain all the way down to the lowest level (dirt). Manufacturing and QA managers need to support the identification and management of material risks.

Manufacturing and Quality Tasks

- Help identify material availability risks to include:
 - DMSMS/obsolete parts and develop plans for suitable replacements
 - Sole Source, Single Source or Foreign Sourced items
 - Counterfeit parts
- Help identify material maturity risks or materials that have not been fully characterized.
- Help identify supply chain risks at the prime, subcontractors, and vendors.
- Help identify special handling risks.
 - Move safe
 - ESOH

6. Operations and Support (O&S) Phase

- Periodically assess product support performance and take corrective action to prevent degraded materiel readiness or O&S cost growth.

Metrics

- Material availability risks have been assessed and identified.
 - DMSMS/Obsolescence
 - Sole Source, Single Source or Foreign Sourced items
 - Counterfeit Parts
- Material maturity risks have been assessed and identified.
- Supply chain risks at the prime, subcontractors, and vendors have been identified.
- Material special handling risks have been assessed.

Tools

- DMSMS Product Life Cycle Assessment
- Interactive MRL Users Guide (Checklist), Materials thread
- Manufacturing Maturation Plan
- Market Research
- Supply Chain Management Risk Assessment Checklist

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Audit Checklist
- AS9103, Variation Management of Key Characteristics
- AS9134, Supply Chain Risk Management Guidelines
- DMSMS Guidebook, SD-22
- DoD Market Research Guide
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- DoDM 4140.01, DoD Supply Chain Materiel Management Procedures
- DoDM 4140.01, Volumes 1-11, DoD SCM Management Procedures
- DoDM 4160.21, Volumes 1-4, Defense Materiel Disposition: Disposal Guidance and Procedures
- MIL-STD-3018, Parts Management
- MRL Deskbook
- SD-22 Diminishing Manufacturing Sources and Material Shortages
- Supply Chain Operations Reference (SCOR) Model

G.2 Identify and Develop Alternate Sources

Programs often face shortages in the supply chain that can cause significant problems in meeting cost, schedule, and performance. Sole source, single source, and foreign sources of supply come with a lot of risks. In addition, suppliers come and go in the marketplace. One day there might be four sources of supply and the next day one or none. Diminishing Manufacturing Sources and Material Shortages, and Obsolescence are two very real problems on DoD programs, especially programs that are past their prime and well into the operations and support activities. One way to mitigate those risks and to increase competition (reduce cost) is to identify and develop alternative sources of supply. But this is not a quick or a cheap fix as the new supplier will probably need to go through a qualification program and prove that they have the capability to produce one, the capacity to produce all that is needed, and the financial stability to be able to perform for the entire contract period of performance.

Manufacturing and Quality Tasks

- Identify potential parts problems and help to identify and develop alternative sources of supply as appropriate.
- Work with product support integrators and product support providers to investigate alternate source options.
 - Sources may be organic, commercial, or a combination.
- Verify the prime supplier has validated alternate sources are capability of meeting quality, manufacturing, engineering, and software requirements.
- Periodically assess product support performance and assist PMs, users, resource sponsors, and materiel enterprise stakeholders to take corrective action to prevent degraded materiel readiness or O&S cost growth.

Metrics

- Alternative sources of supply identified.
- Alternative sources of supply validated.
- Product support performance regularly assessed.
- SCM Functional Performance Measures identified and tracked:
 - Lead Time/Cycle Time
 - Customer Satisfaction/Customer Wait Time
 - Quality (1st Pass Yields, Quality Deficiency Reports, etc.)
 - Cost/Affordability
 - Readiness and Sustainability
 - Fulfillment Rates
 - Inventory and Inventory Turnover
 - Measures of Effectiveness: Key Performance Parameter (KPPs); Technical Performance Measures (TPMs)

Tools

- DMSMS Product Life Cycle Assessment
- Interactive MRL Users Guide (Checklist), Materials thread
- Manufacturing Maturation Plan
- Market Research
- Supply Chain Management Risk Assessment Checklist

Resources

- DoDM 4140.01, DoD Supply Chain Materiel Management Procedures
- Supply Chain Operations Reference (SCOR) Model
- MIL-STD-3018, Parts Management
- SD-22 Diminishing Manufacturing Sources and Material Shortages
- DLA DMSMS Acquisition Guidelines
- DoD Market Research Guide
- AS9134, Supply Chain Risk Management Guidelines
- AS9100, Quality Audit Checklist
- AS9103, Variation Management of Key Characteristics
- AS6500, Manufacturing Management Program
- MRL Deskbook
- SCM: A Recommended Performance Measurement Scorecard
- DoDM 4160.21, Volumes 1-4, Defense Materiel Disposition: Disposal Guidance and Procedures
- DoDM 4140.01, Volumes 1-11

G.3 Review and Manage Critical Sources

A source is only a good source if it provides the right product, at the right time and place, at the right cost and with the right performance. Thus, if an item is the lowest cost but is unreliable or comes in late, or comes in with quality deficiencies, then buying that item was a poor decision. Supply chain material assessments are especially needed for those items that may be considered critical sources of supply. These critical items (Pareto the vital few vs the trivial many) are often long-lead or are sole/single sources of supply. Lead times for defense materials and components can be long and volatile. There are various reasons for this situation, such as:

1. Imbalances between capacity and demand
2. Imperfect forecasting of needs
3. Competition from commercial suppliers
4. Poor quality and lack of process improvement
5. Production bottlenecks
6. Long testing cycles

6. Operations and Support (O&S) Phase

7. Raw materials not available
8. Long contracting process
9. Lack of funding
10. Transportation
11. Labor issues

Manufacturing and Quality Tasks

- Help identify and assess materials risks, especially critical materials, and sources of supply that should include the assessment of:
 - Material Availability: Concerned primarily about sole source and foreign source but could also include limited sourcing and long lead sourcing. In the O&S phase there will be growing concerns about DMSMS and obsolescence. Along with that will be concerns about counterfeit parts.
 - Material Maturity: Concerned about the introduction on new parts, especially electronic parts that are replacing parts that are old and no longer being produced. This is usually concerned with having complete material knowledge at the time of production.
 - Material Supply Chain Management (SCM): Concerned about SCM since 60-80 percent of the fabricated and assembled items come from subcontractors and vendors and this is often where we have problems. Often the design occurs at the supplier level. The supply chain for the O&S phase often shifts from the prime and subcontractors to Maintenance Activities, Inventory Control Points, depots, MRO facilities, and installation support activities.
 - Material Special Handling: Concerned about the movement of material to and within the plant and any ESOH concerns.
- Review critical sources of supply, including contractor's technical capabilities in engineering, configuration management, and quality.
- Analyze and encourage sources to continually improve their processes and products. Encourage internal improvements at depots and within the support facilities.
- Review and analyze a contractor's parts program for the identification and elimination of counterfeit parts and materials.
- Ensure the prime contractor has delegated all technical requirements to include quality requirements.
- Ensure that DCMA at the prime contractor is reviewing the flow-down of requirements and oversight to their counterparts at subcontractor and vendor organizations.

Metrics

- Critical Sources identified and assessed for the following risk areas:
 - Materiel Availability
 - Materiel Maturity

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- Supply chain maturity
- Special handling
- Technical Capabilities assessed at all levels of the supply chain.
- Continuous Improvement activities and results is ongoing at all levels of the supply chain:
 - 1st pass yields
 - Quality Deficiency Reports
- Contractors have a program for identifying and eliminating counterfeit parts.
- Prime contractors have delegated all appropriate technical requirements throughout the supply chain.
- DMCA has delegated oversight throughout the supply chain.

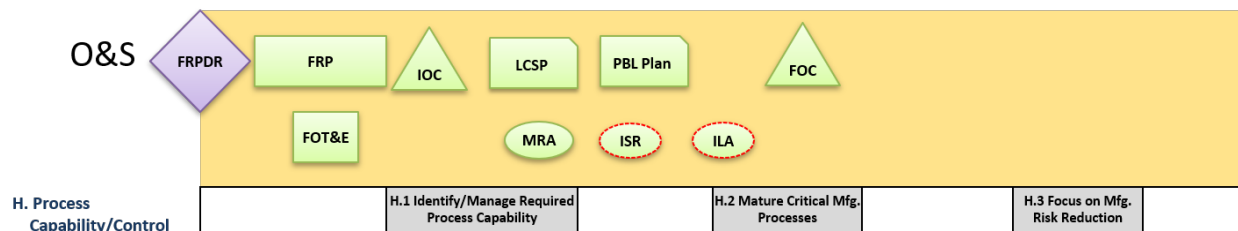
Tools

- AS6500, Manufacturing Management Program
- AS9100, Quality Audit Checklist
- AS9134, Supply Chain Risk Management Guidelines
- Interactive MRL Users Guide (Checklist) for the Materials thread
- ISO 9001, Quality Audit Checklist
- Manufacturing Maturation Plan

Resources

- AS9100, Quality Management System – Aerospace
- AS9103, Variation Management of Key Characteristics
- DAU DMSMS Acquisition Guidelines
- DoD Market Research Guide
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- DoDM 4140.01, DoD Supply Chain Materiel Management Procedures
- DoDM 4140.01, Volumes 1-11
- DoDM 4160.21, Volumes 1-4, Defense Materiel Disposition: Disposal Guidance and Procedures
- ISO 9001, Quality Management System
- MIL-STD-3018 Parts Management
- MRL Deskbook
- SD-22 Diminishing Manufacturing Sources and Material Shortages
- Supply Chain Operations Reference (SCOR) Model

H. PROCESS CABABILITY AND CONTROL



During the sustainment phase, Process Capability and Control should be well understood, based on knowledge and experience during the P&D phase. However, production operations may shift from the prime contractor to government owned and operated facilities such as depots, MROs, and other industrial operations. Moving from one facility to another, with a different workforce, machines and other factory floor considerations may cause the process capability and control to slip below levels required to satisfy the warfighter.

Product quality, and effective operations and sustainment results, are a product of the feedback of M&Q data during production and after the item has been fielded and is in use. The results of the design and manufacturing efforts receive their real test when the item or system is placed in use under rigorous field conditions. If all the prior efforts have been adequately performed, the resulting product should meet the user’s needs.

The goal is to strive for no failures and full user satisfaction. If this is not achieved, then corrective action must be taken, and taken quickly to remove the cause of failure and of the user discontent. Of course, this is more difficult at this late stage of the acquisition cycle than if action were taken to identify and correct the root cause of the problem early in design or production. If the root cause of the problem requires a design change then engineering changes after this point cost more to implement than those discovered during initial design; therefore, it is important that all quality actions take place during design, development, and manufacture of the product. It is essential that M&Q personnel are involved in all aspects of any program and are involved early in the process. If the problem is in the production or MRO/depot facility, then root cause corrective action must be taken on the industrial facilities that caused the defect or problem.

If AS6500, Manufacturing Management Program is invoked on contract, verify the supplier has conducted a PFMEA of critical manufacturing processes. This may also be required to be accomplished by the supplier when required by contract requirements language.

- Review supplier process yields and PFMEA conducted on critical manufacturing processes to identify possible government surveillance.

Studies have shown that by the time a Preliminary Design Review (PDR) is held, around 80 percent of a program’s life cycle costs are locked in even though only a small percentage of the program’s cumulative costs have been expended. It is also the time when a program or contractor has the most opportunity to impact life cycle cost savings. By the time, the Critical Design Review (CDR) is held, the LCC commitment is around 90 percent. Manufacturing, logistics, and other considerations must be taken seriously early, or the program is doomed to becoming unaffordable. All manufacturing

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processes should have been demonstrated and those processes, especially the key processes, should be stable and in control. However, there may have been changes to manufacturing due to engineering changes (Value Engineering Change Proposals, etc.), or to changes in manufacturing facilities as production of items and spares moves from the prime contractor to subcontractors, vendors, or government facilities.

Employ effective performance-based logistics (PBL) planning, development, implementation, and management in developing a system's product support arrangements. PBL is performance-based product support, where outcomes are acquired through performance-based arrangements that deliver warfighter requirements and incentivize product support providers to reduce costs through innovation

During the P&D phase the contractor will produce and deliver requirements-compliant products to receiving military organizations. During the O&S phase, they will have to supply compliant sustainment products, parts, and limited-life supplies to maintain the systems they have produced.

Continually assess and refine the product support strategy based on projected and actual performance.

The Sustainment KPP (Availability) is as critical to a program's success as cost, schedule, and performance. Acquisition Category (ACAT) I and II PMs will use availability and sustainment cost metrics as triggers to conduct further investigation and analysis into drivers of those metrics. Manufacturing and quality managers need to assess and improve specific process capabilities that can have a negative impact on reliability, availability, and maintainability to help reduce cost. The materiel availability portion of the KPP will be based on the entire system inventory and supported by the following sustainment metrics.

The EMD Acquisition Strategy should have highlighted the strategy for assessing the manufacturing processes to ensure they have been effectively demonstrated in an appropriate environment, such as a pilot line environment, before Milestone C.

To the maximum extent practical, the environment should use rate production processes forecasted to be used in LRIP. The Acquisition Strategy should strategically describe the planning to assess and demonstrate that the manufacturing processes/capabilities, required for production will have been matured to a level of high confidence for building production configuration products in the P&D phase and spares during sustainment.

H.1. Identify/Manage Required Process Capability

One of the goals of manufacturing is to have a uniform, defect-free product. To achieve that goal, the production processes must be capable, that is, the outcome of the production process is a product that meets spec. Manufacturing and QA managers need to be working continuously on production processes to reduce variation and make the process robust to design requirements. Process control studies are often accomplished when the contractor finds they are producing product that does not meet spec. But why wait for bad outcomes when the program can plan for success. Identify upfront

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and early what the design requirements are and make all processes capable of meeting those requirements even before the start of production.

Manufacturing and Quality Tasks

- Support the identification and management of key/critical characteristics.
- Identify opportunities for government surveillance of key/critical characteristics.
 - At prime contractor, subcontractor, or government facility.
- Review process control plans for management and control of key/critical characteristics and identify possible government surveillance.
- Review key/critical process capability performance measures (Cp and Cpk) to identify possible government surveillance and flow-down requirements, and to determine process stability and capability.
- Review process yields and Process Failure Modes and Effects Analysis (PFMEA) conducted on key/critical manufacturing processes to identify possible government surveillance and continuous improvement opportunities.
- Manage sustainment performance by using sustainment metrics mapped to the Sustainment KPP and KSAs.
- Conduct a PRR or MRA to assess risk in standing up a new spare parts line or conducting work at a repair facility.

