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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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 Executive Director, Systems Engineering and Architecture (ED, SE&A) 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 Engineering and Technical Management (ETM) practitioners and 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.
- **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.

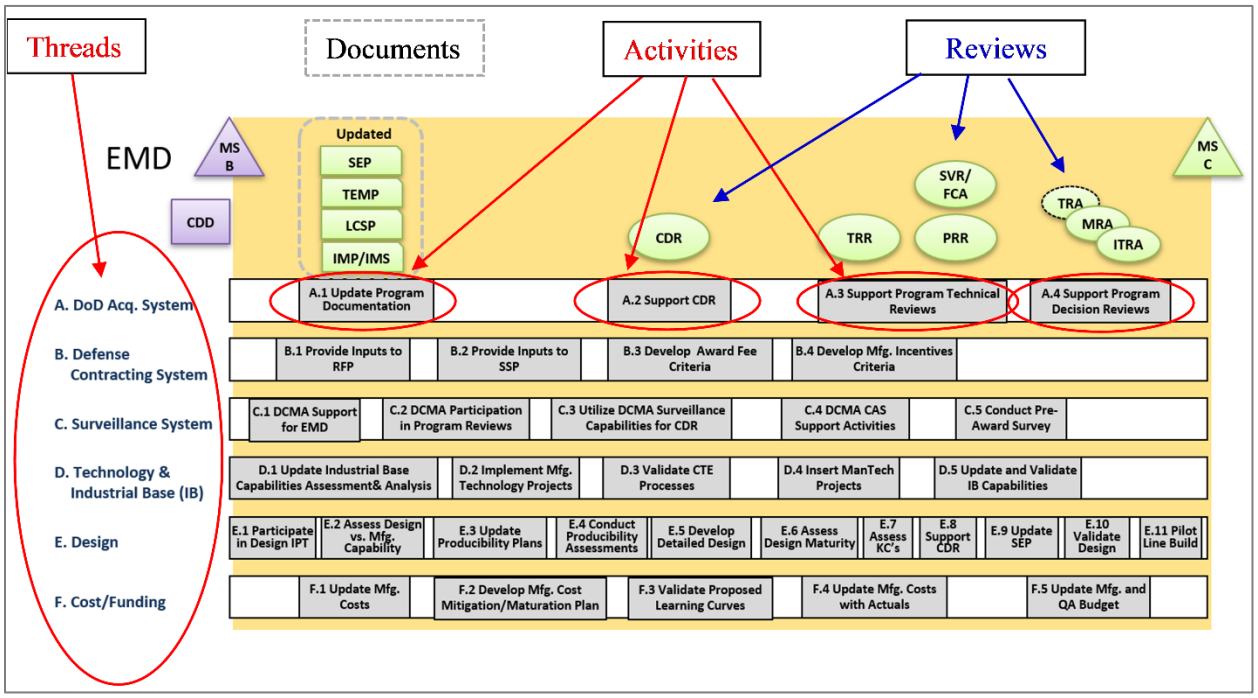
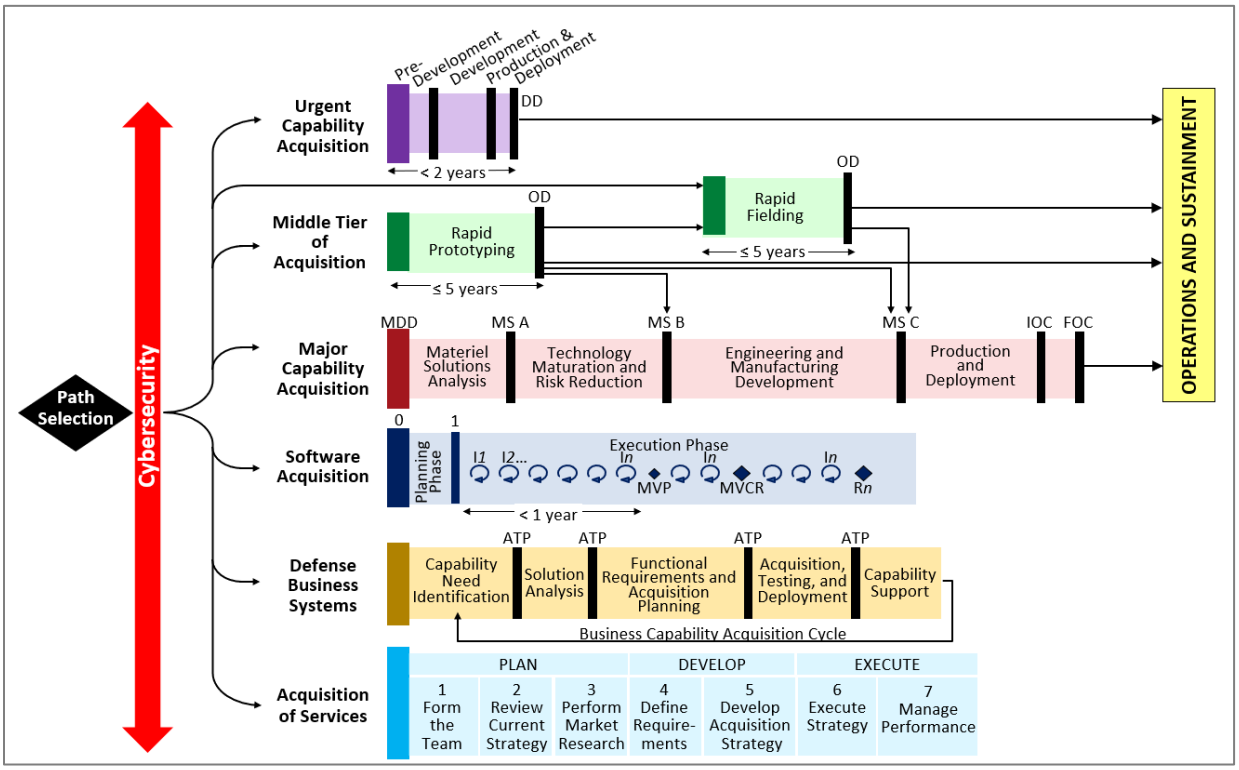


Figure 1. Sample Activity Chart

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 (MCA). 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 pathways as well. AAF pathways 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 (UCA) 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 MCA 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
- 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

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

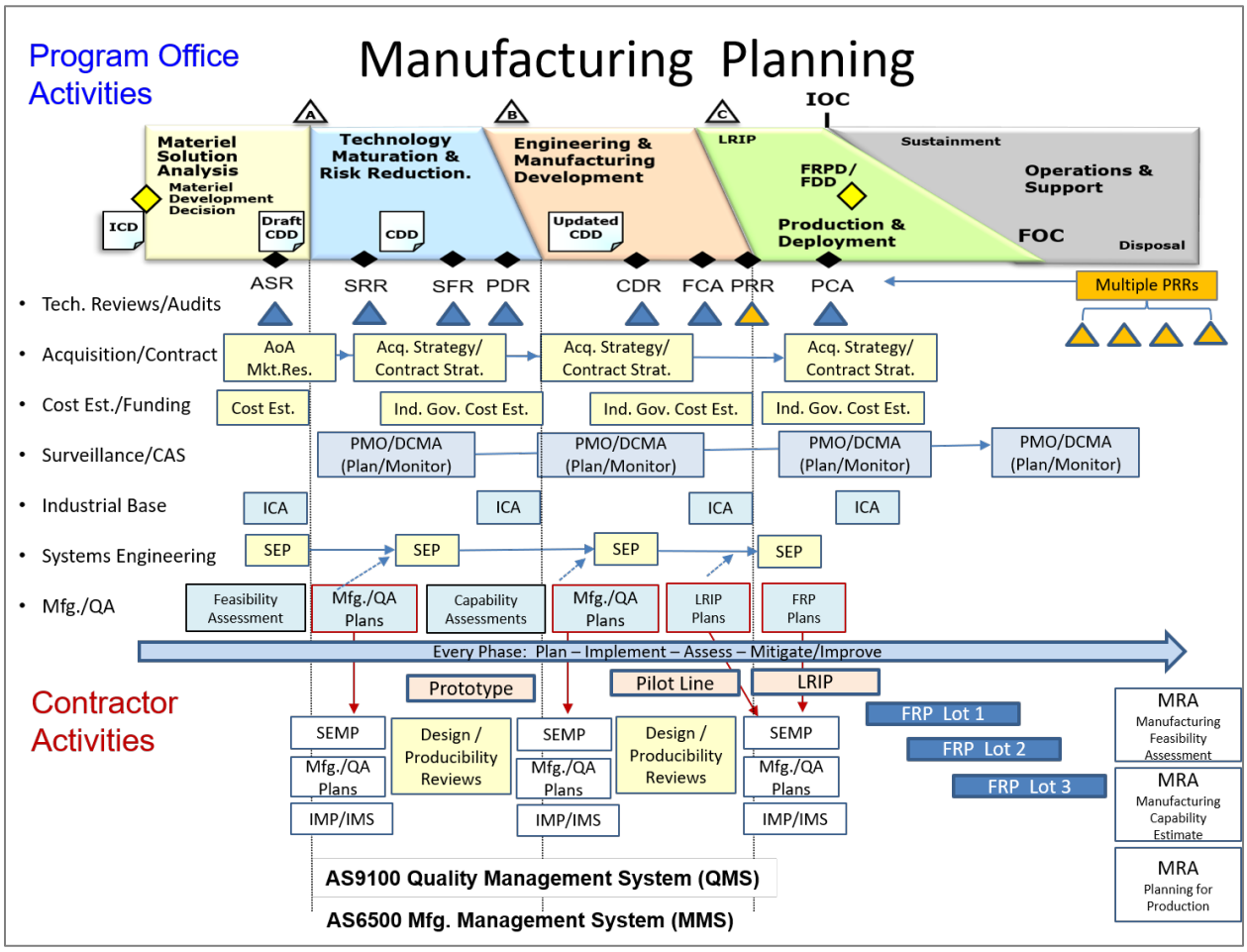


Figure 3. Typical Manufacturing and Quality Planning Activities

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 occur. 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) or other contract surveillance organizations and engineering support activities, 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-HDBK-896, Manufacturing Management Program Guide; SAE Standard AS6500, Manufacturing Management Program; and Quality Management Systems standards ISO 9100 and/or AS9100. In addition, MRL criteria and assessments are a best practice for identifying and mitigating M&Q risks across the system life cycle. As a best practice, DoD ETM practitioners and 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. The following section includes a summary of key references and links by publisher or topic. A more comprehensive list of references is included in Appendix B.

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 Adaptive 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 5000.93, Use of Additive Manufacturing in the DoD
- DoD Instruction 5000.94, Use of Robotic Systems for Manufacturing and Sustainment in the DoD
- 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

- DAU Guidebooks and References https://aaf.dau.edu/guidebooks/
- Acquisition Notes (AcqNotes) www.acqnotes.com
- Adaptive Acquisition Framework (AAF) https://aaf.dau.edu
- Analysis of Alternatives (AoA) www.acqnote/acquisitions/analsis-of-alternatives
- Market Research www.acqnotes/acqnote/acquisitions/market-research
- Acquisition Strategy (AS) Process/Guidance https://ac.cto.mil/wp-content/uploads/2019/06/PDUSD-Approved-TDS_AS_Outline-04-20-2011.pdf
- Systems Engineering Plan (SEP) Outline https://ac.cto.mil/erpo/ (Engineering Guidance tab)
- 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

Federal Acquisition Regulation (FAR) https://www.acquisition.gov/
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-896, 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
- NIST Manufacturing https://www.manufacturing.gov

Office of the Director, Cost Assessment and Program Evaluation (CAPE) www.cape.osd.mil
OSD Manufacturing Technology (ManTech) Program Office https://www.dodmantech.mil
OUSD(R&E) Systems Engineering and Architecture (SE&A) https://ac.cto.mil/engineering
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 activities are 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.