Metrics

- Key/Critical Characteristics have been identified, assessed and are being managed.
- Process Control Plans have been reviewed for control of key/critical characteristics and identify possible government surveillance.
- Process performance measures (Cp and Cpk) are being continuously reviewed and managed on key/critical characteristics.
- Process yields are being reviewed and assessed and PFMEA has been conducted on key/critical manufacturing processes.
- Sustainment performance metrics have been mapped to KPPs and KSAs and are being managed.
- A PRR or an MRA has been conducted when standing up a new spare parts line or conducting work at a repair facility.
- Government surveillance opportunities have been identified for key/critical characteristics.

Tools

- FMEA Template
- Interactive MRL Users Guide (Checklist) for the Process Capability and Control thread
- Manufacturing Maturation Plan
- Process Capability Studies (Cp and Cpk assessment)

6. Operations and Support (O&S) Phase

- Producibility Assessment Worksheet (PAWs)
- Six Sigma Worksheet

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management Program
 - AS9102, First Article Inspection
 - AS9103, Variation Management of Key Characteristics
 - AS9133, Qualification Procedure for Aerospace Parts
 - AS9134, Supply Chain Risk Management Guidelines
 - AS9136, Root Cause Analysis and Problem Solving
 - AS9138, Statistical Process Acceptance
- Capability-Based Assessment (CBA) Handbook
- DCMA-INST 323, Data Collection and Analysis
- DoD Continuous Process Improvement Transformation Guide
- DoD-Wide Continuous Process Improvement (CPI)/Lean and Six Sigma Program
- MRL Deskbook

H.2. Mature Critical Manufacturing Processes

Immature processes are a major source of risks on acquisition programs, especially during the P&D phase when most production takes place. As a program moves forward, process maturity takes on greater importance. According to DoDI 5000.85, Major Capability Acquisition, the FRP decision requires the control of manufacturing processes. If these processes are not capable, in control, and affordable, then the program office needs to continue to mature those processes.

Manufacturing and Quality Tasks

- Support the maturation of critical manufacturing processes.
- Promote standard and stable manufacturing/factory floor processes that could be used in a depot as well as production activities:
 - Utilize SPC or other appropriate controls
- Support performance-based logistics (PBL) planning, development, implementation, and management at contractor and government facilities to mature critical manufacturing processes.
- Identify outcomes for critical manufacturing processes and incentivize product support providers to reduce costs through innovation.
- Support the assessment and refinement of the product support strategy based on projected and actual factory floor performance.

6. Operations and Support (O&S) Phase

- Assess key/critical manufacturing processes to ensure that they are stable and in control.

Metrics

- Critical Manufacturing Processes have been identified and are mature.
- Factory floor processes are standard and stable:
 - Statistical Process Control (Cp and Cpk) is being used to manage key and critical product and process characteristics.
- PBL planning, development, implementation, and management are ongoing.
- Outcomes for critical manufacturing processes have been identified and incentivized on contract.
 - Yield Rates are improving and meeting target values.
- The Product Support Strategy has been developed, assessed, and refined based on factory floor performance.

Tools

- AS6500, Manufacturing Management Program
- Interactive MRL Users Guide (Checklist) for the Process Capability and Control thread
- Manufacturing Maturation Plan
- Process Capability Study (Cp and Cpk assessments)

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management Program
 - AS9102, First Article Inspection
 - AS9103, Variation Management of Key Characteristics
 - AS913,3, Qualification Procedure for Aerospace Parts
 - AS9134, Supply Chain Risk Management Guidelines
 - AS9136, Root Cause Analysis and Problem Solving
 - AS9138, Statistical Process Acceptance
- DCMA-INST 323, Data Collection and Analysis
- DoDI 5000.02, Operation of the Adaptive Acquisition Framework
- DoD-Wide Continuous Process Improvement (CPI)/Lean and Six Sigma Program
- MRL Deskbook
- PBL Guidebook

H.3. Focus on Manufacturing Risk Reduction

According to the DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs, the following approach should be considered to help identify risks in the production environment:

- Make-buy decisions, changes to suppliers, parts obsolescence, product delivery issues
- Manufacturing: manufacturing readiness, tooling, process maturity, etc.
- Other considerations such as government-furnished equipment availability, business consolidations, sole and single source suppliers, access to raw materials, export control, etc.

The risk mitigation option seeks to actively reduce risk to an acceptable level. Mitigation generally entails taking action to reduce the likelihood, and on occasion the consequence, of a risk to as low as possible to minimize potential program impacts.

Manufacturing and Quality Tasks

- Review manufacturing risks at contractor and DoD facilities to ensure compliant products are produced and delivered to the warfighter.
- Assess manufacturing risks and develop a manufacturing maturity program.
- Track cost, schedule, and performance using the sustainment KPP (Availability) as a critical metric.
- Identify, track, and manage sustainment metrics (availability and sustainment cost), and act when metrics exceed goals or targets.
 - KPPs, KSAs, MOEs, TPMs, etc.
- Develop Should Cost targets, and to develop strategies for improving reliability, availability, and maintainability (R&M) while reducing cost.
- Ensure that the materiel availability portion of the KPP is based on the entire system inventory.

Metrics

- Manufacturing risks have been identified and are being tracked.
- Manufacturing risks are being managed and mitigated.
- Availability (Reliability and Maintainability) targets have been identified and risk reduction and mitigation efforts are in place to incentivize continuous improvement.
- KPPs, TPMs, and other measures have been identified and risk reduction efforts implemented where target values are not being met.
- Should Cost targets have been identified, as have strategies for improving RAM.
- Material Availability is based on the entire system inventory.

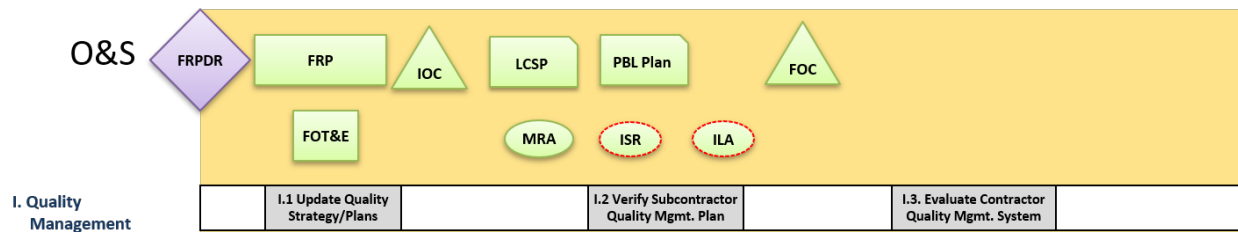
Tools

- Interactive MRL Users Guide (Checklist), Process Capability and Control thread
- Manufacturing Maturation Plan

Resources

- AS6500, Manufacturing Management Program
- AS9100, Quality Management Program
 - AS9102, First Article Inspection
 - AS9103, Variation Management of Key Characteristics
 - AS9133, Qualification Procedure for Aerospace Parts
 - AS9134, Supply Chain Risk Management Guidelines
 - AS9136, Root Cause Analysis and Problem Solving
 - AS9138, Statistical Process Acceptance
- DCMA-INST 323 Data Collection and Analysis
- DoD-Wide Continuous Process Improvement (CPI)/Lean and Six Sigma Program
- MRL Deskbook

I. QUALITY MANAGEMENT



An effective quality management system (QMS) is required to produce operationally safe, suitable, and effective weapon systems. A QMS should be compliant with industry standards such as ISO 9001 or AS9100 and is foundational to producing products that meet contractual requirements. The QMS ensures the as-delivered configuration is the same as the as-designed and as-tested configuration. The QMS serves as the management and control function, requiring controls over requirements reviews, design inputs, verification and validation of design outputs, and control of design changes. It also requires monitoring and measuring of processes and products to ensure they conform to requirements.

Quality Assurance focuses on having a:

- Quality Management System (QMS)
- Product Quality Focus
- Supplier Quality Program

6. Operations and Support (O&S) Phase

A program should ensure that the Acquisition Strategy incorporated a Quality Strategy that supports and aligns with the program strategy, objectives, goals, and the contract. This will involve the use of process audits as to whether the contractor's and supply chain activities, resources, and behaviors are being managed efficiently and effectively including participation of DCMA, Key Characteristic control and management, use of acceptance testing, application of Statistical Process Controls (SPC), etc. Similarly, these audits should be conducted on the supply chain, as necessary.

The initial quality strategy should have been developed during the MSA phase and updated in every phase in support of the Systems Engineering Plan (SEP) to include the O&S phase.

During the sustainment phase, a contractor, or a government owned or operated remanufacturing facility (depot/MRO, etc.) should have implemented an effective QMS in accordance with FAR 46.202-4 Higher-level Contract Quality Requirements.

The Contractor Quality Control Plan (QCP) is the contractor's management plan for executing the contract. The Contractor QCP describes the way in which the contractor will produce the deliverables, and the step-by-step approach that will be taken to ensure the quality of the engineering and design services and the products derived from those services. The contractor is required to submit a Contractor QCP as the first item of work in each delivery order or may submit a Contractor QCP as the first item of work in his contract and, at a minimum, a quality control supplement for each delivery order for an indefinite delivery contract. Subcontractors make up 60-80 percent of the material content on many programs, thus prime control of subcontractors' Quality Management System and Plan are essential to the success of any program.

The intent of verifying supplier quality programs is to draw attention to troubled suppliers or critical processes needing corrective action by on-site visits/reviews. The contractor will usually respond by sending his own representative to the site when the program office outlines their reasoning. Consider inviting the program chief engineer or even the program director if the situation warrants their attention. The contractor will usually respond with equal high-level attention.

Primes and suppliers conduct training in counterfeit parts avoidance for inspectors, operators, auditors, and lower tier suppliers to include awareness of AS5553. Training should discuss how to inspect parts and identify possible counterfeits (e.g., non-conforming part markings).

As our Major Defense Acquisition Programs become more complex and supply chains become longer, more obscure, and prone to unforeseen quality breakdowns, program risk associated with supplier processes has increased exponentially. Since the issues surrounding the supply chain typically impact program quality, cost, and schedule, the M&Q personnel at DCMC can be key contributors in addressing this type of risk and providing visibility into potential future suppliers' problems/ issues.

The Quality Surveillance Plan (QSP) is a government document that establishes the methodology that the government will use to monitor and evaluate contractor performance and to ensure that the contract objectives are being met. A properly developed QSP provides guidance to all government contract oversight personnel on their contract surveillance roles and responsibilities.

A Quality Management System (QMS) is a formal system that documents policies, processes, and procedures that may be required to achieve specific quality goals and objectives. The intent is to use

the QMS to meet or exceed customer expectations and improve overall efficiency and effectiveness. The two dominant QMS programs currently available are ISO 9001 and AS9100. A QMS should be in place at all contractor facilities with a higher-level quality requirement per FAR/DFAR or at any government owned and operated facility doing production type work.

I.1 Update Quality Strategy/Plans

Manufacturing and quality managers support the development and updates to the Acquisition Strategy by providing their inputs into the Systems Engineering Plan (SEP). Quality managers can look to the FAR Part 46 and 52 to understand potential contractual QA requirements and to industry best practices such as ISO 9001 and AS9100 for implementation requirements. Manufacturing managers can look to industry best practices such as AS6500 to help them identify manufacturing requirements. Planning is the foundation for implementation activities and ultimately for the success of a program.

Manufacturing and Quality Tasks

- Review and update the program's Quality Strategy.
 - The Quality Strategy should be updated based on performance results, sustainment metrics mapped to the Sustainment Key Performance Parameter and Key System Attributes, to manage sustainment performance.
- Continually monitor product support performance using field data and correct trends that could negatively impact availability and cost.
- Review factory floor department status (schedule, work measurement, Scrap, Rework, and Repair, yields, etc.).
- Review and improve M&Q processes to reinforce the need for process improvement efforts.
- Review and assess problem/failure reports (Failure Reporting, Analysis and Corrective Action System) as appropriate.
- Determine the root cause of problems, identify corrective actions, and manage continuous improvement activities to completion.
- Ensure quality strategies address the following areas:
 - Process and analyze mission data
 - Manage Preplanned Product Improvements
 - Develop and implement technology refresh schedules
 - Conduct technology insertion efforts as needed to maintain or improve system performance
 - Update system safety assessments
 - Perform engineering analysis to investigate the impact of DMSMS issues
 - Work with vendors and the general technical community to determine opportunities for technology incursion to increase reliability and affordability
 - Support demilitarizing and disposing of the system; in accordance with all legal and regulatory requirements and policy relating to safety (including explosives safety), security, and the environment

6. Operations and Support (O&S) Phase

Metrics

- Quality Strategy has been updated.
- Product support performance is being monitored and corrective action has been taken, as necessary.
- Factory floor status and data is being continuously reviewed.
- Manufacturing and quality processes are being monitored and continuous improvement is ongoing.
- Problem/Failure reports are monitored and assessed.
- Root cause is being determined and corrective action taken.
- Quality Assurance Strategies have been reviewed and assessed.

Tools

- Acquisition Strategy Template
- AS9100, Audit Checklist
- Interactive MRL Users Guide (Checklist), Quality thread
- ISO 9001, QMS Audit Checklist
- Manufacturing Maturation Plan
- Requirements Analysis Roadmap

Resources

- AFMC Instruction 63-145, Manufacturing and Quality
- AS9100, Quality Management System – Aerospace
 - AS9102, First Article Inspection
 - AS9103, Variation Management of Key Characteristics
 - AS9133, Qualification Procedure for Aerospace Parts
 - AS9134, Supply Chain Risk Management Guidelines
 - AS9136, Root Cause Analysis and Problem Solving
 - AS9138, Statistical Process Acceptance
- DoDI 5000.88, Engineering of Defense Systems
- DSMC Acquisition Strategy Guide
- FAR 46.202 Types of Contract Quality Requirements
- FAR 52.246-11, Quality
- ISO 9001, Quality Management System
- MRL Deskbook

I.2 Verify Subcontractor Quality Management Plan

Since much (60-80%) of the program's components and subsystems comes from the supply chain, then the development, execution, and verification of a Supplier QA program becomes a pivotal task. Often

6. Operations and Support (O&S) Phase

program problems originate in the supply chain, but do not manifest themselves until the component is integrated into the system. Program offices and contractors often have efforts to identify and manage problems at the first tier, but do not do well below that level. QA managers need to routinely review and assess contractors supply chain and procurement activities and efforts.