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.

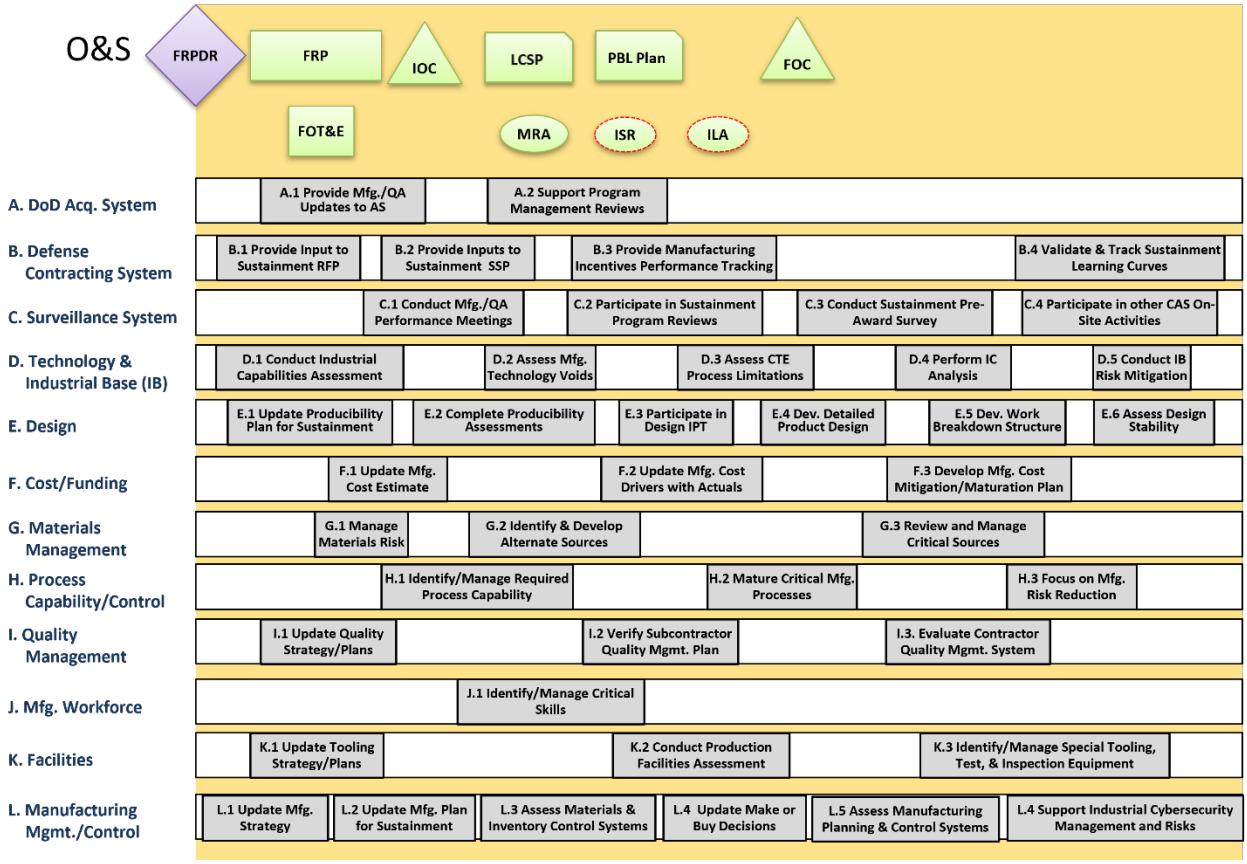


Figure 6-1. O&S Phase Manufacturing and Quality Activities

Key Program Phase Reviews, Documentation, and Activities

The O&S phase begins after the Production and Deployment milestone decision supported by the program's LCSP. 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 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:

- 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)

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 (QMS)
- 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
- Disposal and demil at the end of its useful life

A. DOD ACQUISITION SYSTEM

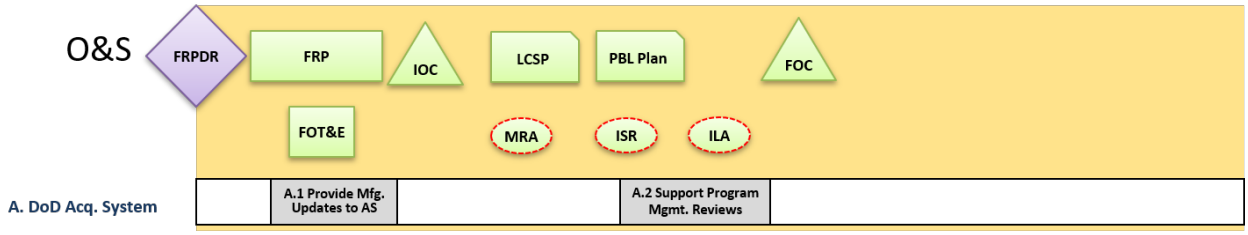


Figure 6-2. DoD Acquisition System Manufacturing and Quality Activities

Introduction

Sustainment planning, including the requirements in 10 USC 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 USC 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 is 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)

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 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.
- 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)**
  - Product Support Strategy
  - 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.
- Support the development and implementation of the Product Support Strategy (PSS) as detailed in the 12 step Product Support Model
- 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.
- 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
- Manufacturing should help to assess field R&M data to evaluate the impact of M&Q activities on field failures. Assess using Fault Tree Analysis (FTA), 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 (DMSMS)
    - 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
- DoD Product Support Managers Handbook
- AS6500, Manufacturing Management Program
- AS9100, Quality Systems–Aerospace
- CJS JCIDS 3170.01, JCIDS System

- 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
- 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
- DoD Systems Engineering Guidebook
- 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)
  - 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.

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

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

B. DEFENSE CONTRACTING SYSTEM

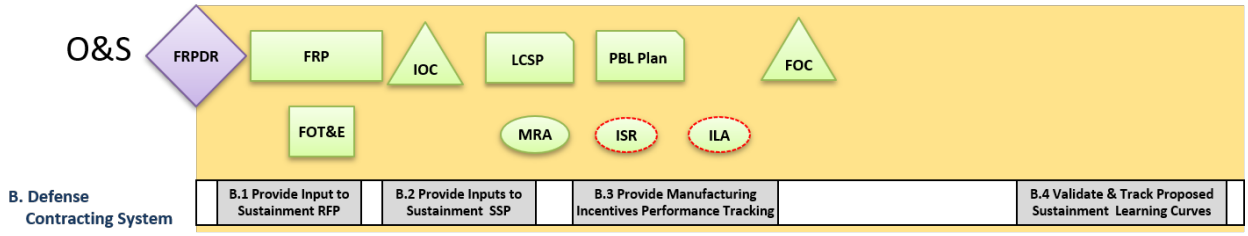


Figure 6-3. Defense Contracting System Manufacturing and Quality Activities

Introduction

DoD contracting requirements and activities are required by the FAR/DFAR and by many DoD, Service and Agency regulations, policies, and guidance documents.

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).

Market Research is a pre-solicitation activity that involves the evaluation of the market's ability to satisfy the user needs. M&Q personnel need to support market research to identify suppliers and evaluate potential sources and opportunities to assess the risks associated with these opportunities. During this phase, programs are often faced with Diminishing Manufacturing Sources and Material Shortages (DMSMS), obsolescence, counterfeit and other supply chain issues, making the finding of alternative sources a priority. Market Research can be conducted at the weapon system, subsystem, component, or part level and during any phase,

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 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.

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 USC 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 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. Performance-based payment events should be used as effective M&Q 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 sub-factors 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 RFP to ensure it contains the following item:
    - 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)
- 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
    - Identify 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
  - Pre-award survey
  - 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:
  - 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.

Tools

- AS6500, Manufacturing Management System Checklist
- AS9100, Quality Management System Checklist
- 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
- DCMA Pre-Award Survey System (PASS)
- SF 1403 DCMA Pre-Award Survey General
- SF 1404 DCMA Pre-Award Survey Technical
- SF 1405 DCMA Pre-Award Survey Production
- SF 1406 DCMA Pre-Award Survey Quality Assurance
- SF 1407 DCMA Pre-Award Survey Financial Capability

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
- DoD Systems Engineering Guidebook
- 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
- AFMC Inst 23-113 Pre-Award Qualification of New or Additional Parts Sources
- DCMA Pre-Award Survey Guide
- Pre-Award Survey User's Manual

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 that 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. The 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 SSP. 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 (source selection team should include M&Q)
    - Security (data, communications and personnel)
    - Pre-solicitation Activities
    - Major Source Selection Events including Visits
    - Evaluation Factors and Sub-factors (should include some M&Q)
    - 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.

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

- DoD Product Support Managers Handbook
- Air Force Contract Sustainment Support Guide
- AS6500, Manufacturing Management System
- AS9100, Quality Management System

- DoD Systems Engineering Guidebook
- 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 System 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.
- 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 at 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)

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
- DoD Systems Engineering Guidebook
- 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.

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.
- 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.

Tools

- Application of Learning Curve Theory, DAU
- 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
- DoD Systems Engineering Guidebook
- 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

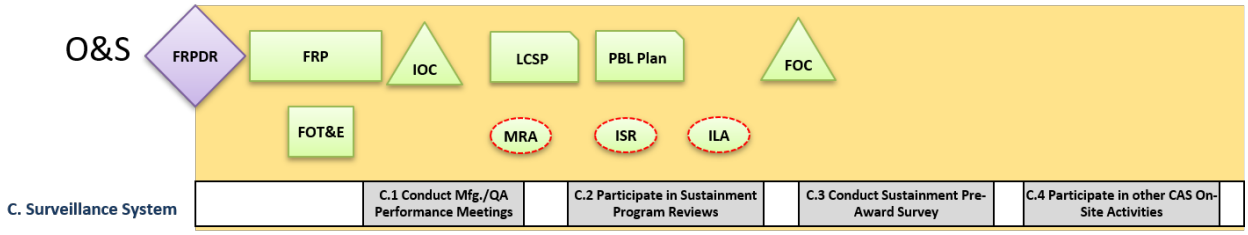


Figure 6-4. Surveillance System Manufacturing and Quality Activities

Introduction

The purpose of contract administration is to ensure that the contractor performs in accordance with the terms and conditions of the contractual agreement (surveillance). DoD contractor surveillance requirements and activities are required by the FAR/DFAR and by many DoD, Service and Agency regulations, policies, and guidance documents. DFAR Part 242.2 Contract Administration Services and DFAR Part 242.3, Contract Administration Office Functions, and PGI 242.3 Contract Administration Functions outlines the 70 CAS functions that are required and the many that may require M&Q support in order to accomplish. M&Q personnel often are called upon to support numerous CAS functions and activities.

Often these activities may be performed under mutual agreement by the program office and DCMA. In many cases these contractor surveillance activities may be performed by on-site program office contract administrators, delegated Service contract surveillance offices, or a variety of engineering support activities (i.e., supervisor of shipbuilding (SUPSHIP), development command field activities).

The PM and PMO should use to the extent possible available personnel from DCMA 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
- Engineering
- Production
- Quality

CAS functions may 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 the program changes contractors. If so, it is important to gain a thorough understanding of their capability, capacity, and financial stability using 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 LCSP.

Major Defense Acquisition Programs (MDAPs) undergo Independent Logistics Assessments (ILAs) before Milestones B and C and the Full-Rate Production Decision to assess the adequacy of the product support strategy and to identify features 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 focus on sustainment planning and execution, including the core logistics analyses and establishment of organic capabilities.

After IOC, the DoD Components will continue to conduct 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 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 multidisciplined 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.

Programs achieve product or service quality by implementing a strategic plan to integrate all business and technical functions, resulting 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 delivery of non-conforming products and 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
- Ensure the contractor has established and implemented a Material Management and Audit System (MMAS).
- Ensure 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.).

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
- DoD Systems Engineering Guidebook
- 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,
- 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
- DoD Product Support Managers Handbook

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
    - 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.

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 Systems Engineering Guidebook
- DoD Product Support Managers Handbook
- 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 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.

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
- 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 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.
- 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.

Tools

- DCMA Manufacturing and Production Surveillance Plan
- DMCA Engineering Surveillance Plan
- DMCA Program Support Plan
- DMCA QA Surveillance Plan

- Interactive MRL Users Guide (Checklist)
- 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
- DoD Systems Engineering Guidebook
- ISO 9001, Quality Management System

D. TECHNOLOGY AND INDUSTRIAL BASE

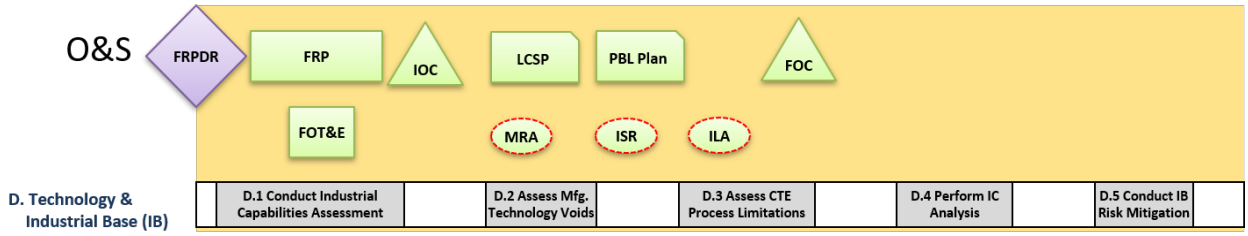


Figure 6-5. Technology and Industrial Base Manufacturing and Quality Activities

Introduction

10 USC 2440 requires the Secretary of Defense to consider the National Technology and Industrial Base (NTIB) in the development and implementation of acquisition plans for each MDAP. The NTIB consists of the people and organizations engaged in national security and dual-use research and development (R&D), production, maintenance, and related activities within the United States, Canada, the United Kingdom, and Australia. Acquisition planning and plans must include considerations of the NTIB for all MDAPs, for example:

- The ability to support development and production (rates and quantities)
- The identification of IB risks in the supply chain
- The identification of single points of failure in the supply chain (sole source, foreign source, etc.)
- Support for a resilient supply base for critical defense capabilities
- Support for procurement surges and contractions

This thread (Technology and Industrial Base) requires an analysis of the capabilities of the NTIB to support the design, development, production, operation, uninterrupted maintenance support of the system, and eventual disposal (including environmentally conscious manufacturing). This thread will focus on the following sub-threads, tasks, activities, tools, and resources:

- Industrial Base Assessments (IBAs)
- Industrial Base Risks
- Critical Enabling Technologies
- ManTech Projects
- Industrial Base Mitigation Plans

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.

- 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 R&D 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. They should 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 USC 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 U.S. defense forces. As a member of the IPT, the program office should lead and support assessments of the impact 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 U.S. 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 (DMSMS)
  - Counterfeit parts
  - Replacement of limited-life items
  - Regeneration options for unique manufacturing processes
  - Conversion to performance specifications at the subsystems, component, and spares levels

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
- DoD Systems Engineering Guidebook
- 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.
- 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.

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-3687Producibility 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 R&D 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.
- Assess maturity of the technology and manufacturing processes.
- Participate in product and process assessments.

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
- DoD Systems Engineering Guidebook
- 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:
    - 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

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
- DoD Systems Engineering Guidebook
- 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 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.

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
- DoD Systems Engineering Guidebook
- DoD Product Support Managers Handbook
- MRL Deskbook, Chapter 5.2 Development of a Manufacturing Maturation Plan

E. DESIGN

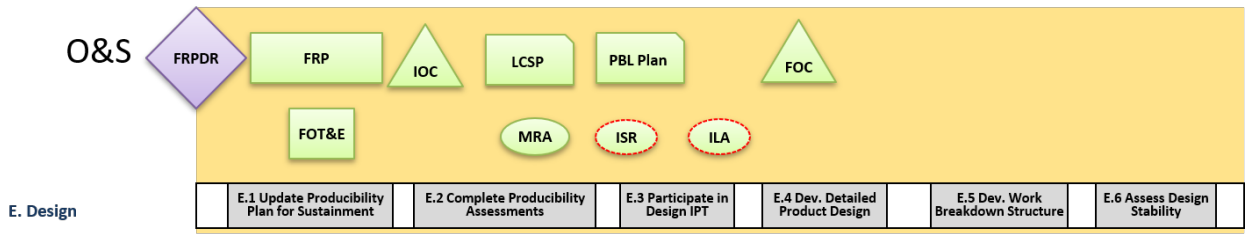


Figure 6-6. Design Manufacturing and Quality Activities

Introduction

DoD Systems Engineering (SE) is a disciplined approach for the specification, design, development, realization, technical management, operation, and retirement of a weapon system. SE is an interdisciplinary and collaborative effort requiring close interaction with many disciplines to include operations, maintenance, logistics, test, production, quality, etc. SE accomplishes these activities by focusing on eight technical processes and eight technical management processes. M&Q personnel need to support these SE activities. M&Q personnel need to support these SE activities.

Manufacturing and quality personnel participation in the program's systems engineering process as a part of the IPTs is critical to succeeding in producibility 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.

During the O&S phase, M&Q should be assessed to support all sustainment activities and concerns. Sustainment activities supporting system operations should address two major efforts: life cycle sustainment and disposal. This includes continued production and design activities associated with technology refresh, life-extension modifications, value engineering activities, Preplanned Product Improvements (P3I), 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.

The producibility engineering and planning (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.

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.

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 O&S phase, systems engineering processes support sustainment efforts using In-Service Reviews (ISRs). ISRs include the identification of root causes of field and other problems, and the development of mitigation strategies for safety and critical readiness on these problems that are degrading performance. Mitigation activities could include the participation in trade studies and decisions making (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 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.
- During the sustainment effort of the O&S phase, systems engineering processes support
- 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 facilitate disposal.

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. They have numerous opportunities to do so, such as during teleconferences, Program Management Reviews, and fact findings. The effort is not confined to contractors, as personnel can encourage internal improvements at depots and within the program office.

E.1 Update Producibility Plan for Sustainment

PEP 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 to the Product Support Strategy (PSS)
- 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.
- 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.
- Product Support Strategy has been updated
- 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

- DoD Life Cycle Sustainment Plan Content Guide
- DoD Life Cycle Sustainment Plan Outline
- DoD PBL Guidebook
- AS9100 Checklist
- AS6500 Checklist
- Interactive MRL Users Guide (Checklist) for the Design thread
- Manufacturing Maturation Plan
- Producibility Engineering and Planning (PEP) Data Item Description

Resources

- 10 USC 2441 Sustainment Reviews
- 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
- DoD Systems Engineering Guidebook

- DoD Product Support Managers Handbook
- MRL Deskbook
- NAVSO P-3687 Producibility System Guidelines
- 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

- AS9100 Checklist
- AS6500 Checklist
- CAD/CAM software
- Producibility Assessment Worksheet
- Interactive MRL Users Guide (Checklist), Design thread
- Manufacturing Maturation Plan

Resources

- DoDI 5000.88, Engineering of Defense Systems
- DoD Systems Engineering Guidebook
- 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 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 (FTA, FMEA, PFMEA, etc.) or on field failures (FRACAS, etc.).

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 4 – Life Cycle Sustainment
- DoDI 5000.85, Major Capability Acquisition
- DoDI 5000.88, Engineering of Defense Systems
- DoD Systems Engineering Guidebook
- 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).

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
- 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
- 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)

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
- DoD Systems Engineering Guidebook
- 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 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.).

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
- 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

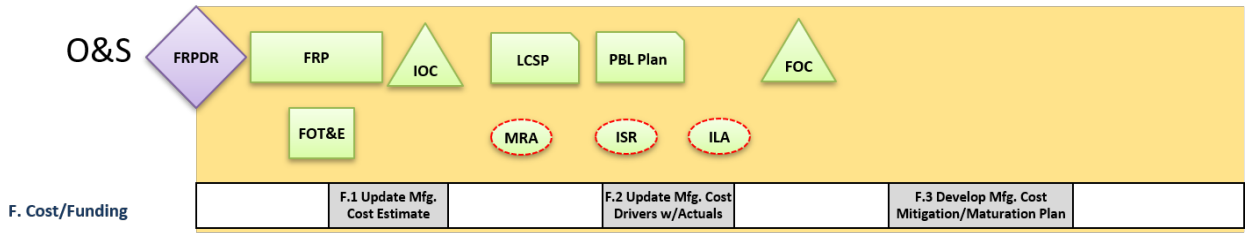


Figure 6-7. Cost and Funding Manufacturing and Quality Activities

Introduction

Services and Agencies develop Program Objective Memorandums (POMs) to identify and request resources (money) to acquire capabilities and perform operations. The POM is part of the Programming Phase of the Program, Planning, Budget, and Execution (PPBE) process. The DoD combines the various Service and Agency POM inputs and Budget Estimate Submission (BES) and submit a DoD Budget Request to the Office of Management and Budget (OMB).

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.

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.

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.
    - Cost Analysis Requirements Description (CARD)
    - Total Ownership Costs (TOC) or Life-Cycle Cost Estimate (LCCE)
    - Program Office Estimate (POE)
    - Independent Cost Estimate (ICE)
    - Independent Government Cost Estimate (IGCE)
    - Component Cost Estimate (CCE)
    - Component Cost Position (CCP)
    - Cost Capability Analysis (CCA)
    - Should Cost Estimate (SCE)
    - Sufficiency Review
- 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.

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
- CAIG website and processes
- DCAPE website and processes
- 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

- DoD Systems Engineering Guidebook
- 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

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.

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
- DoD Systems Engineering Guidebook
- 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.