Manufacturing and Quality Tasks

- Review and verify the Subcontractor Quality Management Plan
- Ensure that the appropriate quality clauses are flowed down into the supply chain.
- Ensure that subcontractor quality requirements to include quality management plans are reviewed and managed at depots and MRO activities.
- Assess how efficiently the subcontractor or vendor is producing products, primarily through on-site quality assessments and the evaluation of work measurement data.
- Analyze the causes of variances, their root causes, and championing and motivating contractor improvements.
- Verify the supplier is conducting a Corrective Action Board (CAB) and/or Material Review Board (MRB), or similar meetings, to discuss quality, manufacturing/production, supply chain, engineering and software deficiencies/issues and proposed/status corrective actions, at a minimum.
- Draw management attention to troubled suppliers or critical processes needing corrective action by on-site visits/reviews.
- Perform government surveillance of supplier's compliance to software quality assurance, configuration management, and testing contract requirements
- Review how primes and suppliers conduct training in counterfeit parts avoidance for inspectors, operators, auditors, and lower tier suppliers.
- Ensure that training discusses how to inspect parts and identify possible counterfeits (e.g., non-conforming part markings).

Metrics

- Supplier Quality Management Plan has been assessed.
- Quality contract clauses have been flowed down the supply chain as appropriate.
- Subcontractor quality requirements have been reviewed at Depots and MRO activities.
- Supplier Quality Audit conducted to include assessments of subcontractor efficiency.
- Variances have been analyzed, root cause identified, and corrective action implemented.
- CABs and MRBs have been established, as necessary.
- Supplier Rating System implemented, and management attention is being focused on problem vendors.
- Software QA is being assessed throughout the supply chain.
- Training has been established to identify and manage counterfeit parts.

Tools

- AS9100, Audit Checklist
- AS9134, Supply Chain Risk Management Guidelines
- Interactive MRL Users Guide (Checklist), Quality thread
- ISO 9001, QMS Audit Checklist
- Manufacturing Maturation Plan
- Supplier QA Questionnaire

Resources

- AS9100, Quality Management System – Aerospace
 - AS9102, First Article Inspection
 - AS9103, Variation Management of Key Characteristics
 - AS9133, Qualification Procedure for Aerospace Parts
 - AS9134, Supply Chain Risk Management Guidelines
 - AS9136, Root Cause Analysis and Problem Solving
 - AS9138, Statistical Process Acceptance
- DAG Chapter 14.3.1.3.6 Quality Plans
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.88, Engineering of Defense Systems
- ISO 9001, Quality Management System
- MRL Deskbook

I.3. Evaluate Contractor Quality Management System

FAR Part 46 is used by quality managers to identify contractual quality requirements. Generally, most programs will require a higher-level quality clause and ISO 9001 and AS9100 satisfy the requirements for a higher-level Quality Management System (QMS).

Manufacturing and Quality Tasks

- Ensure the prime contractor has implemented a Quality Management System Based on Best Practices (AS9100 or ISO 9001 as appropriate).
- Ensure the requirement for a QMS is flowed down throughout the supply chain as appropriate.
- Ensure the depots and MRO activities have implemented a Quality Management System Based on Best Practices (AS9100 or ISO 9001 as appropriate).
- Ensure that quality audits of the QMS and product take place at regular intervals and at the Prime, subcontractor, depot, and MRO activities.
- Ensure the following:

6. Operations and Support (O&S) Phase

- Primes and suppliers have implemented a strong incoming quality review on all parts, and visually inspect for defects.
- Organizations implement root cause corrective action for all defects.
- Prime contractors require certificates of conformance, testing certification, and procedures for handling any counterfeit parts that might slip through the system.
- First Article Inspection (FAI) and First Article Testing (FAT) are conducted, as necessary.
- They determine the need for delegated government surveillance on critical products, configuration items, critical product characteristics and critical manufacturing processes that are produced at a sub tier supplier, especially those that have been designated high or moderate risk and those that impact KSA/KPP compliance.
- Review the implementation of a reliability improvement program based on Failure Modes and Effects Criticality Analysis (FMECA).
- Continually assess and refine the product support strategy based on projected and actual performance.
- Conduct benchmarking to survey outside organizations that perform similar processes.
- Support shutdown activities at all levels (Prime contractor, depot, MRO, etc.).

Metrics

- Quality Management System has been implemented and evaluated:
 - Prime contractor, subcontractor, vendors, depots, and MROs
- Quality contract requirements have been flowed down throughout the supply chain as appropriate.
- Quality Audits have been conducted to assess the QMS and results/ratings developed.

Tools

- AS9100, Audit Checklist
- Interactive MRL Users Guide (Checklist), Quality thread
- ISO 9001, QMS Audit Checklist
- Manufacturing Maturation Plan

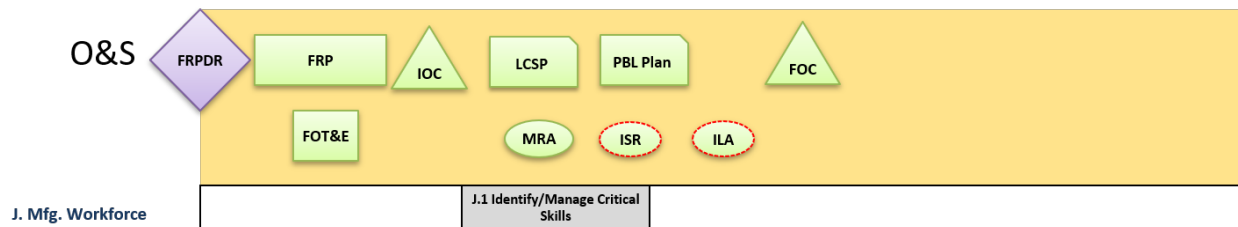
Resources

- AS9100, Quality Management System – Aerospace
 - AS9102, First Article Inspection
 - AS9103, Variation Management of Key Characteristics
 - AS9133, Qualification Procedure for Aerospace Parts
 - AS9134, Supply Chain Risk Management Guidelines
 - AS9136, Root Cause Analysis and Problem Solving
 - AS9138, Statistical Process Acceptance

6. Operations and Support (O&S) Phase

- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.88, Engineering of Defense Systems
- ISO 9001, Quality Management System
- MRL Deskbook

J. MANUFACTURING WORKFORCE



During the sustainment phase, workforce management is concerned about the availability of workers and skill levels required to perform the production and quality operations. Workforce planning should align the skills required to the scope of the effort required to develop, field, and sustain the system. A comprehensive assessment of contractor manufacturing plans for system development is necessary to understand the requirements for workforce skills, capabilities, training, and certifications.

Operations and support workforce requirements and contractor plans should be assessed for human resource policies, processes, and procedures, forecasts for the number of workers, skills, and capabilities, etc. In addition, the current training, certifications, and education, sourcing availability and stability, demographics of the contractor and supply chain should be evaluated for adequacy, as well as their capability and capacity to maintain the workforce as the program moves from Full-Rate Production to Operations and Support.

These production and quality operations may move from a prime or subcontractor facility to a depot or MRO. Problems may occur when the prime contractor cuts back from Full-Rate Production to supporting production for spares and sustainment operations. This lower level of production may cause the contractor to lose sight of important functions while they put their resources into higher rate production programs.

J.1. Identify/Manage Critical Skills

Manufacturing workforce is one of the 5Ms (manpower) that needs to be addressed on a regular and ongoing basis. Two major focus areas are:

- Workforce Skills availability
- Workforce Skills capability

6. Operations and Support (O&S) Phase

Manpower skills availability and capability should have been assessed on a regular basis. Now that the program is in the O&S phase, manpower assessments need to identify critical skills and ensure that they will be available for the duration of the program.

Manufacturing and Quality Tasks

- Review and assess the contractor's manufacturing plans to identify workforce requirements for skills, capabilities, training, and certification requirements:
 - Contractor's make/buy processes for factors that determine the outsourcing of workforce skills
 - Scale-up or scale down of materials, subsystems, items, and components
 - Contractor's labor market (availability, stability, capabilities, training, etc.)
 - Potential ManTech changes, additions, and new manufacturing methods (e.g., automation, upgrades, additive manufacturing, etc.)
 - Potential facilities changes (e.g., location, improvements and expansion, lay-out changes, etc.)
 - Materials handling (e.g., safety processes, storage and disposal processes, environmental processes, etc.)
 - Environment, safety, and occupational health
 - Manufacturing machinery and equipment (e.g., programming and operation, maintenance, calibration, and repair, etc.)
 - Facilities and tooling (e.g., operation and maintenance, safety, security, cleanliness, acoustics, Heating, Ventilation, Air Conditioning (HVAC) and environmental controls, etc.)
 - Quality (e.g., inspections, equipment operation, maintenance, calibration, etc.)
- Assess the factory floor environment (union contract status, earthquakes, power outages, etc.) to determine potential impacts to program performance and sustainability goals.
- Assess factory efficiency and utilization. This activity involves the assessment of how efficiently the contractor is producing products, primarily through the evaluation of work measurement data. It also includes the analysis of causes of variances, their root causes, and championing and motivating contractor improvements.

Metrics

- Manufacturing Plans assessed for workforce requirements:
 - Number of personnel required for production has been identified.
 - Union agreements have been assessed
 - Turnover rate has been assessed
 - Skills, training, and certification requirements of personnel required for production have been identified and are being tracked and managed.

6. Operations and Support (O&S) Phase

- Training and certification hours per employee
- Production workforce metrics have been identified and are being tracked and managed:
 - Efficiency and utilization (throughput, cycle time, takt time, etc.)
 - Earned Value Management or C/SCSC tracked, evaluated, and managed
 - Revenue generated per employee

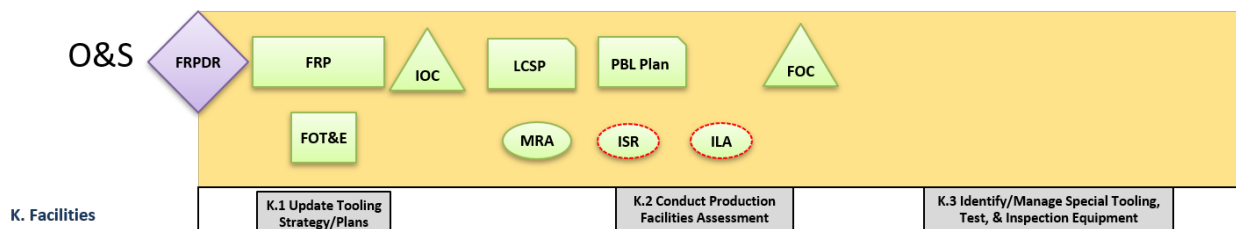
Tools

- Assembly Chart Analysis
- Bottleneck Analysis (Theory of Constraints)
- Capacity Planning Worksheet
- Critical Chain Project Management
- Forecasting and Regression Analysis
- Interactive MRL Users Guide (Checklist), Workforce thread
- Learning Curve Calculator (Estimator)
- Line of Balance Template
- Manufacturing Maturation Plan
- Manufacturing Resource Planning (MRPII)
- Route Sheet Analysis
- Shop Floor Manufacturing Plan Analysis
- SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats)
- Work Measurement Analysis
- Workforce Planning Tools (SAP/Oracle/MRP II)

Resources

- AS6500, Manufacturing Management System
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.88, Engineering of Defense Systems
- Manufacturing Resource Planning (MRP II) software
- MIL-HDBK-896A, Manufacturing and Quality Program
- MRL Deskbook

K. FACILITIES



6. Operations and Support (O&S) Phase

During the sustainment phase, M&Q personnel should update the facility and tooling strategies and plans developed and used during production and operations. In addition, they should conduct assessments of proposed production facilities and update and finalize the tooling plan for the O&S phases and then plan for smart shutdown.

During the sustainment phase, a contractor, or a government owned or operated remanufacturing facility (depot/MRO, etc.) should have implemented an effective facilities management plan along with a tooling plan.

Manufacturing tooling, to include special tooling (ST), special test equipment (STE) and special inspection equipment (SIE), should be assessed for its ability to support sustainment production and operations. Current special tooling strategies favor condition-based maintenance or total productive maintenance (also known as total preventive maintenance). Often special tools, test, and inspection equipment have been in use in the production environment for a long time and may face the need for refurbishment or purchasing of new tools and test equipment. But as production rates and quantities go down, the budget for special tools and test equipment may also go down. In addition, the manufacturing environment may have moved from a prime contractor facility to government owned and operated facilities, such as depots, MROs, etc.

Manufacturing facilities should be assessed for their ability to support sustainment production and operations. Often the prime and subcontractor facilities have been in use for production for a long time and may face the need for refurbishment or capital investment. But as production rates and quantities go down, the budget for facility improvement may also go down. In addition, the manufacturing environment may have moved from a prime contractor facility to government owned and operated facilities, such as depots, MROs, etc.

Manufacturing tooling, to include special tooling (ST), special test equipment (STE) and special inspection equipment (SIE), should be assessed for its ability to support sustainment production and operations. Often ST/STE/SIE has been in use in the production environment for a long time and may face the need for refurbishment or purchasing of new tools and test equipment. But as production rates and quantities go down, the budget for special tools and test equipment may also go down. In addition, the manufacturing environment may have moved from a prime contractor facility to government owned and operated facilities, such as depots, MROs, etc.

K.1. Update Tooling Strategy/Plans

Tooling (special tooling, special test equipment and special inspection equipment) is often a significant cost and schedule driver. The B1 program for example had over \$1 billion in tooling, and the lead times for facility and tooling development can be years. Often one risk reduction strategy is to begin development of facilities and long-lead tooling well in advance of the contract for the next phase. During the O&S phase M&Q managers need to be considering what their strategy is for reducing risk in the implementation of a tooling program.

6. Operations and Support (O&S) Phase

Manufacturing and Quality Tasks

- Ensure that updated Tooling Strategy and Plans include:
 - Identify special tooling, special test, and special inspection equipment
 - Update the manufacturing plan (tooling section)
 - Identify smart shutdown conditions and operations with respect to special tooling, test, and inspection equipment
 - Implement preservation and storage of unique tooling plan once shutdown is accomplished
 - Identify ST, STE, and SIE risk areas
 - Identify ST, STE, and SIE requirements to maintain equipment for the life of the program
- Review the use of existing government owned inventory prior to use of product support arrangements.
 - The government accountable property system that documents all government owned property whether it is held and managed by the government, contractor, or third party
 - The government accountable property system that documents all government-owned property whether it is held and managed by the government, contractor, or third party, in accordance with 40 U.S.C. 524

Metrics

- ST, STE, and SIE Strategy and Plans developed.