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

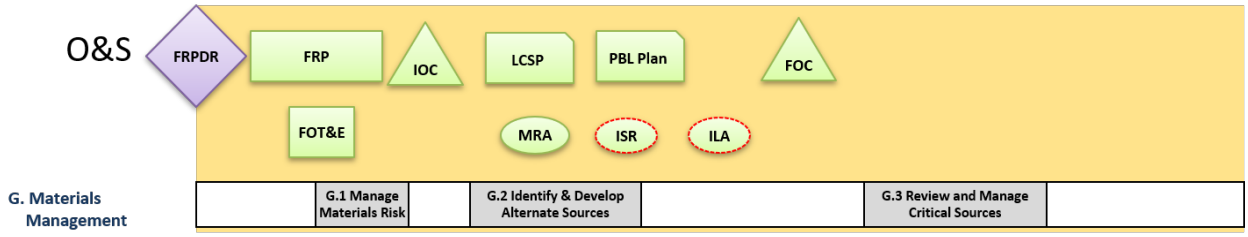


Figure 6-8. Materials Management Manufacturing and Quality Activities

Introduction

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)
- 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 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

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 DMSMS 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.

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 United States can be restricted by International Traffic in Arms Regulations (ITAR). 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 may 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
- Periodically assess product support performance and take corrective action to prevent degraded materiel readiness or O&S cost growth.

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
- DoD Systems Engineering Guidebook
- DoD Product Support Managers Handbook
- 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. DMSMS 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.

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

- DoD Product Support Managers Handbook
- 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
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.

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

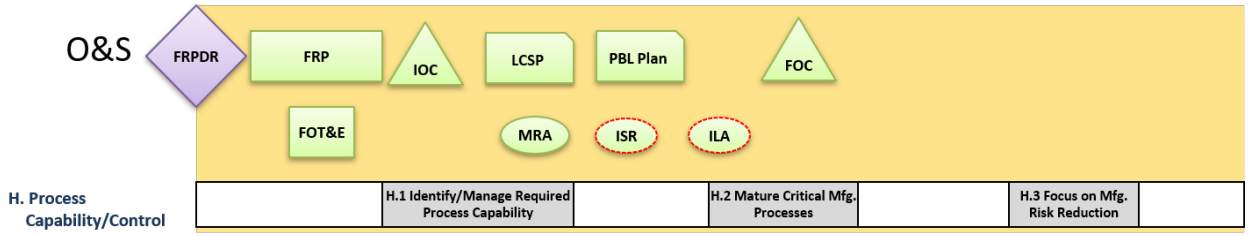


Figure 6-9. Process Capability and Control Manufacturing and Quality Activities

Introduction

One of the major goals of manufacturing is to provide the customer with "uniform, defect free product that has consistent performance and is affordable. Product quality comes from robust product and process design and process control activities to include continuous process improvement to identify and remove sources of variation.

Process Capability and Control is a requirement of both ISO 9001 and AS9100 quality standards and requires a process control plan, which describes the actions and activities that will demonstrate process capabilities. Process capability is used to determine if a process is stable (predictable) and in a state of control. Typical process control measures include Cp/Cpk and Pp/Ppk. For each concept being considered, a determination of the manufacturing processes capability will be completed. This assessment of manufacturing feasibility will include the investigation of process maturity for similar manufacturing processes. Critical and key manufacturing processes can also be identified during the assessment and analysis either through M&S or experimentation.

Advances in digital engineering to include modeling and simulation along with continual improvements in computer performance have made it possible to perform comprehensive analysis of virtual parts and to test and assess the capability of processes before actual manufacturing begins. The use of solid modeling, finite element analysis, multi-paradigm numerical computing environments, and simulation software analysis tools, allows users to simulate different conditions that are likely to occur during manufacturing processes and model the behavior of systems under real-world conditions. An understanding of the capabilities to model products and processes for each of the concepts under consideration can be a valuable discriminator.

This thread (Acquisition) requires an analysis of the risk that the manufacturing processes may not be able to reflect the design intent (repeatability and affordability) of key characteristics and will focus on the following sub-threads, tasks, activities, tools, and resources:

- Modeling and Simulation (M&S) of Processes
- Process Capability Studies
- Process Yields and Rates
- Process Demonstrations

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 then 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 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.

The program should 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 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 and early what the design requirements are and make all processes capable of meeting those requirements even before the start of production. Note: There is no one standard process capability measurement for all process and product characteristics. However, key and critical characteristics should receive the most focus on development of a standard and on the management of those characteristics during the life of the product.

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, Pp and Ppk, or other appropriate measure) 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.

Tools

- AS9100 Checklist
- AS6500 Checklist
- FMEA Template
- Interactive MRL Users Guide (Checklist) for the Process Capability and Control thread
- Manufacturing Maturation Plan
- Process Capability Studies (Cp and Cpk assessment)
- 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
- AS6500 Manufacturing Management Program
- DoD Systems Engineering Guidebook

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

Tools

- AS9100 Checklist
- AS6500 Checklist
- 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
- AS6500 Manufacturing Management Program
- DoD Systems Engineering Guidebook
- 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.
  - KPPSs, 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 be based on the entire system inventory.

Tools

- AS9100 Checklist
- AS6500 Checklist
- 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
- AS6500 Manufacturing Management Program
- DoD Systems Engineering Guidebook
- DCMA-INST 323 Data Collection and Analysis
- DoD-Wide Continuous Process Improvement (CPI)/Lean and Six Sigma Program
- MRL Deskbook

I. QUALITY MANAGEMENT

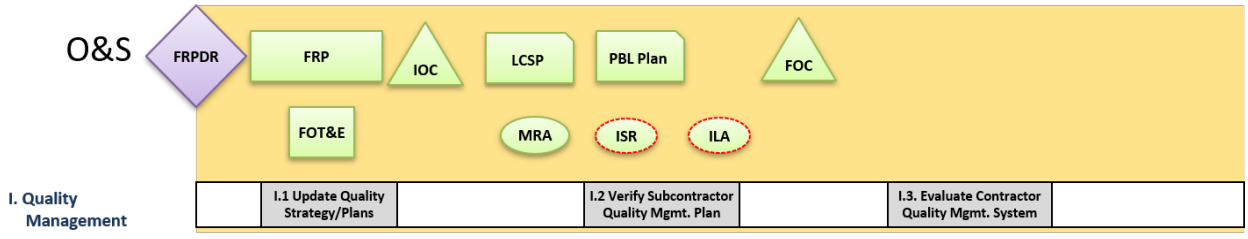


Figure 6-10. Quality Management Manufacturing and Quality Activities

Introduction

DoD has increased management focus on M&Q management during early program phases. Quality is the degree to which material attributes, performance features, and characteristics of a product satisfy a

given need. Quality may apply to a product, process, or system and may be physical, sensory, behavioral, temporal, ergonomic, or functional.

Quality management is an integral part of design and development efforts. QMS standards include industry best practices such as ISO 9001, Quality Management Systems–Requirements; and AS9100, Quality Management Systems - Requirements for Aviation, Space and Defense Organizations, Product Realization (clause 7) includes typical systems engineering tasks under sub-clause 7.3, Design and Development. The typical systems engineering processes included in the QMS are:

- Design and Development Planning – SE Management, Failure Modes, Effects, and Criticality Analysis (FMECA), System Safety, etc.
- Design and Development Inputs/Outputs – T&E, Reviews, and Audits.
- Design and Development Review, Verification and Validation.
- Control of Design and Development Changes – hardware and software Configuration Management.
- Hardware and Software Configuration Management.
- Risk, Issue, and Opportunity Management.
- Corrective Action System.

The requirements for Quality Assurance and Control come from the FAR/DFAR and general industry guidance comes from ISO 9001 and AS9100 quality standards. These standards require that organizations establish a formal quality policy and submit documentation on internal processes, procedures, and standards. The following are mandatory requirements of ISO 9001:

- Monitoring and measuring equipment calibration records
- Records of training, skills, experience and qualifications
- Product/service requirements review records
- Record about design and development outputs review
- Record about design and development inputs
- Records of design and development controls
- Records of design and development outputs
- Design and development changes records
- Characteristics of product to be produced and service to be provided
- Records about customer property
- Production/service provision change control records
- Record of conformity of product/service with acceptance criteria
- Record of nonconforming outputs
- Monitoring measurement results
- Internal audit program
- Results of internal audits
- Results of the management review

- Results of corrective actions

Note: AS9100 standards includes all of the above, and more.

This thread (Quality) requires an analysis of the risk and management efforts to control quality, and foster continuous quality improvement and will focus on the following sub-threads, tasks, activities, tools, and resources:

- Quality Management System (QMS)
- Quality Strategy and Plan
- Product Quality
- Supply Chain Quality
- Quality Risk

An effective 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

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 MDAPs 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 DCMA 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 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

M&Q 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

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 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 may 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.
- Establish supply chain quality management metrics for each of the concepts being considered for incoming quality inspection to include the identification of acceptable quality levels (AQLs)
  - Determine the frequency that the metrics should be reviewed, commensurate with M&Q risks
- 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).

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 and Organic Facility Quality Management System

The following applies to either contractor or organic (i.e., depot, arsenal, shipyard) manufacturing operations. M&Q personnel need to identify the potential product quality requirements of an identified

material based on FAR 46.202, Types of Contract Quality Requirements, and FAR 52.246.1, Contractor Inspection Requirements. In addition, the organizations needs to identify the process of measuring, examining, testing, or otherwise comparing the product to the requirements for acceptance. FAR 46.291 Production Lot Testing identifies the purpose of production lot testing is to validate quality conformance of products prior to lot acceptance, which usually occurs after acceptance testing. Best practices has contractors operating to either ISO 9001 Quality Management System or AS9100 Quality Management System. A typical QMS will address leadership and policy, planning, organizational support, operations, performance measurement and evaluation, and continuous improvement.

Manufacturing and Quality Tasks

- Ensure the prime contractor or organic has implemented a Quality Management System Based on Best Practices (AS9100 or ISO 9001 as appropriate).
- The QMS should include:
    - Management responsibility
    - Resource management
    - Quality System
    - Contract Review
    - Product Realization
    - Design Control
    - Document Control
    - Purchasing
    - Purchaser-Supplied Product
    - Product Identification and Traceability
    - Process Control
    - Measurement, Analysis, and Improvement (metrology and calibration)
- 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 product quality requirements have been identified and are being managed:
    - Identify product acceptance methods and determine sampling plans as appropriate
    - Mature new quality technologies and process state of the art into product quality requirements
    - Identify and manage product quality requirements (i.e., specific product characteristics)
    - Identify and manage product quality for metrics and the frequency that the metrics should be reviewed, commensurate with M&Q risks

  - Ensure the contractor/organization provides and maintains a measurement system to validate that products conform to requirements
  - Ensure that measuring and testing devices are calibrated at specified intervals prior to use and are traceable to national standards

- Ensure the following:
  - 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 managing 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.).