Tools

- Acquisition Strategy Template
- Interactive MRL Users Guide (Checklist), Facilities thread
- Manufacturing Maturation Plan
- Manufacturing Strategy (no template available)

Resources

- AS6500, Manufacturing Management System
- AS9100, Quality Management Program
- Condition-Based Maintenance Plus DoD Guidebook
- Defense Manufacturing Management Guide for Program Managers, Chapter 4.5, Elements of a Manufacturing Strategy
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 4151.22, Condition Based Maintenance Plus for Material Management
- DoDI 5000.88, Engineering of Defense Systems
- FAR/DFAR 52.245.17, Special Tooling
- FAR/DFAR 52.245.18, Special Test Equipment

6. Operations and Support (O&S) Phase

- MRL Deskbook
- P.L. 110-417, Section 815, program documentation must include the review cycle for assessing tool retention across the life of the system.

K.2. Conduct Production Facilities Assessment

Manufacturing facilities assessment includes an analysis of the capabilities and capacity of the production facilities to continue production through the O&S phase and prepare for a smart shut-down. Facilities assessments should include facilities at the prime, subcontractor, supplier, vendor, lab, maintenance, or repair activities anywhere production may occur.

Manufacturing and Quality Tasks

- Conduct production facilities assessments to ensure that:
 - Facilities had the capability and capacity to produce items needed during the O&S phase
 - Facilities assessments consider the impact of a program winding down production and producing only to support spares.
 - Facilities should plan for a smart shut down at the end of the program.
 - The contractor's manufacturing plan has been updated to include facilities management.
 - That the current usage and utilization rates are cost effective and affordable.
 - Product support integrators and product support providers identify future production or remanufacturing as organic, commercial, or a combination.
- Prepare an assessment of facility capacity to include:
 - General knowledge of factory and environment (union contract status, earthquakes, power outages, etc.)
 - Identify schedule, key milestones, decision points, risks, and long lead items
 - Delineate between shutdown tasks to be charged directly to the shutdown effort, tasks covered by existing contracts including postproduction planning, and tasks to be otherwise allocated to overhead/indirect expenses
 - Assess any impact to the last production contract due to Ramp-Down. There may be a loss of efficiency due in part to employee morale unless the workforce moves to another program immediately
 - Process to include government personnel in the preliminary planning phases to identify items to be retained, disposed, and/or stored for sustainment or production restart
 - Union termination agreements
 - Shutdown of subcontractor activities and contract close-out
 - Cessation of production, disposal, and other related activities unless initially negotiated for the government to pay certain costs

Metrics

- Facilities plans have been developed and assessed.

6. Operations and Support (O&S) Phase

- Facilities risk assessment has been conducted.

Tools

- DCMA Manufacturing Systems Risk Assessment (MSRA) Checklist
- DCMA Production Planning and Control Risk Assessment Checklist
- Interactive MRL Users Guide (Checklist), Facilities thread
- Manufacturing Maturation Plan

Resources

- AS6500, Manufacturing Management System
- AS9100, Quality Management Program
- DCMA-INST-204, Manufacturing and Production
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.02, Operation of the Adaptive Acquisition Framework
- DoDI 5000.88, Engineering of Defense Systems
- MIL-HDBK-896A, Manufacturing and Quality Program
- MRL Deskbook

K.3. Identify/Manage Special Tooling, Test, and Inspection Equipment

DoD often permits contractors to acquire Special Tooling, Special Test Equipment, and Special Inspection Equipment (ST/STE/SIE) as government-furnished property to be used in the development or manufacturing of a product. Special tooling can include jigs, dies, fixtures, molds, patterns, taps, and gauges of a specialized nature intended for the development or production of specific DoD products. Special test equipment can be single or multi-purpose test units to accomplish special purpose testing in the performance of a DoD contract. Special inspection equipment can be single or multipurpose equipment used in the inspection and acceptance of DoD products

Manufacturing and Quality Tasks

- Identify unique tooling associated with the production of hardware to facilitate its protection and storage through the end of the program's service life.
- Review the contractor's or government's tooling plan and inventory.
- Review movement of special tooling and special test equipment.
- Review the use of existing government owned inventory prior to use of product support arrangements.
- Minimize the need for unique automatic test equipment (ATE) by using designated DoD automatic test system families for all ATE hardware in DoD field and depot operations.
- Review the Preservation and Storage of Unique Tooling Plan and ensure that it includes the review cycle for assessing tool retention across the life of the system.

6. Operations and Support (O&S) Phase

- Review and assess all STE whether single or multipurpose integrated test units engineered, designed, fabricated, or modified to accomplish special purpose testing in performing a contract.

Metrics

- ST, STE, and SIE plans have been developed.
- ST, STE, and SIE equipment has been identified.
- ST, STE, and SIE risks have been identified.

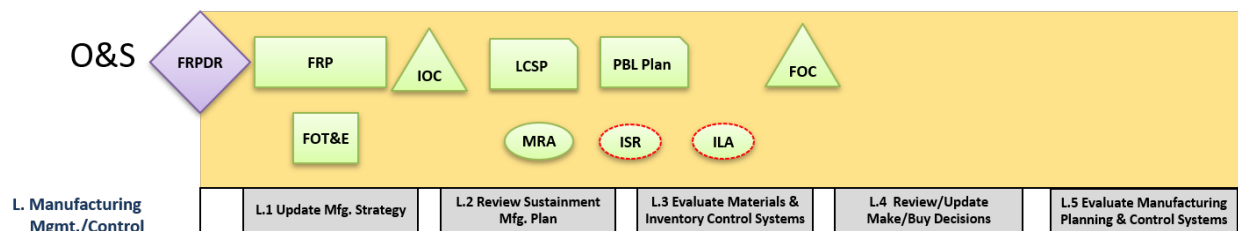
Tools

- Interactive MRL Users Guide (Checklist), Facilities thread
- Life Cycle Sustainment Plan Outline, Tooling Plan
- Manufacturing Maturation Plan

Resources

- DCMA Instruction 124, Contract Property Administration
- Defense Manufacturing Management Guide for Program Managers, Chapter 4.5, Elements of a Manufacturing Strategy
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.88, Engineering of Defense Systems
- FAR 45 Government Property
- FAR 52.245-1 Government Property
- Guidebook for Contract Property Administration
- MRL Deskbook
- USD(AT&L) Memo, Preservation, and Storage of Tooling for MDAPs

L. MANUFACTURING MANAGEMENT AND CONTROL



During the sustainment phase, Manufacturing Management/Control includes Materials Planning (MRP) and Manufacturing Planning (MRP II).

MRP is a production control system that integrates production requirements (rates and quantities) with the Bill of Material and inventories to calculate shipping schedules for parts and components and initiate the purchasing or subcontracting activities to support production. The primary functions of an

6. Operations and Support (O&S) Phase

MRP system is to ensure that the right materials are at the right place and at the right time to support production operations. A secondary function is to reduce waste by maintaining the lowest possible levels of materials and stock (inventory) while still meeting customer demand.

Manufacturing management is generally concerned with three types of material inventories:

- **Raw Materials:** Raw materials are the basic building blocks for the company. Often this is in the form of raw materials and components.
- **Work-in-Progress (WIP):** WIP is made up of materials, components, subassemblies, and assemblies that are in the process of being produced. That is, they have been released from material stores and have not yet been through final inspection and acceptance.
- **Finished Goods:** Finished goods have been inspected and accepted and are awaiting delivery to the customer.

Manufacturing Resource Planning (MRPII) is a planning control system that addresses factory floor planning from rough cut capacity planning, capacity requirements planning, cost reporting and control, and down to the execution of shop floor activities to meet daily demand. An MRP II system:

- Integrates Operational Planning and Execution with Financial Planning and Execution.
- Predicts production outcomes using simulation before the start of production.
- Involves every facet of the factory floor from planning to execution.

MRP II software auxiliary systems include:

- Lot traceability
- Contract management
- Tool management
- Configuration management
- Engineering change control

Manufacturing plans should have been developed in support of the O&S phase and sustainment operations. The manufacturing environment may have moved from a prime contractor facility to government owned and operated facilities, such as depots, MROs, etc.

Manufacturing resources consist of facilities, materials, machines, manpower, methods, measurement systems, and capital that are used to convert or transform raw materials and component parts into end items. Contractors must have an effective combination of people and systems to plan for, monitor, and control these manufacturing resources. A well-structured manufacturing management system generally employs the use of industry best practices. Assessment of the contractor's manufacturing management and quality systems should be performed against the recognized industry best practices such as AS6500, ISO 9000, AS9100, etc.

During the system Sustainment, the PM will deploy the product support package and monitor its performance according to the Life Cycle Sustainment Plan (LCSP). PMs are responsible for developing and maintaining an LCSP consistent with the product support strategy. The LCSP describes how sustainment influences the technical, business, and management activities that help to implement a

6. Operations and Support (O&S) Phase

product support package that maintains affordable system operational effectiveness over the system life cycle. The Acquisition Strategy will also include an overview of the product support strategy and sustainment-related contracts.

DMSMS, obsolescence, and counterfeiting of parts and materials, especially in the electronic segment, are growing at an alarming rate. A large network of suppliers in an increasingly global supply chain creates limited visibility into these sources, leading to a greater risk of procuring counterfeit parts. In addition, there are unique conditions that make aerospace and defense products susceptible to counterfeiting, including a long-life cycle and DMSMS issues. Therefore, supporting aerospace and defense programs require increased vigilance and oversight.

During the O&S phase, M&Q personnel will be involved in the following:

- Conduct Environment, Safety and Occupational Health risk assessments and maintain oversight of critical safety item supply chain management.
- Conduct analysis to identify and mitigate potential obsolescence impacts (i.e., Diminishing Manufacturing Sources and Material Shortages).
- Support implementation of follow-on development efforts in response to formal decisions to extend the weapon system's service life extension program (SLEP), or to initiate a major modification (may be treated as a stand-alone acquisition program).

L.1. Update Manufacturing Strategy

A manufacturing strategy is developed as part of the program acquisition strategy and often includes considerations such as competition. Manufacturing voids, deficiencies, and dependencies on critical foreign source materials should also be addressed. The producibility of each system design concept should be evaluated to determine if the proposed system can be manufactured in compliance with the production cost and industrial base goals and thresholds.

Manufacturing and Quality Tasks

- Support the development of a Manufacturing Strategy to include the following items:
 - Should be included in the Systems Engineering Plan (SEP) and/or the Life Cycle Sustainment Plan (LCSP)
 - Should include Make/Buy decisions and the decision to have either organic or contractor sustainment support.
 - Should support the PMs in developing and maintaining an LCSP consistent with the product support strategy.
 - Should describe sustainment influences on system design and the technical, business, and management activities to develop, implement, and deliver a product support package that maintains affordable system operational effectiveness over the system life cycle and seeks to reduce cost without sacrificing necessary levels of program support.

6. Operations and Support (O&S) Phase

- Should specify Manufacturing Management System requirements (e.g., AS6500), if applicable to be met by the prime contractor and flowed down to suppliers, as appropriate.
- Review the following sources of industrial and manufacturing readiness data to develop the Manufacturing Strategy:
 - Program Status Reviews
 - Pre-award surveys
 - Production Readiness Reviews
 - Industrial Base Assessments
 - Trade-off studies, tooling plans
 - Make-or-buy plans
 - Manufacturing plans
 - Bills of material
- Identify risks and actions to reduce or address any remaining risks to include:
 - Manufacturing should review foreign sources and international cooperative development should be used where advantageous.
 - Manufacturing should provide inputs to support production surge capability and what-if exercises.
 - Manufacturing should provide inputs to program cuts and smart shutdown once a program has concluded.
 - Manufacturing should review priorities of competing programs (commercial and military).
 - Manufacturing should review production shutdown planning efforts.

Metrics

- Manufacturing Strategy has been updated.
- Systems Engineering Plan has been updated and includes the Manufacturing Strategy.
- Life Cycle Sustainment Plan updated and includes the Manufacturing Strategy.
- Industrial and manufacturing readiness has been addressed.
- Manufacturing risks and risk mitigations have been identified.

Tools

- Acquisition Strategy Template
- Interactive MRL Users Guide (Checklist), 2018 for the Manufacturing Management and Control thread
- Manufacturing Maturation Plan
- Systems Engineering Plan (SEP) Outline

6. Operations and Support (O&S) Phase

Resources

- AS6500, Manufacturing Management System
- ASD(LM&R) Life-Cycle Sustainment Plan memo
- DAG Chapter 4-3.5 Operating and Support Phase
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.02, Operation of the Adaptive Acquisition Framework
- DoDI 5000.88, Engineering of Defense Systems
- DSMC Acquisition Strategy Guide
- ISO/IEC/IEEE 15288, Systems and Software Engineering–System Life Cycle Processes
- MIL-HDBK-896A, Manufacturing Management Program Guide
- MRL Deskbook
- Systems Engineering Plan (SEP) Outline

L.2. Review Sustainment Manufacturing Plan

Manufacturing planning is about understanding everything it takes to produce the items required by the contract, on time, on budget, and with the right performance features. It includes considerations of all the 5Ms (manpower, machines, materials, methods, and measurements), at the prime contractor and throughout the supply chain. During the O&S phase, there may be manufacturing processes and requirements (5Ms) that will require planning for sustaining these capabilities through the duration of this phase.

Manufacturing and Quality Tasks

- Support development of Manufacturing Plans in support of the O&S phase and sustainment operations.
- Review the Manufacturing Plan to ensure it will provide the resources needed for sustainment operations as outlined in the LCSP.
- Assess the Manufacturing Plan for impact to the ‘5Ms’ (Manpower, Material, Methods, Measurement and Machinery).
- Assess the Manufacturing Plan for Risks, Issues and Opportunities.
- Ensure that Defense acquisition programs minimize the need for new defense-unique industrial capabilities.
- Support the development a Smart Shutdown plan.
- Ensure the contractor is conducting First Article Inspections on the hardware being produced from any new facility.
 - The manufacturing environment may have moved from a prime contractor facility to government owned and operated facilities, such as depots, MROs, etc.