Tools

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

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

- 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
- MIL-STD-1916 DoD Test Method Standard, Apr 1996,
- ANSI Z1.4 Sampling Procedures and Tables for Inspection by Attributes
- ANSI Z1.9 Sampling Procedure and Tables for Inspection by Variables for Percent Nonconforming
- DCMA-INST 302 First Article and Production Lot Testing
- DoD Systems Engineering Guidebook

J. MANUFACTURING WORKFORCE

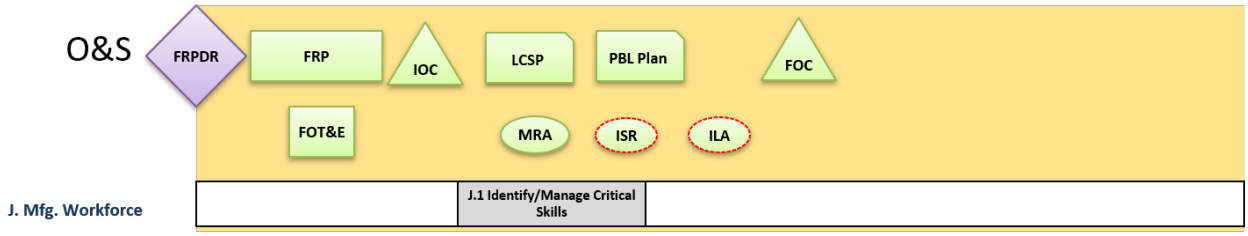


Figure 6-11. Manufacturing Workforce Manufacturing and Quality Activities

Introduction

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 sills availability
- Workforce skills capability

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.

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/MRPII)

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-896, Manufacturing Management Program Guide
- MRL Deskbook

K. FACILITIES

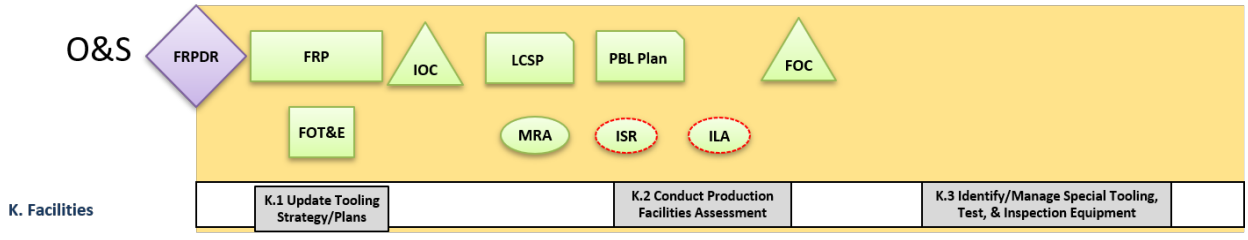


Figure 6-12. Facilities Manufacturing and Quality Activities

Introduction

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.

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.

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 USC 524

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
- 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 if 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

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-896, Manufacturing Management Program Guide
- 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.
- 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.

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

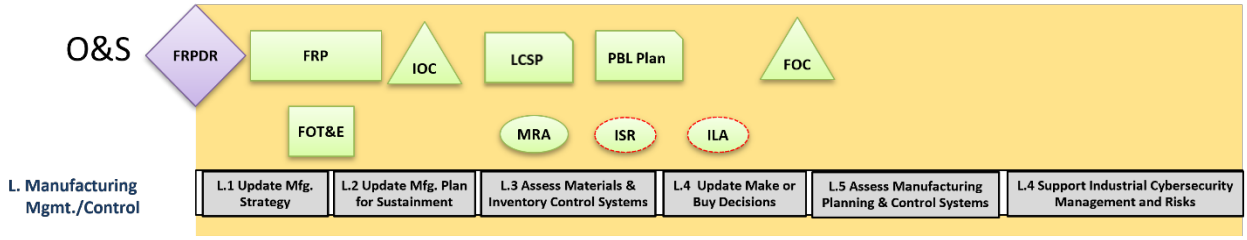


Figure 6-13. Manufacturing Management and Control Manufacturing and Quality Activities

Introduction

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 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 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., DMSMS).
- 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.
  - 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.

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

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-896, Manufacturing Management Program Guide
- MRL Deskbook
- Systems Engineering Plan (SEP) Outline

L.2. Update Manufacturing Plan for Sustainment

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.

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
- 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-896, Manufacturing Management Program Guide
- MRL Deskbook
- Systems Engineering Plan (SEP) Outline

L.3. Assess 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 that 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.

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
- 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-896, Manufacturing Management Program Guide
- MRL Deskbook

L.4. Update 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

Tools

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

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

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-896, Manufacturing Management Program Guide
- MRL Deskbook

L.6 Support Industrial Cybersecurity Management and Risk Assessment

Industrial cybersecurity is concerned with the ability of organizations to share information digitally (government to industry, prime contractor to subs, labs to program offices, etc.). While the sharing of information is critical, it is equally important to do so in a safe and secure environment. Industrial cybersecurity is concerned with the transfer of digital data via Operational Technologies (OT) inside a facility and through the cloud to other organizations and facilities.

NIST standard NIST SP 800-37, 'Risk Management Framework for Information Systems and Organizations' defines Operational Technology as:

> *Programmable systems or devices that interact with the physical environment (or manage devices that interact with the physical environment). These systems/devices detect or cause a direct change through the monitoring and/or control of devices, processes, and events. Examples include industrial control systems, building management systems, fire control systems, and physical access control mechanisms.*

There are three main types of operational technologies of concern:

- Product lifecycle management (PLM) systems for creating and managing the design process.
- Manufacturing execution system (MES) support the planning, execution, and synchronization of manufacturing processes across multiple functions, distributed plants, and suppliers
- Enterprise resource planning (ERP) system supports functional management resources within an enterprise, and control process performance.
- These data systems are often digital and shared across multiple functions and organizations.

DFARS 252.204-7012 requires contractors to follow NIST SP 800-171 and to:

- Provide adequate security to safeguard covered defense information that resides on or is transiting through a contractor's internal information system or network
- Report cyber incidents that affect a covered contractor information system or the covered defense information residing therein

- Submit malicious software discovered and isolated in connection with a reported cyber incident to the DoD Cyber Crime Center
- Submit media/information as requested to support damage assessment activities
- Flow down the contract clause in subcontracts for operationally critical support, or for which subcontract performance will involve covered defense information

Manufacturing, as an industry, is the most targeted industry for cyber-attacks. DoD policy and best business practices require that data be protected from attack. This includes classified data, controlled unclassified data (CUI), personal data, financial data, etc.

This thread (Industrial Cybersecurity) requires an analysis of the risk that the manufacturing environment may not be able to protect digital and other forms of data from cyber risks and will focus on the following sub-threads, tasks, activities, tools, and resources:

- Identification of Cybersecurity Risks
- Cybersecurity Planning and Management (Execution)

M&Q personnel need to identify and manage industrial cybersecurity risks for system concepts identified, and cybersecurity vulnerabilities at potential industrial facilities. The focus on cybersecurity must encompass platforms, weapons, and the DIB and must be regularly assessed, properly resourced, and continually mitigated. Cybersecurity crosses all pathways within the AAF.

M&Q personnel need to develop and execute industrial cybersecurity planning for system concepts identified and execute the management of those plans. Programs will employ system security engineering methods and practices, including cybersecurity, cyber resilience, and cyber survivability in design, test, manufacture, and sustainment. Such methods and practices will ensure that systems function as intended, mitigating risks associated with known and exploitable vulnerabilities to provide a level of assurance commensurate with technology, program, system, and mission objectives.

Manufacturing and Quality Tasks

- Assess supply chain OT cybersecurity and vulnerability risks, and develop risk management plans
- Implement supply chain OT cybersecurity and vulnerability risk mitigation plans
- Demonstrate OT cybersecurity solutions in an LRIP environment
- Demonstrate OT cybersecurity solutions in an FRP environment
- Assess the design of OT systems for facilities and equipment (i.e., in-house factory systems, production equipment, STE/SIE, and tooling) to ensure they include cybersecurity and physical/digital controls and access requirements
- Plan for and document that LRIP facilities and equipment OT systems include cybersecurity and physical/digital controls, and access requirements
- Identify and assess OT cyber incidents throughout the supply chain

- Ensure that OT cybersecurity Incident Reporting procedures are in-place, including reporting, tracking, and corrective actions
- Train the workforce in current cybersecurity procedures for production environment

Tools

- Cybersecurity and Acquisition Lifecycle Integration Tool (DAU)
- Cybersecurity Strategy ADDM Template
- Interactive MRL Users Guide (Checklist), Cybersecurity thread
- USMC Cybersecurity Management Checklist

Resources

- FAR 52.202.21 Basic Safeguarding of Covered Contractor Information Systems
- DFAR 252.7012 Safeguarding Covered Defense Information and Cyber Incident Reporting
- DoDI 5000.83 Technology and Program Protection
- DoDI 8500.01 Cybersecurity
- DoDI 5000.90 Cybersecurity for Acquisition Decision Authorities and Program Managers
- DoD 5220.22-M National Industrial Security Program
- DoD Program Managers Guidebook for Integrating Cybersecurity Risk Management Framework into Acquisition Life Cycle
- NIST SP 800-171 Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations
- NIST Special Publication 800-82 Guide to Industrial Control Systems (ICS) Security

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
AQAP	Advanced Product Quality Planning
AQL	Acceptable Quality Level
ARL	Army Research Laboratory
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
BES	Budget Estimate Submission
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
CAD	Computer-Aided Design
CAE	Component Acquisition Executive
CAI	Critical Application Item
CAIG	Cost Analysis Improvement Group
CAIV	Cost as an Independent Variable

CAM	Computer-Aided Manufacturing
CAPE	Cost Assessment and Program Evaluation
CARD	Cost Analysis Requirements Description
CAS	Contract Administration Services
CBA	Capabilities-Based Assessment
CCA	Cost Capability Analysis
CCB	Configuration Control Board
CCE	Component Cost Estimate
CDD	Capability Development Document
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
CPI	Continuous Process Improvement
Cp/Cpk	Process Capability/Process Capability Index
CRI	Cost Reduction Initiative
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
DPM	Defective Parts Per Million
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
DIB	Defense Industrial Base
DID	Data Item Description
DLA	Defense Logistics Agency
DMS	Diminishing Manufacturing Sources
DMMG	Defense Manufacturing Management Guide
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
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
ED, SE&A	Executive Director, Systems Engineering and Architecture
EMC	Electromagnetic Compatibility
EMD	Engineering and Manufacturing Development
EMI	Electromagnetic Interference

EOQ	Economic Order Quantity
ERP	Enterprise Resource Plan
ESA	Engineering Support Activity
ESOH	Environment, Safety, and Occupational Health
ESS	Environmental Stress Screening
EVMS	Earned Value Management System
FA	First Article
FAI	First Article Inspection
FAR	Federal Acquisition Regulation
FAT	First Article Test
FCA	Functional Configuration Audit
FDD	Full Deployment Decision
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes, Effects, and Criticality Analysis
FOD	Foreign Object Damage
FOT&E	Follow-on Test and Evaluation
FPAF	Fixed Price Award Fee
FRACAS	Failure Reporting, Analysis, and Corrective Action System
FRP	Full-Rate Production
FRPDR	Full-Rate Production Decision Review
FTA	Fault Tree Analysis
FYDP	Future Years Defense Program
GAO	Government Accountability Office
GCQA	Government Contract Quality Assurance
GFE	Government-Furnished Equipment
GFM	Government-Furnished Material
GFP	Government-Furnished Property
GIDEP	Government and Industry Data Exchange Program
GOTS	Government Off-the-Shelf
HAZMAT	Hazardous Material
HSI	Human Systems Integration
HVAC	Heating, Ventilation, and Air Conditioning
HWCIs	Hardware Configuration Items
IB	Industrial Base