6. Operations and Support (O&S) Phase

Metrics

- Manufacturing Plan has been reviewed, updated, and implemented
 - Impact on the 5Ms (Manpower, Material, Methods, Measurement and Machinery).
- Life Cycle Sustainment Plan has been updated and the Manufacturing Plan provides the resources necessary for sustainment operations.
- Manufacturing Plan was assessed for Risks, Issues, and Opportunities.
- Requirements for defense-unique industrial capabilities have been minimized.
- A Smart Shutdown Plan has been developed and analyzed.
- First Article Inspections have been conducted when a product was built for the first time at any facility.

Tools

- Assembly Chart Analysis
- Bottleneck Analysis (Theory of Constraints)
- Capacity Planning Worksheet
- Critical Chain Project Management
- Interactive MRL Users Guide (Checklist), Manufacturing Management and Control thread
- Manufacturing Maturation Plan
- Manufacturing Resource Planning (MRPII)
- Material Management and Accounting System (MMAS) audit
- Risk, Issue, and Opportunity assessment
- Route Sheet Analysis
- Shop Floor Manufacturing Plan Analysis

Resources

- AS6500, Manufacturing Management Program
- DAG, Chapter 3-4 3.18, Producibility, Quality and Manufacturing Readiness
- DFARS 252.72 Contractor Material Management and Accounting System
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.02, DoDI 5000.02, Operation of the Adaptive Acquisition Framework
- DoDI 5000.88, Engineering of Defense Systems
- ISO/IEC/IEEE 15288, Systems and Software Engineering–System Life Cycle Processes
- MIL-HDBK-896A, Manufacturing and Quality Program
- MRL Deskbook
- Systems Engineering Plan (SEP) Outline

L.3. Evaluate Materials and Inventory Control Systems

Manufacturing and QA managers should be actively involved in the evaluation of a contractor's material management and control systems and with Material Resource Planning activities. DFAR 242.72 outlines the requirement for the Contractor Material Management and Accounting System (MMAS). An evaluation of the contractor's MMAS should include a review of the contractor's system for planning, management, and costing of materials used in the production of the DoD system.

Manufacturing and Quality Tasks

- Evaluate Material and Inventory Control Systems such as Material Requirements Planning.
 - Determine material requirements and components to support the manufacturing rate and determination of manufacturing lot quantities.
 - Minimize the total cost of inventory, which includes raw materials, work-in-progress, and finished goods.
 - Minimize buffer and supermarket inventories (identify and mitigate bottlenecks)
 - Implement Lean manufacturing and sustainment practices
 - Minimize setup times and batch sizes which lead to excess inventory
- Periodically assess product support performance and take corrective action to prevent degraded materiel readiness or O&S cost growth.
- Support DCMA in their assessment of contractor Production Planning and Control systems.
- Support the use of DCAA material management audit program.
- MSRA Production Planning and Control (PPC), Material Requirement Planning Checklist can be used to assess Material Requirements Planning.

Metrics

- Material Management and Accounting System (MMAS) has been implemented.
- MMAS Audits have been conducted and actions taken to improve.
- MMAS risks have been identified.
- Inventories have been reduced because of Lean or other initiatives.
- Cycle time has been reduced.
- Set-up time and batch sizes have been reduced.

Tools

- AS6500, Assessment
- AS9100, Assessment
- DCAA Materials Management Audit Program and Checklist
- DCMA MSRA Production Planning and Control (PPC), Material Requirement Planning Checklist
- Interactive MRL Users Guide (Checklist), Manufacturing Management and Control thread

6. Operations and Support (O&S) Phase

- ISO 9001, Assessment
- Manufacturing Maturation Plan

Resources

- AS5553, Counterfeit Electronic Parts
- AS6174, Counterfeit Material
- AS6500, Manufacturing Management System
- AS9100, Quality Management System – Aerospace
- DCMA, Audit Policies, Procedures and Internal Controls Relative to Accounting and Management Systems
- DFAR Subpart 242.72 – Contractor Material Management and Accounting System
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.88, Engineering of Defense Systems
- ISO 9001, Quality Management System
- Material Management and Accounting System – Audit Program
- MIL-HDBK-896A, Manufacturing and Quality Program
- MRL Deskbook

L.4. Review/Update of Make/Buy Decisions

The Make/Buy decision, sometimes called outsourcing, is a common practice, with the prime contractor often outsourcing 60-80 percent of the material costs of the system. The decision to make or buy should be based on the capability to produce, the capacity to produce, the availability of resources to produce, and the cost to produce.

Manufacturing and Quality Tasks

- Review and assess the contractor's Make/Buy plan identifying those items to be produced (make) or work that will be subcontracted (buy).
- Support the assessment of Make/Buy decision factors such as lowest overall cost or technical risk.
 - At the prime contractor's facility, subcontractors, vendors, depot, or MRO facility

Metrics

- Contractor Make/Buy plan and criteria have been reviewed and assessed.
- Make/Buy decisions factors have been assessed.

Tools

- Interactive MRL Users Guide (Checklist), Manufacturing Management and Control thread
- Manufacturing Maturation Plan

6. Operations and Support (O&S) Phase

- Product Support Business Case Analysis Guidebook Appendix A BCA Checklist
- Weapon System Acquisition Reform Product Assessment report requirements tool

Resources

- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.88, Engineering of Defense Systems
- MRL Deskbook
- Product Support Business Case Analysis Guidebook

L.5 Evaluate Manufacturing Planning and Control Systems

Manufacturing and quality managers need to be actively involved in the evaluation of a contractor's Manufacturing Resource Planning system. This includes the evaluation of the system's ability to collect, integrate, and process factory floor information to support manufacturing planning and execution activities. This includes capacity planning, production scheduling, manufacturing cost reporting, performance measurement, quality, and labor reporting.

Manufacturing and Quality Tasks

- Support the evaluation of Manufacturing Planning and Control systems (MRP II) to include:
 - Long-Term Planning
 - Medium-term planning
 - Short-term planning
- Support the following Long-term Planning requirements:
 - Demand Management (Customer requirements, how many and when)
 - Sales and Operations Planning
 - Resource/Production Planning (Rough Cut Capacity Planning)
 - Master Production Scheduling
 - Medium-term planning is the “engine” of an MRP II system and includes:
 - Detailed Material Planning
 - Demand Capacity Planning (Capacity Requirements Planning)
 - Material and Capacity Plans
- Support planning and implementation activities associated with the “back-end” of an MRP II system and includes:
 - Supplier Systems (Purchase Order Release)
 - Shop-Floor Systems (Work Order Release)
 - Shop Floor Activities
- Periodically assess manufacturing plans along with the LCSP to identify risks and develop risk mitigation measures.

6. Operations and Support (O&S) Phase

- Review the Manufacturing Plan to ensure it will provide the resources needed for sustainment operations as outlined in the LCSP.
- Assess the Manufacturing Plan for impact to the “5Ms” (Manpower, Material, Methods, Measurement and Machinery).
- Assess the Manufacturing Plan for Risks, Issues, and Opportunities.
- Identify any assumptions made in developing the shutdown plan.
- Ensure the contractor is conducting First Article Inspections on the hardware being produced from the new facility.
- The DCMA MSRA Production Planning and Control, Material Requirement Planning Checklist can be used to assess:
 - Resource Requirements Planning
 - Aggregate Planning
 - Master Production Schedule
 - Rough Cut Capacity Planning
 - Capacity Requirements Planning
 - Shop Floor Controls

Metrics

- Manufacturing Planning and Control systems (MRP II) have been evaluated to include:
 - Long-Term Planning
 - Medium-term planning
 - Short-term planning
- MMAS Audits conducted
- Support the conduct of “back-end” planning to include:
 - Supplier Systems (Purchase Order Release)
 - Shop-Floor Systems (Work Order Release)
 - Shop Floor Activities
- Manufacturing Plans and LCSP have been evaluated.
- Risk assessments have been conducted on the Manufacturing Planning and Control System.
- Audit results and risks used to continuously improve.

Tools

- AS6500, Assessment
- DCMA Production Planning and Control Checklist
- Interactive MRL Users Guide (Checklist), Manufacturing Management and Control thread
- Manufacturing Maturation Plan
- Material Management and Accounting System Audit

6. Operations and Support (O&S) Phase

Resources

- AS6500, Manufacturing Management System
- DCMA MSRA Production Planning and Control (PPC), Material Requirement Planning Checklist
- DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs
- DoDI 5000.88, Engineering of Defense Systems
- MIL-HDBK-896A, Manufacturing and Quality Program
- MRL Deskbook

Appendix A: Abbreviations and Acronyms

A _m	Materiel Availability
A _o	Operational Availability
AAF	Adaptive Acquisition Framework
ADM	Acquisition Decision Memorandum
AFRL	Air Force Research Laboratory
AM	Additive Manufacturing
ANSI	American National Standards Institute
AoA	Analysis of Alternatives
APA	Additional Performance Attributes
APB	Acquisition Program Baseline
APQP	Advanced Product Quality Planning
AS	Acquisition Strategy
ASME	American Society of Mechanical Engineers
ASR	Alternative Systems Review
AT	Anti-Tamper
ATE	Automatic Test Equipment
AUPC	Average Unit Procurement Cost
BCA	Business Case Analysis
BER	Beyond Economical Repair
BoK	Body of Knowledge
BOM	Bill of Materials
C/SCSC	Cost/Schedule Control Systems Criteria
C4I	Command, Control, Communications, Computers, and Intelligence
CAB	Corrective Action Board
CAE	Component Acquisition Executive
CAI	Critical Application Item
CAIG	Cost Analysis Improvement Group
CAIV	Cost as an Independent Variable
CAPE	Cost Assessment and Program Evaluation
CARD	Cost Analysis Requirements Description
CAS	Contract Administration Services
CBA	Capabilities-Based Assessment

Appendix A: Abbreviations and Acronyms

CCB	Configuration Control Board
CDD	Capability Development Document
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CI	Configuration Item
CI	Critical Item
CJCS	Chairman of the Joint Chiefs of Staff
CLIN	Contract Line Item Number
CM	Configuration Management
CMO	Contract Management Office
CMP	Configuration Management Plan
CMP	Critical Manufacturing Process
COE	Center of Excellence
COMSEC	Communications Security
CONOPS	Concept of Operations
COSSI	Commercial Operations and Support Savings Initiative
COTS	Commercial Off-the-Shelf
CPAR	Contractor Performance Assessment Report
CPC	Corrosion Prevention and Control
CPD	Capability Production Document
CPFF/CPIF	Cost Plus Fixed Fee/Cost Plus Incentive Fee
CPI	Continuous Process Improvement
C _p / C _{pk}	Process Capability
C/SCSC	Cost and Schedule Control Systems Criteria
CSI	Critical Safety Item
CTC	Critical to Customer
CTE	Critical Technology Element
CTQ	Critical to Quality
CUI	Controlled Unclassified Information
DAE	Defense Acquisition Executive
DAG	Defense Acquisition Guidebook
DARPA	Defense Advanced Research Projects Agency
DAU	Defense Acquisition University
DCMA	Defense Contract Management Agency

Appendix A: Abbreviations and Acronyms

DD, ENG	Deputy Director for Engineering
DFA	Design for Assembly
DFARS	Defense Federal Acquisition Regulation Supplement
DFM	Design for Manufacturability
DFMA	Design for Manufacture and Assembly
DFMEA	Design Failure Modes and Effects Analysis
DFSS	Design for Six Sigma
DID	Data Item Description
DLA	Defense Logistics Agency
DMMG	Defense Manufacturing Management Guide
DMS	Diminishing Manufacturing Sources
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DoD	Department of Defense
DoDD	DoD Directive
DoDI	DoD Instruction
DoDM	DoD Manual
DOE	Design of Experiments
DPAS	Defense Priorities and Allocation System
DSMC	Defense Systems Management College
DSS	Design for Six Sigma
DTRAM	Defense Technical Risk Assessment Methodology
DTC	Design to Cost
DT&E	Developmental Test and Evaluation
EAC	Estimate at Completion
ECP	Engineering Change Proposal
EMC	Electromagnetic Compatibility
EMD	Engineering and Manufacturing Development
EMI	Electromagnetic Interference
EOQ	Economic Order Quantity
ERP	Enterprise Resource Plan
ESOH	Environment, Safety, and Occupational Health
ESS	Environmental Stress Screening
EVMS	Earned Value Management System
FA	First Article

Appendix A: Abbreviations and Acronyms

FAI	First Article Inspection
FAR	Federal Acquisition Regulation
FAT	First Article Test
FCA	Functional Configuration Audit
FDD	Full Deployment Decision
FFP	Firm Fixed Price
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes, Effects, and Criticality Analysis
FOD	Foreign Object Damage
FOT&E	Follow-on Test and Evaluation
FPIF	Fixed Price Incentive Fee
FRACAS	Failure Reporting, Analysis, and Corrective Action System
FRP	Full-Rate Production
FYDP	Future Years Defense Program
GAO	Government Accountability Office
GCQA	Government Contract Quality Assurance
GFE	Government-Furnished Equipment
GFF	Government-Furnished Facility
GFI	Government-Furnished Information
GFM	Government-Furnished Material
GFP	Government-Furnished Property
GIDEP	Government-Industry Data Exchange Program
GOTS	Government Off-the-Shelf
HALT	Highly Accelerated Life Testing
HASS	Highly Accelerated Stress Screen
HSI	Human Systems Integration
HVAC	Heating, Ventilation, and Air Conditioning
HWCIs	Hardware Configuration Items
IB	Industrial Base
IC	Intelligence Community
ICA	Industrial Capabilities Assessments
ICD	Initial Capabilities Document
IEEE	Institute of Electrical and Electronics Engineers
IG	Inspector General

Appendix A: Abbreviations and Acronyms

IPT	Integrated Product Team
ILA	Independent Logistics Assessment
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IOC	Initial Operational Capability
IP	Intellectual Property
IPS	Integrated Product Support
IPT	Integrated Product Team
IRAD	Independent Research and Development
ISO	International Organization for Standardization
ISR	In-Service Review
ITAR	International Trafficking in Arms Regulation
ITRA	Independent Technical Risk Assessment
JCIDS	Joint Capabilities Integration and Development System
JROC	Joint Requirements Oversight Council
KC	Key Characteristics
KLP	Key Leadership Position
KPP	Key Performance Parameter
KSA	Key System Attribute
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
LCSP	Life Cycle Sustainment Plan
LOD	Letter of Delegation
LFT&E	Live-Fire Test and Evaluation
LRIP	Low-Rate Initial Production
5Ms	Manpower, Machines, Materials, Methods, Measurement
ManTech	Manufacturing Technology
MATE	Multi-Attribute Trade Space Exploration
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MDD	Materiel Development Decision
MEP	Manufacturing Extension Program
MIL-STD	Military Standard
MMAS	Material Management and Accounting System

Appendix A: Abbreviations and Acronyms

MMP	Manufacturing Maturation Plan
MMS	Manufacturing Management System
MOA	Memorandum of Agreement
MOE	Measure of Effectiveness
MOSA	Modular Open Systems Approach
MP	Mission Profile
M&Q	Manufacturing and Quality
MRA	Manufacturing Readiness Assessment
MRB	Material Review Board
MRL	Manufacturing Readiness Level
MRO	Maintenance, Repair, and Overhaul
MRP	Material Requirements Planning
MRPII	Manufacturing Resource Planning
M&S	Modeling and Simulation
MS A	Milestone A
MS B	Milestone B
MS C	Milestone C
MSA	Materiel Solution Analysis
MSRA	Manufacturing Systems Risk Assessment
MTA	Middle Tier of Acquisition
MTBF	Mean Time Between Failure
NAVSO	National Association of Veteran-Serving Organizations
NDAA	National Defense Authorization Act
NDI	Non-Developmental Item
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NRL	Navy Research Laboratory
NSPAR	Non-Standard Parts Approval Request
NTIB	National Technology and Industrial Base
O&A	Over and Above
OEE	Overall Equipment Effectiveness
OEM	Original Equipment Manufacturer
OIPT	Overarching Integrated Product Team
O&M	Operations and Maintenance

Appendix A: Abbreviations and Acronyms

OMS	Operational Mode Summary
O&S	Operations and Support
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
OTRR	Operational Test Readiness Review
OUUSD(R&E)	Office of the Under Secretary of Defense for Research and Engineering
P3I/P ³ I	Preplanned Product Improvement
PAOC	Post-Award Orientation Conference
PAW	Producibility Assessment Worksheet
PBL	Performance-Based Logistics
PCA	Physical Configuration Audit
PCD	Process Control Document
PCO	Procurement Contracting Officer
P&D	Production and Deployment
PDR	Preliminary Design Review
PEP	Producibility Engineering and Planning
PESHE	Programmatic Environmental, Safety, and Occupational Health Evaluation
PFMEA	Process Failure Modes and Effects Analysis
PHL	Preliminary Hazard List
PHST	Packing, Handling, Storage, and Transportation
PM	Program Manager
PMP	Parts, Materials, and Processes
PMR	Program Management Review
PMO	Program Management Office
POE	Program Office Estimate
Pp / Ppk	Process Performance
PPAP	Production Part Approval Process
PPC	Production Planning and Control
PPP	Program Protection Plan
PQM	Production, Quality, and Manufacturing
Pre-MDD	Pre-Materiel Development Decision
PRR	Production Readiness Review
PSA	Program Support Assessment
PSM	Product Support Manager

Appendix A: Abbreviations and Acronyms

PSS	Product Support Strategy
PTAC	Procurement Technical Assistance Center
PWBS	Preliminary Work Breakdown Structure
QA	Quality Assurance
QALI	Quality Assurance Letter of Instruction
QDR	Quality Deficiency Report
QFD	Quality Function Deployment
QMS	Quality Management System
QSP	Quality Surveillance Plan
R&D	Research and Development
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
RIO	Risk, Issue, and Opportunity
RFI	Request for Information
RFP	Request for Proposal
RFP DP	Request for Proposal Release Decision Point
RFV	Request for Variation
R&M	Reliability and Maintainability
SAE	Society of Automotive Engineers
SAR	Safety Assessment Report
SAT	Software Acceptance Test
SCD	Surveillance Criticality Designator
SCM	Supply Chain Management
SCMP	Software Configuration Management Plan
SCOR	Supply Chain Operations Reference
SCRM	Supply Chain Risk Management
SDP	Software Development Plan
SE	Systems Engineering
SEMP	Systems Engineering Management Plan
SEP	Systems Engineering Plan
SF	Standard Form
SFMEA	System Failure Modes and Effects Analysis
SFQT	Software Formal Qualification Testing
SFR	System Functional Review
SIE	Special Inspection Equipment

Appendix A: Abbreviations and Acronyms

SLEP	Service Life Extension Program
SME	Society of Manufacturing Engineers
SOO	Statement of Objectives
SOW	Statement of Work
SPC	Statistical Process Control
SPI	Special Packaging Instructions
SQAP	Software Quality Assurance Plan
SRR	System Requirements Review
SSA	System Safety Assessment
SSE	Systems Security Engineering
SSP	Source Selection Plan
ST	Special Tooling
S&T	Science and Technology
STE	Special Test Equipment
STEM	Science, Technology, Engineering, and Math
SVR	System Verification Review
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TBD	To Be Determined
TDP	Technical Data Package
T&E	Test and Evaluation
TEMP	Test and Evaluation Master Plan
TMRR	Technology Maturation and Risk Reduction
TO	Technical Order
TOC	Total Ownership Cost
TOC	Theory of Constraints
TPM	Technical Performance Measure
TRA	Technology Readiness Assessment
TRIZ	Theory of Innovative Problem Solving
TRL	Technology Readiness Level
TRR	Test Readiness Review
USAFA	United States Air Force Academy
USD(R&E)	Under Secretary of Defense for Research and Engineering
U.S.C.	United States Code
VCRM	Verification Cross-Reference Matrix

Appendix A: Abbreviations and Acronyms

VOLT	Validated Online Lifecycle Threat
VR	Variability Reduction
VSM	Value Stream Mapping
V&V	Verification and Validation
WBS	Work Breakdown Structure
WIP	Work in Progress

Appendix B: References

Resources identified in the M&Q BoK are listed below alphabetically and contain links to the referenced document. As many of these resources are revised frequently, readers are advised the documents may change or may be updated, replaced, or cancelled between editions of this BoK. Readers may need to conduct an Internet search to find the most recent version.

10 USC 144B, Weapon Systems Development and Related Matters

<https://uscode.house.gov/view.xhtml?path=/prelim@title10/subtitleA/part4/chapter144B&edition=prelim>

10 USC 2304, Contracts: Competition Requirements

<https://www.govinfo.gov/content/pkg/USCODE-1995-title10/pdf/USCODE-1995-title10-subtitleA-partIV-chap137-sec2304.pdf>

10 USC 2305, Contracts: Planning, Solicitation, Evaluation and Award Procedures

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10 USC 2334, Independent Cost Estimate and Cost Analysis

<https://www.law.cornell.edu/uscode/text/10/2334>

10 USC 2337, Life-cycle Management and Product Support

<https://www.govinfo.gov/content/pkg/USCODE-2015-title10/pdf/USCODE-2015-title10-subtitleA-partIV-chap137-sec2337.pdf>

10 USC 2430, Major Defense Acquisition Program Defined

<https://www.law.cornell.edu/uscode/text/10/2430>

10 USC 2431a. Acquisition Strategy

<https://www.law.cornell.edu/uscode/text/10/2431a>

10 USC 2431b, Risk Management

<https://www.govinfo.gov/content/pkg/USCODE-2015-title10/pdf/USCODE-2015-title10-subtitleA-partIV-chap144-sec2431b.pdf>

10 USC 2435, Acquisition Program Baseline

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- 10 USC 2438, Performance Assessments
<https://www.govinfo.gov/content/pkg/USCODE-2010-title10/pdf/USCODE-2010-title10-subtitleA-partIV-chap144-sec2438.pdf>
- 10 USC 2440, Technology and Industrial Base Plans
<https://www.govinfo.gov/app/details/USCODE-2011-title10/USCODE-2011-title10-subtitleA-partIV-chap144-sec2440>
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<https://www.govinfo.gov/content/pkg/USCODE-2016-title10/html/USCODE-2016-title10-subtitleA-partIV-chap144B-subchapIII.htm>
- 10 USC 2501, National Security Strategy for NTIB
<https://www.govinfo.gov/app/details/USCODE-2015-title10/USCODE-2015-title10-subtitleA-partIV-chap148-subchapII-sec2501>
- 10 USC 2502, National Defense Technology and Industrial Base Council
<https://www.govinfo.gov/app/details/USCODE-2010-title10/USCODE-2010-title10-subtitleA-partIV-chap148-subchapII-sec2502>
- 10 USC 2503, Analysis of the Technology and Industrial Base
<https://www.govinfo.gov/app/details/USCODE-2011-title10/USCODE-2011-title10-subtitleA-partIV-chap148-subchapII-sec2503>
- 10 USC 2504, Annual Report to Congress
<https://www.govinfo.gov/app/details/USCODE-2010-title10/USCODE-2010-title10-subtitleA-partIV-chap148-subchapII-sec2504>
- 10 USC 2505, NTIB Periodic Defense Capability Assessments
<https://www.govinfo.gov/app/details/USCODE-2006-title10/USCODE-2006-title10-subtitleA-partIV-chap148-subchapII-sec2505>
- 10 USC 2521, Manufacturing Technology Program
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https://static.e-publishing.af.mil/production/1/saf_aq/publication/afi63-145/afi63-145.pdf

AFMC Instruction 63-145, Manufacturing and Quality

https://static.e-publishing.af.mil/production/1/saf_aq/publication/afi63-145/afi63-145.pdf

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<http://www.acqnotes.com/Attachments/Modeling%20&%20Simulation%20Guidance%20for%20the%20Acquisition%20Workforce.pdf>
- Modeling and Simulation (M&S) Management (DoDD 5000.59)
<https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/500059p.pdf>
- MRL Deskbook, 2018
http://www.dodmrl.com/MRL_Deskbook_2018.pdf
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<https://www.dau.edu/tools/dag>

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<https://uscode.house.gov/statutes/pl/114/328.pdf>

National Defense Authorization Act (NDAA) for Fiscal Year 2017 (Public Law 114-328), Section 807, Sect 2448b, Independent Technical Risk Assessments

<https://uscode.house.gov/statutes/pl/114/328.pdf>

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NIST 800-171, Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations, Rev 2, Feb 2020

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-171r2.pdf>

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https://www.cape.osd.mil/files/OS_Guide_v9_March_2014.pdf

O&S Cost Management Guide, DAU, Mar 2016

[https://www.dau.edu/tools/t/Operating-and-Support-\(OandS\)-Cost-Management-Guidebook](https://www.dau.edu/tools/t/Operating-and-Support-(OandS)-Cost-Management-Guidebook)

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<https://www2.ed.gov/about/inits/ed/implementation-support-unit/tech-assist/request-proposals-evaluation-guide.pdf>

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https://www.dau.edu/tools/Documents/SAM/resources/RTM_Risk_Register.html

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<http://acqnotes.com/wp-content/uploads/2017/07/DoD-Risk-Issue-and-Opportunity-Management-Guide-Jan-2017.pdf>

Robust Design and Taguchi Methods

<https://www.dau.edu/cop/risk/DAU%20Sponsored%20Documents/Robust%20Design%20and%20Taguchi%20Methods.pdf>

SAE EIA 649B-2011, Configuration Management Standard

https://webstore.ansi.org/Standards/SAE/SAEEIA649B2011EIA649B?gclid=EAiaIQobChMI6NS4yPOL6wIVxf7jBx0qGQxrEAAAYAiAAEgLSmPD_BwE

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SD-5 Market Research, Defense Standardization Program, Jan 2008

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<https://www.dsp.dla.mil/Programs/DMSMS>

Section L Guide - IG5315,204-5(b)

https://far.affinitext.com/public/book?id=18966&toc_id=5280626#PG_5280626_60386996

Section M Guide - IG5315,204-5(c)

https://far.affinitext.com/public/book?id=18966&toc_id=5280626#PG_5280775_60387757

SF 1403 Preaward Survey of Prospective Contractor

<http://www.acqnotes.com/Attachments/Standard%20Form%201403.pdf>

SF 1404 Preaward Survey of Prospective Contractor – Technical

<https://www.gsa.gov/forms-library/pre-award-survey-prospective-contractor-technical>

SF 1405 Preaward Survey of Prospective Contractor – Production

<https://www.gsa.gov/forms-library/pre-award-survey-prospective-contractor-technical>

SF 1406 Preaward Survey of Prospective Contractor – Quality Assurance

<https://www.gsa.gov/forms-library/pre-award-survey-prospective-contractor-quality-assurance>

SF 1407 Preaward Survey of Prospective Contractor – Financial Capability

<https://www.gsa.gov/forms-library/pre-award-survey-prospective-contractor-financial-capability>

SF 1408 Preaward Survey of Prospective Contractor – Contractor Accounting System

<https://www.gsa.gov/forms-library/pre-award-survey-prospective-contractor-financial-capability>

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<https://www.acq.osd.mil/fo/docs/Should-cost%20and%20Affordability.pdf>

Source Selection Procedure, DoD Memo, Apr 2016

<http://acqnotes.com/wp-content/uploads/2014/09/DoD-Source-Selection-Procedures-31-Mar-2016.pdf>

Strategic and Critical Materials Stockpiling Act, 1939

[https://uscode.house.gov/view.xhtml?req=\(title:50%20section:98%20edition:prelim\)](https://uscode.house.gov/view.xhtml?req=(title:50%20section:98%20edition:prelim))

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Supply Chain Operations Reference (SCOR) Model, Association for Supply Chain Management

<https://www.apics.org/apics-for-business/frameworks/scor>

Sustainability Analysis Guidance: Integrating Sustainability into Acquisition Life Cycle Assessment

<https://www.denix.osd.mil/esohacq/home/dod-guidance/dod-sustainability-analysis-guidance/OSD-ATL%20SA%20Guidance%20v5%20508%20Additions.pdf>

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Technology Readiness Assessment Guide, GAO Report: GAO-20-48G, Jan 2020

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<https://apps.dtic.mil/dtic/tr/fulltext/u2/a484102.pdf>

Test and Evaluation Management Guide (TEMG), DAU, Aug 2016

[https://www.dau.edu/tools/t/Test-and-Evaluation-Management-Guide-\(TEMG\)](https://www.dau.edu/tools/t/Test-and-Evaluation-Management-Guide-(TEMG))

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Appendix C: Tools

Tools identified in the M&Q BoK are listed below alphabetically and many contain a link to the referenced tools published by a U.S. Government entity and available in the public domain. If the tool is commercially available either for free or for a charge, the entry will direct the reader to *Internet Search*. Individual publishers may provide a short video on how to use the tool.