ICA	Industrial Capabilities Assessments
ICD	Initial Capabilities Document
ICE	Independent Cost Estimate
ICS	Industrial Control Systems
IEEE	Institute of Electrical and Electronics Engineers
IG	Inspector General
IGCE	Independent Government Cost Estimate
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
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
M&S	Modeling and Simulation
ManTech	Manufacturing Technology

MATE	Multi-Attribute Trade Space Exploration
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MDD	Milestone Development Decision
MEP	Manufacturing Extension Program
MES	Manufacturing Execution System
MIL-STD	Military Standard
MMAS	Material Management and Accounting System
MMP	Manufacturing Maturation Plan
MMS	Manufacturing Management System
MOA	Memorandum of Agreement
MOE	Measure of Effectiveness
MOSA	Modular Open Systems Approach
MP	Mission Profile
MRO	Maintenance, Repair, and Overhaul
MMP	Manufacturing Maturation Plan
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
MRP II	Manufacturing Resource Planning
MS A	Milestone A
MS B	Milestone B
MS C	Milestone C
MSA	Materiel Solution Analysis
MSRA	Manufacturing Systems Risk Assessment
MTA	Middle Tier Acquisition
MTTR	Mean Time to Repair
MTBF	Mean Time Between Failure
MTBM	Mean Time Between Maintenance
NAVSO-P	Navy Standard Operating Procedure
NDAA	National Defense Authorization Act

NDI	Non-Developmental Item
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NRL	Naval Research Laboratory
NSPAR	Non-Standard Parts Approval Request
NTIB	National Technology 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
OMB	Office of Management and Budget
OMS/MP	Operational Mode Summary/Mission Profile
O&S	Operations and Support
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
OT	Operational Technology
OTRR	Operational Test Readiness Review
OUSD(R&E)	Office of the Under Secretary of Defense for Research and Engineering
P3I/P^3I	Preplanned Product Improvement
PAOC	Post-Award Orientation Conference
PAW	Producibility Assessment Worksheet
PBL	Performance-Based Logistics
PCA	Physical Configuration Audit
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
PLM	Product Lifecycle Management
PM	Program Manager

PMP	Parts, Materials, and Processes
PMR	Program Management Review
PMO	Program Management Office
POE	Program Office Estimate
POM	Program Objective Memorandum
Pp / Ppk	Process Performance/Process Performance Index
PPAP	Production Part Approval Process
PPBE	Program, Planning, Budget, and Execution
PPC	Production Planning and Control
PPP	Program Protection Plan
PPV	Production Part Verification
PQM	Production, Quality, and Manufacturing
Pre-MDD	Pre-Materiel Development Decision
PRR	Production Readiness Review
PSA	Program Support Assessment
PSM	Product Support Manager
PSS	Product Support Strategy
PTAC	Procurement Technical Assistance Center
PWBS	Program 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, Issues and Opportunities
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
RMBoK	Reliability and Maintainability Body of Knowledge

SAE	Society of Automotive Engineers
SAR	Safety Assessment Report
SAT	Software Acceptance Test
SCE	Should Cost Estimate
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
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
SUPSHIP	Supervisor of Shipbuilding
SVR	System Verification Review

SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAPP	Technology Area Protection Plan
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
TRL	Technology Readiness Level
TRR	Test Readiness Review
USD(R&E)	Under Secretary of Defense for Research and Engineering
USC	United States Code
VCRM	Verification Cross-Reference Matrix
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 Manufacturing and Quality Body of Knowledge (M&Q BoK) are listed below alphabetically and contain links to the referenced document or website. As many of these resources are revised frequently, readers are advised the documents may change or 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
https://www.govinfo.gov/content/pkg/USCODE-2012-title10/pdf/USCODE-2012-title10-subtitleA-partIV-chap137-sec2305.pdf

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
https://www.govinfo.gov/content/pkg/USCODE-2010-title10/pdf/USCODE-2010-title10-subtitleA-partIV-chap144-sec2435.pdf

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

10 USC 2445b, Cost, Schedule, and Performance Information
https://www.govinfo.gov/content/pkg/USCODE-2011-title10/pdf/USCODE-2011-title10-subtitleA-partIV-chap144A-sec2445b.pdf

10 USC 2448b, Independent Technical Risk Assessments
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
https://www.govinfo.gov/content/pkg/USCODE-2010-title10/pdf/USCODE-2010-title10-subtitleA-partIV-chap148-subchapIV-sec2521.pdf

48 CFR 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting
https://www.law.cornell.edu/cfr/text/48/252.204-7012

Acquisition Process/Acquisition Strategy
www.acqnote/acquisitions/acquisition-strategy

Acquisition Strategy Guide, 4th Edition, DSMC, Dec 1999
http://www.acqnotes.com/Attachments/DSMC%20Acquisition%20Strategy%20Guide.pdf

Adaptive Acquisition Framework
https://aaf.dau.edu

AFI 10-601, Operational Capability Requirements Development
https://static.e-publishing.af.mil/production/1/af_a3_5/publication/afi10-601/afi10-601.pdf

AFI 63-145, Manufacturing and Quality Management, Dec 2020
https://static.e-publishing.af.mil/production/1/saf_aq/publication/afi63-145/afi63-145.pdf

Air Force Technology Development and Transition Strategy Guidebook, Jul 2010
http://acqnotes.com/dod-guides-handbooks

Analysis of Alternatives
www.acqnote/acquisitions/analsis-of-alternatives

Analysis of Alternative (AoA) Handbook, Office of Aerospace Studies, Aug 2017
https://afacpo.com/AQDocs/AoAHandbook.pdf

Application of Learning Curve Theory to Systems Acquisition, Defense Acquisition University (DAU) Teaching Note, Feb 2011
https://www.dau.edu/cop/ce/DAU%20Sponsored%20Documents/B5%20Application%20of%20Learning%20Curve%20Theory%20Feb%2011.pdf

AR 700-90 Army Industrial Base Process, Feb 2020
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN20450_AR_700-90_FINAL.pdf

AS5553, Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition, Mar 2019, SAE International
https://www.sae.org/standards/content/as5553/

AS6174, Counterfeit Materiel; Assuring Acquisition of Authentic and Conforming Materiel, Jul 2014, SAE International
https://www.sae.org/standards/content/as6174/

S6500A, Manufacturing Management Program, Jul 2021, SAE International
https://www.sae.org/standards/content/as6500/

AS9100D: 2016, Quality Management Systems - Requirements for Aviation, Space and Defense Organizations, Sep 2016. SAE International
https://www.sae.org/standards/content/as9100d/

AS9102, First Article Inspection Requirement, Oct 2014, SAE International
https://www.sae.org/standards/content/as9102/

AS9103, Variation Management of Key Characteristics, Oct 2001, SAE International
https://www.sae.org/standards/content/as9103/

AS9133, Qualification Procedure for Aerospace Standard Products, Jul 2002, SAE International
https://www.sae.org/standards/content/as9133/

AS9134, Supply Chain Risk Management Guidelines, Feb 2014, SAE International
https://www.sae.org/standards/content/arp9134/

AS9136, Root Cause Analysis and Problem Solving, Nov 2016, SAE International
https://www.sae.org/standards/content/arp9136/

AS9138, Quality Management Systems Statistical Product Acceptance, Jan 2018, SAE International
https://www.sae.org/standards/content/as9138/

Award Fee Board Member Guide, Army, Sep 2003
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjSk43F8aLsAhVkmuAKHftkBLAQFjAAegQIBBAC&url=https%3A%2F%2Fwww.acq.osd.mil%2Fdpap%2Fccap%2Fcc%2Fjcchb%2FFiles%2FTopical%2FSource_Selection%2Fguides%2Faca_award_fee_board_member_guide.docx&usg=AOvVaw3UXncnSQOnEdnZS5sssBBs

Award Fee Guide, Air Force, Oct 2008
https://www.acq.osd.mil/dpap/ccap/cc/jcchb/Files/Topical/1Restricted/award.fee.oct08.pdf

Award Fee Guide, Navy/Marine Corps, Jul 2004
http://acqnotes.com/acqnote/careerfields/award-fee-contracts

Capability-Based Assessment (CBA) Handbook, Office of Aerospace Studies, Mar 2014
https://daytonaero.com/wp-content/uploads/USAF-Capabilities-Based-Assessment-CBA-Handbook-10-Mar-2014.pdf

Capability Development Document (CDD) Writer's Guide, Army Training and Doctrine Command, Jun 2009
http://www.acqnotes.com/Attachments/CDD%20Writers%20Guide.pdf

CJCS Instruction 5123.01, JROC and Implementation of JCIDS
CJCS Instruction 5123.01 JROC & Implementation of JCIDS - AcqNotes

Condition Based Maintenance Plus DoD Guidebook, May 2008
https://www.dau.edu/guidebooks/Shared%20Documents/Condition%20Based%20Maintenance%20Plus%20(CBM+)%20Guidebook.pdf

Cost Analysis Requirements Description (CARD) Guidance (See CAPE website for 897 guidance)
https://cade.osd.mil/policy/card

Cost Analysis Requirements Description (CARD) Template, Oct 2009
http://acqnotes.com/acqnote/careerfields/cost-analysis-requirements-description

Cost/Schedule Control System Criteria Reference Guide, Sep 1991
https://www.secnav.navy.mil/rda/OneSource/Documents/CEVM/Tools%20and%20Examples/DOD%20Guides/BowmanInterpretiveGuide1.pdf

Defense Acquisition University Guidebooks and References
https://aaf.dau.edu/guidebooks
Cost Estimating
Cybersecurity
Engineering
Human Systems Integration
Intellectual Property
Intelligence
International Acquisition
IT and Business Systems
Program Management
Program Protection
Sustainment
Test and Evaluation

DCMA (Defense Contract Management Agency) Instructions/Policies
https://www.dcma.mil/Policy/

DCMA-INST 204, Manufacturing and Production
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-204.pdf

DMCA-INST 205, Major Program Support, Dec 2013
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-205.pdf

DMCA-INST 207, Engineering Surveillance, Dec 2014
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-207.pdf

DCMA-INST-209, Pre-award Surveys
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-209.pdf

DCMA-INST-219, Supplier Risk Management Through Standard Contract Surveillance, May 2013
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-219.pdf

DCMA-INST-221, Integrated Surveillance Plan, Apr 2014
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-221.pdf

DCMA-INST-302, First Article and Production Lot Testing, Jan 2015
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-302.pdf

DCMA-INST-309, Government Contract Quality Assurance Surveillance Planning, Mar 2015
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-309.pdf

DCMA-INST-311, Process Review -QA, Aug 2014
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-311.pdf

DCMA-INST-322, Quality System Audit, Sep 2015
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-322.pdf

DCMA-INST-323, Data Collection and Analysis
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-323.pdf

DCMA-INST-324, Product Examination, Aug 2014
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-324.pdf

DCMA-INST-325, Technical Reviews
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-325.pdf

DCMA-INST 401, Industrial Analysis
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-401.pdf