Acquisition Decision Memorandum (ADM) MDD Template

[https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-\(ADM\),-Materiel-Development-Decision-\(MDD\)-Template-v1-4](https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-(ADM),-Materiel-Development-Decision-(MDD)-Template-v1-4)

Acquisition Decision Memorandum (ADM) MDD Template, Milestone A

[https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-\(ADM\),-MS-A-Template-v1-4](https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-(ADM),-MS-A-Template-v1-4)

Acquisition Decision Memorandum (ADM) MDD Template, Milestone B

[https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-\(ADM\),-MS-B-Template-v1-4](https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-(ADM),-MS-B-Template-v1-4)

Acquisition Decision Memorandum (ADM) MDD Template, Milestone C

[https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-\(ADM\),-MS-C-Template-v1-4](https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-(ADM),-MS-C-Template-v1-4)

Acquisition Logistician's Assessment Checklist (Army)

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiRsPqKmdXtAhULIKwKHZ_IBX4QFjAAegQIAxAC&url=https%3A%2F%2Fwww.dau.edu%2Fcop%2Flog%2FDAU%2520Sponsored%2520Documents%2FArmy%2520Acquisition%2520Logistician%2520s%2520Assessment%2520Checklist%2520V5.0.doc&usg=AOvVaw2wved2qLjb0ZMNM6cyiBzL

Acquisition Logistics: An Assessment Tool (NAVSO P-3690)

<https://www.dau.edu/cop/log/DAU%20Sponsored%20Documents/NAVSO%20P%203690%20ILA%20Assess%20Tool%20Sep%2001.pdf>

Acquisition Plan Preparation Guide template

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjYzKf-p7TsAhVIT6wKHYfvA8oQFjAAegQIBBAC&url=http%3A%2F%2Fwww.acqnotes.com%2FAttachments%2FAcquisition%2520Plan%2520Preparation%2520Guide.doc&usg=AOvVaw1yKslG_VAKiWoUuIxnBO2C

Acquisition Strategy Outline

https://ac.cto.mil/wp-content/uploads/2019/06/PDUSD-Approved-TDS_AS_Outline-04-20-2011.pdf

Acquisition Strategy Template

<https://www.dau.edu/tools/t/Acquisition-Strategy-Template-v2-4>

Alternative System Review (ASR) Checklist

<http://acqnotes.com/acqnote/tasks/alternative-systems-review-2>

Appendix C: Tools

Analysis of Alternatives (AoA) Study Plan Template

[https://www.dau.edu/tools/t/Analysis-or-Alternatives-\(AoA\)-Study-Plan-Template-v2-0](https://www.dau.edu/tools/t/Analysis-or-Alternatives-(AoA)-Study-Plan-Template-v2-0)

AoA Study Guidance Template

[https://www.dau.edu/tools/t/Analysis-or-Alternatives-\(AoA\)-Study-Guidance-Template-v1-0](https://www.dau.edu/tools/t/Analysis-or-Alternatives-(AoA)-Study-Guidance-Template-v1-0)

AoA Study Plan Template

[https://www.dau.edu/tools/t/Analysis-or-Alternatives-\(AoA\)-Study-Plan-Template-v2-0](https://www.dau.edu/tools/t/Analysis-or-Alternatives-(AoA)-Study-Plan-Template-v2-0)

AS5553, Counterfeit Electronic Parts: Avoidance, Detection, Mitigation, and Disposition

Internet Search

AS6500, Manufacturing Management Program Checklist

Internet Search

AS9100, Quality Management System Checklist

Internet Search

AS9100, Quality Audit Checklist

Internet Search

AS9103, Variation Management of Key Characteristics Assessment

Internet Search

AS9133, Qualification Procedure for Standard Products (Supplier Audit) Checklist

Internet Search

AS9134, Supply Chain Risk Management Guidelines

Internet Search

AS9137, Advanced Quality Assurance Procedure (AQAP) Checklist

Internet Search

AS9145, Requirements for Advanced Product Quality Planning (APQP) and Production Part Approval Process (PPAP) Checklist

Internet Search

Assembly Chart

Internet Search

Assessment of Manufacturing Risk and Readiness, DI-SESS-81974

<http://www.dodmrl.com/DI-SESS-81974.pdf>

Automated Requirements Roadmap Tool (ARRT) Suite, DAU

[https://www.dau.edu/tools/t/Acquisition-Requirements-Roadmap-Tool-\(ARRT\)-Suite](https://www.dau.edu/tools/t/Acquisition-Requirements-Roadmap-Tool-(ARRT)-Suite)

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Award Fee Plan Checklist and Template

<https://www.acq.osd.mil/dpap/ccap/cc/jcchb/Files/Topical/1Restricted/award.fee.oct08.pdf>

Award Fee Sample Rating Definitions

<https://www.acq.osd.mil/dpap/ccap/cc/jcchb/Files/Topical/1Restricted/award.fee.oct08.pdf>

Award Fee Sample Evaluation Criteria

<https://www.acq.osd.mil/dpap/ccap/cc/jcchb/Files/Topical/1Restricted/award.fee.oct08.pdf>

Benchmarking

Internet Search

Bill of Material Assessment

Internet Search

Bill of Material Data Item Description - DI-PSSS-81656B

<https://www.dau.edu/cop/dmsms/Lists/Tools/DispForm.aspx?ID=48&ContentTypeId=0x0100AE321BA2819FFD499A441F9A8F574C1600A3866BA66DC4B546AF0E2614A20E809A>

Bottleneck Analysis (Theory of Constraints)

Internet Search

Capabilities-Based Assessment (CBA) Tool, DAU

<https://www.dau.edu/tools/t/CBA-Tool>

Capability Development Document (CDD) Template

<http://acqnotes.com/acqnote/acquisitions/capability-development-document-cdd>

Capacity Assessment Worksheet

Internet Search

Cash Flow Tool for Evaluating Alternative Finance Arrangement

<https://www.acq.osd.mil/dpap/policy/policyvault/USA005332-10-DPAP.pdf>

Cause and Effect Diagram

Internet Search

Contractor Purchasing System Review (CPSR)

<https://www.dcmamail.com/>

User must register on the DCMA 360 portal to obtain access

Cost Analysis Requirements Description (CARD) Guidance (see CAPE website for tools)

<http://acqnotes.com/acqnote/careerfields/cost-analysis-requirements-description>

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Cost Analysis Requirements Description (CARD) Template

[https://www.dau.edu/tools/t/Cost-Analysis-Requirements-Description-\(CARD\)-Template-v1-3](https://www.dau.edu/tools/t/Cost-Analysis-Requirements-Description-(CARD)-Template-v1-3)

Cost Estimating Technique – Analogy

<http://acqnotes.com/acqnote/careerfields/cost-estimating-methods>

Cost Estimating Technique – Parametric

<http://acqnotes.com/acqnote/careerfields/cost-estimating-methods>

Cost Estimating Technique – Engineering

<http://acqnotes.com/acqnote/careerfields/cost-estimating-methods>

Cost Estimating Technique – Actuals

<http://acqnotes.com/acqnote/careerfields/cost-estimating-methods>

Cost/Schedule Control System Criteria (C/SCSC) Reference Guide – DTIC

<https://apps.dtic.mil/dtic/tr/fulltext/u2/a258445.pdf>

Cost/Schedule Control System Criteria (C/SCSC) Guide and Checklist – DTIC

<https://www.secnav.navy.mil/rda/OneSource/Documents/CEVM/Tools%20and%20Examples/DOD%20Guides/BowmanInterpretiveGuide1.pdf>

Cost of Quality (CoQ) Estimates

Internet Search

Critical Chain Project Management

Internet Search

Critical Design Review (CDR) Checklist

<http://acqnotes.com/acqnote/acquisitions/critical-design-review>

Critical Path Template

Internet Search

Critical to Customer Template

Internet Search

Critical to Quality Tree Template

Internet Search

Cyber Security Assessment see Cyber Security Assessment see Cybersecurity & The Acquisition Lifecycle Integration Tool (CALIT)

[https://www.dau.edu/tools/t/Cybersecurity-and-Acquisition-Lifecycle-Integration-Tool-\(CALIT\)](https://www.dau.edu/tools/t/Cybersecurity-and-Acquisition-Lifecycle-Integration-Tool-(CALIT))

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DMCA Engineering Surveillance Plan

<https://www.dema.mil/Portals/31/Documents/Policy/DCMA-INST-207.pdf>

DCMA Industrial Capability Assessment Survey

<https://www.dema.mil/>

User must register on the DCMA 360 portal to obtain access

DCMA Manufacturing and Production Surveillance Plan

<https://www.dema.mil/Portals/31/Documents/Policy/DCMA-INST-204.pdf>

DCMA Manufacturing Systems Risk Assessment (MSRA) Checklist

<https://www.dema.mil/>

User must register on the DCMA 360 portal to obtain access

DCMA Material Management and Accounting System (MMAS) Audit

<https://www.dema.mil/Portals/31/Documents/Policy/DCMA-INST-211.pdf>

DCMA Pre-Award Survey System (PASS) review

<https://www.dema.mil/WBT/pass/>

DCMA Pre-Award Survey (SF 1403)

https://www.gsa.gov/reference/forms?search_keyword=SF%201403

DCMA Pre-Award Survey – Technical (SF 1404)

<https://www.gsa.gov/forms-library/pre-award-survey-prospective-contractor-technical>

DCMA Pre-Award Survey – Production (SF 1405)

https://www.gsa.gov/reference/forms?search_keyword=SF%201405

DCMA Pre-Award Survey – Quality Assurance (SF 1406)

https://www.gsa.gov/reference/forms?search_keyword=SF%201406

DCMA Pre-Award Survey – Financial Capability (SF 1407)

https://www.gsa.gov/reference/forms?search_keyword=SF%201407

DCMA Pre-Award Survey – Contractor Accounting System (SF 1408)

https://www.gsa.gov/reference/forms?search_keyword=SF%201407

DCMA Production Planning and Control Risk Assessment Checklist

<https://www.dema.mil/Portals/31/Documents/Policy/DCMA-INST-204.pdf>

DCMA Program Assessment Report

<https://www.dema.mil/Portals/31/Documents/Policy/DCMA-MAN-3101-02.pdf>

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DCMA Program Support Plan (DCMA-ANX 205-02)

<https://www.dema.mil/>

User must register on the DCMA 360 portal to obtain access

DMCA QA Surveillance Plan

<https://www.dema.mil/Portals/31/Documents/Policy/DCMA-INST-309.pdf>

Design Failure Modes and Effects Analysis (DFMEA)

Internet Search

Design for Affordability

Internet Search

Design for Manufacture and Assembly (DFMA)

Internet Search

Design for Performance

Internet Search

Design for Producibility

Internet Search

Design for Six Sigma (DFSS)

Internet Search

Design of Experiments (DoE)

Internet Search

Design of Experiments (DoE) Analysis

Internet Search

DFAR Subpart 232.10

https://www.acq.osd.mil/dpap/dars/dfars/html/current/232_10.htm

DMSMS Cost of Alternative Solutions Worksheet (see SD-22)

[https://www.dau.edu/tools/t/SD-22-Diminishing-Manufacturing-Sources-and-Material-Shortages-\(DMSMS\)-Guidebook](https://www.dau.edu/tools/t/SD-22-Diminishing-Manufacturing-Sources-and-Material-Shortages-(DMSMS)-Guidebook)

DMSMS Implementation Plan - DI-MGMT-81949

https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=280073

DMSMS Health Assessment Report

https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=283247

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Earned Value Management

[https://www.dau.edu/tools/t/EVM-General-Reference-\(Gold-Card\)](https://www.dau.edu/tools/t/EVM-General-Reference-(Gold-Card))

Failure Mode and Effects Analysis (FMEA)

Internet Search

Failure Modes, Effects, and Criticality Analysis (FMECA)

Internet Search

First Pass Yield Estimates Worksheet

Internet Search

First Article Inspection (FAI) Checklist, AFMC Form 260, First Article Requirements

<https://www.e-publishing.af.mil/Product-Index/#/?view=form&orgID=4&catID=9&low=200&high=299&modID=449&tabID=131>

First Article Test (FAT) Checklist

<https://www.dema.mil/Portals/31/Documents/Policy/DCMA-INST-302.pdf>

Functional Configuration Audit (FCA) Checklist (Air Force)

[Templates – USAF Acquisition Process Model \(afacpo.com\)](#)

Gantt Charts

Internet Search

Government Property Compliance Checklist (Navy)

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiyivT-sbnsAhVHuVkJHaU5Di0QFjAAegQIAhAC&url=http%3A%2F%2Fwww.secnnav.navy.mil%2Frd%2FDocuments%2FCompliance%2520Checklist.xlsx&usg=AOvVaw0Jec3r4-gNaxYYoLYbcDLM>

Histograms

Internet Search

IEEE 15288.1-2014, Application of Systems Engineering on Defense Programs

Internet Search

IEEE 15288.2-2014, Technical Reviews and Audits on Defense Programs

Internet Search

IG5315.204-5(b), Section L Guide and Template

https://far.affinitext.com/public/book?id=18966&toc_id=5280626#PG_5280626_60386996

IG5315.204-5(c), Section M Guide and Template

https://far.affinitext.com/public/book?id=18966&toc_id=5280779#PG_5280779_60387780

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Incentive Fee Template

<https://www.dau.edu/tools/t/FPIF-CPIF>

Independent Logistics Assessment Checklist (MCSC)

https://www.dau.edu/cop/log/_layouts/15/WopiFrame.aspx?sourcedoc=/cop/log/DAU%20Sponsored%20Documents/MCSC%20ILA%20Checklist%20v3%206AUG09.xls&action=default

Independent Technical Risk Assessments (ITRAs) Execution Guidance

<https://ac.cto.mil/wp-content/uploads/2020/12/DoD-ITRA-ExecGuide-2020s.pdf>

Industrial Base Assessment Survey Form (DCMA Industrial Analysis Group)

Internet Search

Industrial Base Sector Plans (no specific tool)

Internet Search

Initial Capabilities Document (ICD) Template (on page 2 of ICD Writers Guide

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiz0K6U09XtAhUNWq0KHYuuAMEQFjABegQIARAC&url=http%3A%2F%2Fwww.acqnotes.com%2FAttachments%2FCapability%2520Development%2520Document%2520Template%252030%2520Oct%252012.doc&usg=AOvVaw167Ffrt1uVVB8BdH4AjRAj>

In-Service Review (Checklist)

[In-Service Review - AcqNotes](#)

Integrated Master Plan/Integrated Master Schedule (IMP/IMS)

Internet Search MS Project

Interactive MRL Users Guide (Checklist)