DCMA-INST-1201, Corrective Action
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-1201.pdf

DCMA-INST 3401, Defense Industrial Base Mission Assistance
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-3401.pdf

Defense Manufacturing Management Guide for Program Managers (DMMG for PMs), Defense Acquisition University (DAU)
https://www.dau.edu/tools/t/Defense-Manufacturing-Management-Guide-for-Program-Managers-(PQM-for-PMs)
DMMG for PMs Chapter 1, Overview of DOD Manufacturing Management
DMMG for PMs Chapter 2, Industrial Base
DMMG for PMs Chapter 3, Acquisition Environment for Manufacturing
DMMG for PMs Chapter 4, Manufacturing Strategy
DMMG for PMs Chapter 5, CPI/Lean Six Sigma
DMMG for PMs Chapter 6, Manufacturing Planning
DMMG for PMs Chapter 7, Producibility
DMMG for PMs Chapter 8, Technology Development and Investments
DMMG for PMs Chapter 9, Manufacturing Cost Estimating
DMMG for PMs Chapter 10, Contracting Issues in Manufacturing
DMMG for PMs Chapter 11, Transition for Development to Production
DMMG for PMs Chapter 12, Technical Reviews and Audits
DMMG for PMs Chapter 13, Manufacturing Controls
DMMG for PMs Chapter 14, Factory of the Future
DMMG for PMs Chapter 15, Supply Chain Management and Sustainable Manufacturing
DMMG for PMs Chapter 16, Manufacturing Problems and Organic Capabilities
DMMG for PMs Chapter 17, Manufacturing Readiness

Defense Production Act, Title III
https://www.businessdefense.gov/Programs/DPA-Title-III/

Defense Technical Risk Assessment Methodology (DTRAM) Tier 0-1 Criteria, Sep 2021
https;//ac.cto.mil/wp-content/uploads/DTRAM-0-1.pdf

Design for Manufacturing and Assembly (DFMA)
https://www.dau.mil/cop/pqm/DAU%20Sponsored%20Documents/DFMA%20new.doc

DFARS 15.407-2, Make or Buy Programs
https://www.acquisition.gov/content/15407-2-make-or-buy-programs#:~:text=When%20make%2Dor%2Dbuy%20programs,or%20implementation%20of%20socioeconomic%20policies.

DFARS 246 – Quality Assurance
https://www.acquisition.gov/dfars/part-246-quality-assurance

DFARS 246.870, Contractors' Counterfeit Electronic Part Detection and Avoidance
https://www.acquisition.gov/dfars/part-246-quality-assurance

DFARS 252 – Solicitation Provisions and Contract Clauses
https://www.acquisition.gov/dfars/part-252-clauses

DFARS 252.72, Contractor Material Management and Accounting System
https://www.acquisition.gov/dfars/part-252-clauses

DFARS 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting
https://www.acquisition.gov/dfars/part-252-clauses

DFARS 252.228-7001, Ground and Flight Risk
https://www.acquisition.gov/dfars/part-252-clauses

DFARS 252.242-7004, Material Management and Accounting System (MMAS)
https://www.acquisition.gov/dfars/part-252-clauses

DFARS 252.246-7007, Contractor Counterfeit Electronic Part Detection and Avoidance System
https://www.acquisition.gov/dfars/part-252-clauses

DFARS 252.246-7008, Sources of Electronic Parts
https://www.acquisition.gov/dfars/part-252-clauses

Diminishing Manufacturing and Materials Shortages (DMSMS) Guidebook, SD-22, Sep 2009
https://www.dsp.dla.mil/Programs/DMSMS

DMSMS Acquisition Guidelines, Rev 3, Defense MicroElectronics Agency (DMEA), 2007
https://apps.dtic.mil/sti/citations/ADA518172

DoD Continuous Process Improvement Transformation Guide, May 2006
https://www.dau.edu/cop/se/DAU%20Sponsored%20Documents/DoD%20Continuous%20Process%20Improvement%20CPI%20Guidebook%20May%202006.pdf

DoD Directives
https://www.esd.whs.mil/Directives/issuances/dodd/

DoD Directive 4200.15, Manufacturing Technology (ManTech) Program
https://www.esd.whs.mil/Directives/issuances/dodd/

DoD Directive 4400.01E, Defense Production Act Programs
https://www.esd.whs.mil/Directives/issuances/dodd/

DoD Directive 5000.01, The Defense Acquisition System
https://www.esd.whs.mil/Directives/issuances/dodd/

DoD Directive 5105.84, Cost Analysis Guidance and Procedures, May 2020
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/510584p.pdf

DoD Directive 5105.84, Director of Cost Assessment and Program Evaluation
https://www.esd.whs.mil/Directives/issuances/dodd/

DoD Handbook 5000.60-H, Assessing Defense Industrial Capabilities
https://esd.whs.mil/DD/

DoD Human Computer Interface (HCI) Style Guide, Apr 1996
http://everyspec.com/DoD/DOD-General/download.php?spec=DISA_TAFIM_VOL8.007545.pdf

DoD Instructions
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 4140.01, Supply Chain Materiel Management Policy
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/414001p.pdf

DoD Instruction 4275.5, Acquisition and Management of Industrial Resources, Mar 2005
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/427505p.pdf?ver=2018-11-08-122537-997

DoD Instruction 5000.01, The Defense Acquisition System, 2020
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.02, Operation of the Adaptive Acquisition Framework
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.60, Defense Industrial Capabilities Assessments
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.73, Cost Analysis Guidance and Procedures
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.80, Operation of the Middle Tier of Acquisition (MTA)
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.81, Urgent Capability Acquisition
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.83, Technology and Program Protection, May 2021
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.84, Analysis of Alternatives, Aug 2020
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.85, Major Capability Acquisition, Aug 2020
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.88, Engineering of Defense Systems, Nov 2020
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.90, Cybersecurity for Acquisition Decision Authorities and Program Managers
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.92, Innovation and Technology to Sustain Materiel Readiness, May 2021
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.93, Use of Additive Manufacturing in the DoD, Jul 2021
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5000.94, Use of Robotic Systems for Manufacturing and Sustainment in the DoD, Mar 2022
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Instruction 5105.84, Director of Cost Assessment and Program Evaluation
https://www.esd.whs.mil/Directives/issuances/dodi/

DoD Integrated Product and Process Development Handbook, 1998
http://www.acqnotes.com/Attachments/DoD%20Integrated%20Product%20and%20Process%20Development%20Handbook,%20Aug%2098.pdf

DoD Manuals
https://www.esd.whs.mil/Directives/issuances/dodm/

DoD Manual 4140.01, DoD Supply Chain Materiel Management Procedures (Volumes 1-12)
https://www.esd.whs.mil/Directives/issuances/dodm/

DoD Manual 4160.21, Defense Materiel Disposition: Disposal Guidance and Procedures
Volume 1
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodm/416021_vol1.pdf?ver=2019-10-02-080613-750
Volume 2, Sep 2019
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodm/416021m_vol2.PDF
Volume 3, Sep 2019
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodm/416021_vol3.PDF?ver=2019-09-30-130146-047
Volume 4, Sep 2019
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodm/416021_vol4.PDF?ver=2019-09-30-130144-453

DoD Manual 4245.7 Transition from Development to Production, Sep 1985
http://everyspec.com/DoD/DoD-PUBLICATIONS/DoD_4245--7-M_3692/

DoD Manual 4245.7-M Transition from Development to Production, Sep 1985
https://apps.dtic.mil/dtic/tr/fulltext/u2/a303209.pdf

DoD Manufacturing Technology (ManTech) Program
https://www.dodmantech.mil/

DoD Market Research Guide, May 2012
http://acqnotes.com/acqnote/acquisitions/market-research

DoD Market Research Report Guide, Mar 2017
https://www.acq.osd.mil/dpap/cpic/cp/docs/2017_Market_Research_Guide_(Final).pdf

DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs, Jan 2017
https://www.dau.edu/tools/t/DoD-Risk,-Issue,-and-Opportunity-Management-Guide-for-Defense-Acquisition-Programs

DoD Source Selection Procedures Memo, Apr 2016
https://www.acq.osd.mil/dpap/policy/policyvault/USA004370-14-DPAP.pdf

DoD Supply Chain Management Implementation Guide, 2000
https://apps.dtic.mil/dtic/tr/fulltext/u2/a387934.pdf

DoD Supply Chain Metrics Handbook, Sep 2021
https://www.acq.osd.mil/log/LOG_SD/.policy_vault.html/Supply_Chain_Metrics_Guide_22Sep2021.pdf

DoD-Wide Continuous Process Improvement (CPI/Lean Six Sigma) Program, May 2008
file:///C:/Users/ganoy/Documents/George/DAU/Guidance%20Docs/Quality/QA%20Guides/DOD%20CPI%20Memo%20501042p,%20May%202008.pdf

Early Manufacturing and Quality Engineering Guide, Jul 2022
https://ac.cto.mil/maq/
https://ac.cto.mil/erpo/

Engineering of Defense Systems Guidebook, Feb 2022
https://ac.cto.mil/wp-content/uploads/2022/02/Eng-Defense-Systems_Feb2022-Cleared-slp.pdf

Environmental Safety and Occupational Health (ESOH) in Acquisition Guide, Apr 2009
https://safety.army.mil/Portals/0/Documents/ON-DUTY/ARMYSYSTEMS/Standard/Independent_Safety_Assessments.pdf

FAR (Federal Acquisition Regulation) Homepage
https://www.acquisition.gov/browse/index/far

FAR Part 2, Definitions of Words and Terms
https://www.acquisition.gov/content/part-2-definitions-words-and-terms

FAR Subpart 7.1 Acquisition Plans
https://www.acquisition.gov/content/subpart-71-acquisition-plans

FAR Subpart 9.1 Responsible Prospective Contractors
https://www.acquisition.gov/content/part-9-contractor-qualifications#i1116049

FAR Subpart 9.2 Qualification Requirements
https://www.acquisition.gov/content/part-9-contractor-qualifications#i1115819

FAR Subpart 9.3 First Article Inspection
https://www.acquisition.gov/content/part-9-contractor-qualifications#i1115649

FAR Part 10 - Market Research
https://www.acquisition.gov/content/part-10-market-research

FAR Subpart 15.1 Source Selection Processes and Techniques
https://www.acquisition.gov/content/part-15-contracting-negotiation

FAR Subpart 15.2 Solicitation and Receipt of Proposals and Information
https://www.acquisition.gov/content/part-15-contracting-negotiation

FAR Subpart 15.3 Source Selection
https://www.acquisition.gov/content/part-15-contracting-negotiation

FAR Subpart 15.4 Contract Pricing
https://www.acquisition.gov/content/part-15-contracting-negotiation

FAR Subpart 15.5 Pre-award, Award and Post-award Notifications
https://www.acquisition.gov/content/part-15-contracting-negotiation

FAR Subpart 16 Types of Contracts
https://www.acquisition.gov/content/part-16-types-contracts

FAR Subpart 16.4 Incentive Contracts
https://www.acquisition.gov/content/part-16-types-contracts

FAR Subpart 30.6 Contract Administration Service (CAS) Administration
https://www.acquisition.gov/content/subpart-306-cas-administration#