<http://www.dodmrl.com/>

Initial Capabilities Document (ICD) Template

<http://acqnotes.com/acqnote/acquisitions/initial-capabilities-document-icd>

ISO 9001, Quality Management Systems, Quality Audit Checklist

Internet Search

ISO 14001, Gap Analysis Checklist

Internet Search

ITAR Compliance Checklist

Internet Search

Lead Time Estimator

Internet Search

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Learning Curve Calculator (Estimator)

<https://www.dau.edu/tools/t/Learning-Curve-QuickCalc>

Learning Curve Estimation (M&S Software)

Internet Search

Learning Curve Worksheet (in Excel)

Internet Search

Life Cycle Sustainment Plan outline

[https://www.dau.mil/tools/t/Life-Cycle-Sustainment-Plan-\(LCSP\)-Outline](https://www.dau.mil/tools/t/Life-Cycle-Sustainment-Plan-(LCSP)-Outline)

Life Cycle Sustainment Plan template (AFLCMC)

[https://www.dau.mil/tools/Lists/DAUTools/Attachments/56/Life%20Cycle%20Sustainment%20Plan%20\(LCSP\)%20%20Outline%20AFLCMC%20ADDM%20Template%20v2.docx](https://www.dau.mil/tools/Lists/DAUTools/Attachments/56/Life%20Cycle%20Sustainment%20Plan%20(LCSP)%20%20Outline%20AFLCMC%20ADDM%20Template%20v2.docx)

Line of Balance Template

Internet Search

Logistics Assessment Guidebook (DAU), Appendix A: Integrated Product Support Element

<https://www.dau.edu/tools/t/Logistics-Assessment-Guidebook>

Long Lead Times Material Report, DI-PSSS-82201

<https://standards.globalspec.com/std/10291122/di-psss-82201>

Make/Buy Plans/Decision

Internet Search

ManTech Roadmap

Internet Search

ManTech Strategic Plan

Internet Search

Manufacturing Capability Assessment Worksheet

Internet Search

Manufacturing Cost Estimating Worksheet (commercial)

Internet Search

Manufacturing Maturation Plan (see MRL Deskbook)

<http://www.dodmrl.com/>

Manufacturing Plan, DI-MGMT-81889A

http://everyspec.com/DATA-ITEM-DESC-DIDs/DI-MGMT/DI-MGMT-81889A_55798/

Appendix C: Tools

Manufacturing Resource Planning (MRP II)

Internet Search

Manufacturing Resource Planning (MRPII) Assessment

Internet Search

Manufacturing Technology (ManTech) Report, DI-MISC-81176A

http://everyspec.com/DATA-ITEM-DESC-DIDs/DI-MISC/DI-MISC-81176A_13522/

Manufacturing Strategy (no template available)

Internet Search

Market Research (DAU)

<https://www.dau.edu/tools/t/Market-Research-Methods>

Market Research Report Template

<https://www.dau.edu/tools/t/Market-Research-Report-Template-v1-1>

Material Forecasting Models

- Qualitative Forecasting
 - Executive Opinion
 - Sales Forecast Composite
 - Consumer Market Survey
 - Delphi
 - Group Discussion
- Quantitative Forecasting
 - Time Series
 - Regression Modeling

Internet Search

Material Management and Accounting System (MMAS) Audit

[https://www.dcaa.mil/Portals/88/Documents/Guidance/Directory%20of%20Audit%20Programs/12500%20Material%20Management%20and%20Accounting%20System%20\(MMAS\)%20AP.pdf?ver=2020-07-01-133628-443](https://www.dcaa.mil/Portals/88/Documents/Guidance/Directory%20of%20Audit%20Programs/12500%20Material%20Management%20and%20Accounting%20System%20(MMAS)%20AP.pdf?ver=2020-07-01-133628-443)

Material Requirements Planning (MRP I)

Internet Search

Materials Requirements Planning (MRP) Assessment

Internet Search

Material Development Decision (MDD) ADM Template

[https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-\(ADM\)-Material-Development-Decision-\(MDD\)-Template-v1-4](https://www.dau.edu/tools/t/Acquisition-Decision-Memorandum-(ADM)-Material-Development-Decision-(MDD)-Template-v1-4)

Appendix C: Tools

Materiel Development Decision (MDD) ADM Template (Air Force)

<https://www.afacpo.com/apm/core-documents/templates/>

Materiel Development Decision (MDD) Development Planning Templates

<https://www.afacpo.com/apm/core-documents/templates/>

Milestone Charts (Program)

Internet Search

Multi-Attribute Tradespace Exploration (MATE) (see MIT Thesis)

Internet Search

Operational Test Readiness Review (OTRR) Checklist

<http://acqnotes.com/acqnote/acquisitions/operational-test-readiness-review>

Operations Process Chart

Internet Search

Pareto Analysis

Internet Search

Parts List

Internet Search

Performance-Based Payments Guide

[https://www.acq.osd.mil/dpap/cpic/cp/docs/Performance_Based_Payment_\(PBP\)_Guide.pdf](https://www.acq.osd.mil/dpap/cpic/cp/docs/Performance_Based_Payment_(PBP)_Guide.pdf)

PERT/Network Charts

Internet Search

Pilot Line Demonstration and Assessment

Internet Search

Plant Design and Facility Layout Software Evaluation Tools

Internet Search

Plant Modeling and Simulation tools (FlexSim, SimFactory, etc.)

Internet Search

Pre-award Survey – Technical (SF 1404)

<http://www.acqnotes.com/Attachments/SF%201404%20Preaward%20Survey%20of%20Prospective%20Contractor%20-%20Technical.pdf>

Appendix C: Tools

Pre-award Survey – Production (sf 1405)

<http://www.acqnotes.com/Attachments/SF%201405%20Preaward%20Survey%20of%20Prospective%20Contractor%20-%20Production.pdf>

Pre-award Survey – Quality Assurance (SF 1406)

<http://www.acqnotes.com/Attachments/SF%201406%20Preaward%20Survey%20of%20Prospective%20Contractor%20-%20Quality%20Assurance.pdf>

Pre-award Survey – Financial Capability (SF 1407)

<http://www.acqnotes.com/Attachments/SF%201407%20Preaward%20Survey%20of%20Prospective%20Contractor%20-%20Financial%20Capability.pdf>

Preliminary Hazard List (PHL) (*See MIL-STD-882E, Task 201*)

<https://www.dau.edu/cop/armyesh/DAU%20Sponsored%20Documents/MIL-STD-882E.pdf>

Preliminary Hazards Analysis (PHA) (*See MIL-STD-882E, Task 202*)

<https://www.dau.edu/cop/armyesh/DAU%20Sponsored%20Documents/MIL-STD-882E.pdf>

Preservation, Handling, Storage, Packaging and Delivery (PHSPD) Checklist

Internet Search

Process Capability Studies (Cp and Cpk assessment)

Internet Search

Process Capability Study Worksheet (Cp and Cpk Assessment)

Internet Search

Process Control Document (PCD)

Internet Search

Process Control Plan Worksheet

Internet Search

Process Failure Modes and Effects Analysis (PFMEA)

Internet Search

Process Modeling Tools (Siemens PLM, Delmia)

Internet Search

Producibility Assessment Worksheet (PAW) (see NAVSO P-3687, page F-20)

<https://www.dau.edu/cop/pqm/DAU%20Sponsored%20Documents/NAVSO%20P%203687.PDF>

Producibility Engineering and Planning (PEP) Data Item Description – DI- MGMT-80797A

http://everyspec.com/DATA-ITEM-DESC-DIDs/DI-MGMT/DI-MGMT-80797_4277/

Appendix C: Tools

Production Part Approval Process (PPAP), see AS9137 Advanced Quality Assurance Procedure (AQAP)

Internet Search

Production Part Approval Process (PPAP) Checklist

Internet Search

Production Plan (schedule)

Internet Search

Production Readiness Review (PRR) Checklist

Internet Search

Production Verification Test

Internet Search

Product Support Business Case Analysis Guidebook Appendix A BCA Checklist

[https://www.dau.edu/tools/t/Product-Support-Business-Case-Analysis-\(BCA\)-Guidebook](https://www.dau.edu/tools/t/Product-Support-Business-Case-Analysis-(BCA)-Guidebook)

Product Support Strategy Development Tool, Defense Acquisition University (DAU)

<https://www.dau.edu/guidebooks/Shared%20Documents/Product%20Support%20Strategy%20Development%20Tool.pdf>

Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE) Template

<https://www.dau.mil/cop/pm/DAU%20Sponsored%20Documents/PESHE%20AFLCMC%20ADDM%20Template%20v2.1.docx>

Progress-Based Payments Tool (recommend changing to Performance Based Payments Analysis Tool (DAU)

<https://www.dau.edu/tools/t/Performance-Based-Payments-Analysis-Tool>

Pugh Matrix Template

Internet Search

Quality Assurance Program Plan, DI-QCIC-81794

http://everyspec.com/DATA-ITEM-DESC-DIDs/DI-QCIC/DI-QCIC-81794_20418/

Quality Assurance Provisions, DI-SESS-80789A

http://everyspec.com/DATA-ITEM-DESC-DIDs/DI-QCIC/DI-QCIC-81794_20418/

Quality Function Deployment (QFD) or House of Quality Matrix

Internet Search

Quality Function Deployment (QFD) Excel Spreadsheet

Internet Search

Appendix C: Tools

Quality Management Plan (Sample)

Internet Search

Quality Management System (QMS), DI-MGMT-82184

https://quicksearch.dla.mil/qaDocDetails.aspx?ident_number=282795

Quality Program Plan, DI-QCIC-81722

http://everyspec.com/DATA-ITEM-DESC-DIDs/DI-QCIC/DI-QCIC-81722_43871/

Quality Status Report, DI-MGMT-82186

https://quicksearch.dla.mil/qaDocDetails.aspx?ident_number=282783

Requirements Roadmap Worksheet, DAU

https://www.dau.edu/tools/Documents/SAM/resources/Requirements_Roadmap.html

Requirements Traceability Matrix Template, DAU

https://www.dau.edu/tools/Documents/SAM/resources/RTM_Risk_Register.html

Risk, Issue, and Opportunity (RIO) Management Guide for Defense Acquisition Programs (DoD)

<http://acqnotes.com/wp-content/uploads/2017/07/DoD-Risk-Issue-and-Opportunity-Management-Guide-Jan-2017.pdf>

Risk, Issue, and Opportunity (RIO) assessment

Internet Search

Risk Management Plan Template – DAU

<https://www.dau.edu/tools/t/Risk-Management-Plan-Template-2017>

Robust Design (Taguchi)

Internet Search

Rough Cut Capacity Planning Spreadsheet

Internet Search

Route Sheet

Internet Search

Route Sheet Analysis

Internet Search

Safety and Industrial Hygiene Hazard Assessment Checklist

<https://www.dla.mil/Portals/104/Documents/Strategic%20Materials/IATK/Copy%20of%20Safety%20and%20health%20checklist%20Strategic%20Materials.pdf?ver=2015-09-23-114310-987>

Appendix C: Tools

Shop Floor Manufacturing Plan Analysis

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Six Sigma Worksheet

Internet Search

Solid modeling and analysis software programs (e.g., NX, CATIA, Pro-Engineer, Nastran add-ins)

Internet Search

Source Selection Plan Template (USMC)

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiOiba-i8bsAhUCR6wKHfTRAGsQFjAAegQIBRAC&url=https%3A%2F%2Fwww.quantico.marines.mil%2FPortals%2F147%2FDocs%2FRCO%2FSource%2520Selection%2520Plan%2520Template.doc&u sg=AOvVaw0v19l6mRIO1PqWG6r6zOWY>

Supplier Quality Questionnaire

Internet Search

Supply Chain Management Risk Assessment Checklist

Internet Search

Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis

Internet Search

System Capabilities Analytic Process (SCAP)

<https://apps.dtic.mil/dtic/tr/fulltext/u2/a539905.pdf>

Systems Engineering Management Plan, DI-SESS-81785A

http://everyspec.com/DATA-ITEM-DESC-DIDs/DI-SESS/DI-SESS-81785A_53778/

Systems Engineering Plan (SEP) Outline

<http://acqnotes.com/acqnote/acquisitions/systems-engineering-plan>

Systems and Software Engineering–System Life Cycle Processes, ISO/IEC/IEEE 15288

Internet Search

System Verification Review (SVR) Checklist

[http://acqnotes.com/acqnote/acquisitions/system-verification-review-svr#:~:text=The%20System%20Verification%20Review%20\(SVR,and%20Development%20\(EMD\)%20Phase.](http://acqnotes.com/acqnote/acquisitions/system-verification-review-svr#:~:text=The%20System%20Verification%20Review%20(SVR,and%20Development%20(EMD)%20Phase.)

Taguchi Loss Function Analysis

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Appendix C: Tools

Technology Readiness Assessment Calculator

<https://www.dau.edu/cop/stm/Lists/Tools/AllItems.aspx>

Technology Readiness Assessment Guide (Best Practices) (Report GAO-20-48G)

<https://www.gao.gov/products/GAO-20-48G>

Technology Readiness Level (TRL) Assessment Checklist

Internet Search

Test and Evaluation Master Plan (TEMP) Guidebook

<http://www.acqnotes.com/Attachments/DOT&E%20and%20TEMP%20Guidebook%20-%2028%20Mar%202013.pdf>

Test and Evaluation Master Plan (TEMP) template

[https://www.dau.edu/tools/t/Test-and-Evaluation-Master-Plan-\(TEMP\)-Template--v3-0](https://www.dau.edu/tools/t/Test-and-Evaluation-Master-Plan-(TEMP)-Template--v3-0)

Test Readiness Review (TRR) Checklist

<http://acqnotes.com/acqnote/careerfields/test-readiness-review-te>

Theory of Inventive Problem Solving (TRIZ) Matrix

Internet Search

Tolerance Design

Internet Search

Transition from Development to Production, DoD 4245.7-M

<https://apps.dtic.mil/dtic/tr/fulltext/u2/a303209.pdf>

TRIZ Matrix Template

Internet Search

Work Breakdown Structure (Template)

Internet Search

Work Measurement Analysis

Internet Search

Work Measurement Time Study Worksheet (DD Form 2042-1)

<https://www.esd.whs.mil/Portals/54/Documents/DD/forms/dd/dd2042-1.pdf>

Workforce Planning Tools (SAP/Oracle/MRP II)

Internet Search

Yield Rate Assessment

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Department of Defense Manufacturing and Quality Body of Knowledge (M&Q BoK)

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