FAR Subpart 31 Contract Cost Principles
https://www.acquisition.gov/content/part-31-contract-cost-principles-and-procedures

FAR Subpart 32.5 Progress Payments Based on Cost
https://www.acquisition.gov/content/part-32-contract-financing#i1082047

FAR Subpart 37.6 Performance Based Acquisition
https://www.acquisition.gov/content/part-37-service-contracting#i1077388

FAR Subpart 42.3 Contract Administration Service (CAS) Functions
https://www.acquisition.gov/content/part-42-contract-administration-and-audit-services

FAR Subpart 42.11 Production surveillance and Reporting
https://www.acquisition.gov/content/part-42-contract-administration-and-audit-services

FAR Subpart 42.15 Contractor Performance Information
https://www.acquisition.gov/content/part-42-contract-administration-and-audit-services

FAR Subpart 44.3 Contractors Purchasing System Reviews
https://www.acquisition.gov/content/part-44-subcontracting-policies-and-procedures#i1073426

FAR Subpart 45.1 Government Property
https://www.acquisition.gov/content/part-45-government-property

FAR Subpart 46 Quality Assurance
https://www.acquisition.gov/content/part-46-quality-assurance

FAR Subpart 48 Value Engineering
https://www.acquisition.gov/content/part-48-value-engineering

FAR Subpart 52 Solicitation Provisions and Contract Clauses
https://www.acquisition.gov/content/part-52-solicitation-provisions-and-contract-clauses

Guidance on Using Incentive and Other Contract Types, Apr 2016
https://www.acq.osd.mil/dpap/policy/policyvault/USA001270-16-DPAP.pdf

Guide to Environment, Safety, and Occupational Health (ESOH) in the Systems Engineering Plan
http://www.acqnotes.com/Attachments/Guide%20PESHE.pdf

IEEE Standards Association Homepage
https://standards.ieee.org/

IEEE 15288, Systems and Software Engineering – System Life Cycle Processes, ISO/IEC/IEEE document, 2015
https://www.iso.org/obp/ui/#iso:std:iso-iec-ieee:15288:ed-1:en

IEEE 15288.1-2014, Application of Systems Engineering on Defense Programs, May 2015, ASO/IEC/IEEE Document
https://ieeexplore.ieee.org/document/7105318

IEEE 15288.2-2014, Application of Systems Engineering on Defense Programs, May 2015, ASO/IEC/IEEE Document
https://ieeexplore.ieee.org/document/7105321

Incentive Contracting Guide, DoD/NASA, Oct 1969
https://www.dau.edu/tools/t/Department-of-Defense-(DoD)-and-National-Aeronautics-and-Space-Administration-(NASA)-Incentive-Contracting-Guide,-1969

Independent Logistics Assessment Guidebook, DAU, Jul 2011
https://www.dau.edu/tools/t/Logistics-Assessment-Guidebook

Independent Technical Risk Assessment (ITRA) Resources
https://ac.cto.mil/itra/

Initial Capabilities Document (ICD) Writer's Guide, TRADOC, Aug 2009
http://www.acqnotes.com/Attachments/Initial%20Capabilities%20Document%20(ICD)%20Writers%20Guide.pdf

Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide, DOD, Oct 2005
https://www.dau.edu/cop/pm/DAU%20Sponsored%20Documents/Integrated%20Master%20Plan%20and%20Integrated%20Master%20Schedule%20Prep%20and%20Use%20Guide.pdf

Integrated Product Support (IPS) Element Guide, Chapter 2.1.1.3 FMECA, Apr 2017
https://www.dau.edu/guidebooks/Shared%20Documents/IPS_Element_Guidebook.pdf

ISO 9000:2015 Quality Management Systems, International Organization for Standardization (ISO)
https://www.iso.org/iso-9001-quality-management.html

ISO 14001:2015, Environmental Management Systems, International Organization for Standardization (ISO)
https://www.iso.org/standard/60857.html

JCIDS Process: CJCS Instruction 5123.01 JROC and Implementation of JCIDS
http://acqnotes.com/acqnote/acquisitions/cjcsi-5123-01-jroc-and-implementation-of-jcids

JCIDS Manual, Feb 2015 was replaced by CJCS Instruction 5123.01 above
http://acqnotes.com/wp-content/uploads/2014/09/Manual-for-the-Operation-of-the-Joint-Capabilities-Integration-and-Development-System-JCIDS-12-Feb-2015.pdf

Life Cycle Sustainment Plan Content Guide, Apr 2010, DAU AcqNotes
http://acqnotes.com/acqnote/careerfields/life-cycle-sustainment-plan-lcsp

Life-Cycle Sustainment Plan Outline, Aug 2019
www.dau.edu/tools/t/Life-Cycle-Sustainment-Plan-(LCSP)-Outline

Logistics Assessment Guidebook, DAU, Jul 2011
www.dau.edu/tools/t/logistics-assessment-guidebook

ManTech, DoD (DoD Manufacturing Technology Program)
https://www.dodmantech.mil/

ManTech Guidance, Air Force
https://www.dodmantech.com/ManTechPrograms/AirForce

ManTech Guidance, Army
https://www.dodmantech.com/ManTechPrograms/Army

ManTech Guidance, Navy
https://www.dodmantech.com/ManTechPrograms/Navy

ManTech Strategic Plan, Mar 2012-2019
https://www.dodmantech.com/About/files/FINAL_DoD_ManTech_Pgm_2012_Strat_Plan.pdf

Manufacturing.gov: A National Advanced Manufacturing Portal
https://www.manufacturing.gov

Manufacturing Maturation Plan (see MRL Deskbook, Chapter 5), 2022
http://www.dodmrl.com/MRL_Deskbook_2018.pdf

Manufacturing Readiness Level (MRL) Deskbook, 2022
http://www.dodmrl.com/MRL_Deskbook_2018.pdf

Manufacturing Resource Planning (MRP II)
Internet Search

Market Research
http://acqnotes.com/acqnote/acquisitions/market-research

Market Research Report Guide for Improving the Tradecraft in Services Acquisition, DoD, Oct 2014
www.acqnotes/acqnote/acquisitions/market-research

Material Management and Accounting System – Audit Program, Jul 2020
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)
Internet Search

Materiel Solution Analysis (MSA) Guide, DAG Chapter 3-3.2.2 Materiel Solution Analysis Phase
https://aaf.dau.edu/aaf/mca/msa

The Memory Jogger, Goal/QPC
https://goalqpc.com/product/memory-jogger/

The Memory Jogger, Design for Six Sigma, Goal/QPC
https://goalqpc.com/product/design-for-six-sigma-mem-jogger/

MIL-HDBK-245E, Preparation of Statement of Work
https://quicksearch.dla.mil/

MIL-HDBK-727, Design Guidance for Producibility
https://quicksearch.dla.mil/

MIL-HDBK-766, Design to Cost
https://quicksearch.dla.mil/

MIL-HDBK-896, Manufacturing Management Program Guide
https://quicksearch.dla.mil/

MIL-HDBK-29612-1A, Guidance for Acquisition of Training Data Products and Services
https://quicksearch.dla.mil/

MIL-STD-882E, System Safety
https://quicksearch.dla.mil/

MIL-STD-1472H, Human Engineering
https://quicksearch.dla.mil/

MIL-STD-11991A, General Standard for Parts, Materials, and Processes
https://quicksearch.dla.mil/

MIL-STD-1521B, Technical Reviews and Audits for Systems, Equipments, and Computer Software
https://quicksearch.dla.mil/

Mission Engineering Guide, Nov 2020
https://ac.cto.mil/erpo

Modeling and Simulation (M&S) Guidance for the Acquisition Workforce, Oct 2008
http://www.acqnotes.com/Attachments/Modeling%20&%20Simulation%20Guidance%20for%20the%20Acquisition%20Workforce.pdf

Modeling and Simulation (M&S) Management, DODD 5000.59, Oct 2018
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/500059p.pdf

MSA Guide, DAG Chapter 3-3.2.2 Materiel Solution Analysis Phase
https://dau.edu/tools/dag

National Defense Authorization Act (NDAA) for Fiscal Year 2017. Public Law 114-238. 114th Congress, Dec 23, 2016.
https://www.congress.gov/bill/114th-congress/senate-bill/2943/text

NDAA – National Defense Authorization Act, FY 2017 Section 807, Sect 2448b. Independent Technical Risk Assessments
https://uscode.house.gov/statutes/pl/114/328.pdf

NDAA – National Defense Authorization Act, FY 2017 Section 807 (Public Law 114-328), Cost, Schedule, and Performance of Major Defense Acquisition Programs
https://uscode.house.gov/statutes/pl/114/328.pdf

NAVSO P-3687 Producibility Systems Guidelines
http://everyspec.com/USN/NAVY-General/NAVSO_P-3687_8510/

NIST Documents, National Institutes of Standards and Technology
https://csrc.nist.gov/publications

NIST 800-82, Guide to Industrial Control Systems Security, May 2015
https://csrc.nist.gov/publications/detail/sp/800-82/rev-2/final

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

O&S Cost Estimating Guide, CAPE, Mar 2014
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

OUSD(R&E) Systems Engineering and Architecture (SE&A)
https://ac.cto.mil/engineering/

OUSD(R&E) Manufacturing and Quality
https://ac.cto.mil/maq/

Parametric Estimating Handbook, DAU, Apr 2008
https://www.dau.edu/tools/Lists/DAUTools/Attachments/112/Parametric%20Handbook%204th%20Edition.pdf

Performance-Based Logistics (PBL) Guidebook, DAU Apr 2016
https://www.dau.edu/tools/t/Performance-Based-Logistics-(PBL)-Guidebook

Pre-Materiel Development Decision (MDD) Analysis Handbook, Jul 2010, Office of Aerospace Studies, Kirtland AFB, NM. ***Note:*** *This document was replaced with The Measures Handbook, Aug 2014, Office of Aerospace Studies, Kirtland AFB*
https://daytonaero.com/wp-content/uploads/USAF_The-Measures-Handbook_6Aug2014.pdf

Preservation and Storage of Tooling for MDAPs, DUSD Memo, Aug 2009
https://www.acq.osd.mil/dpap/pdi/uid/docs/DrCarterSignedMemo.pdf

Process Capability Control and Improvement Requirements – Process Control Plan Reference Guide, Picatinny Arsenal
https://ac.ccdc.army.mil/organizations/QESA/_files/PCCI_Review_Guide_Rev-1.pdf

Producibility Engineering and Planning (PEP) Program Management Guide, Jan 1985
https://apps.dtic.mil/sti/citations/ADA153730

Producibility Engineering Standard Practice Manual, US Army Belvoir, R&D Center, Sep 1993
http://everyspec.com/ARMY/ARMY-General/PRODUCIBILITY_STD_PRACTICE_MANUAL_SEP1993_34552/

Producibility Systems Guidelines, NAVSO P-3687, Dec 1999
http://everyspec.com/USN/NAVY-General/NAVSO_P-3687_8510/

Product Support Manager Guidebook, May 2022
https://www.dau.edu/tools/t/Product-Support-Manager-(PSM)-Guidebook

Public Law 114-328, §807, Cost, Schedule and Performance of Major Defense Acquisition Programs
https://www.govinfo.gov/content/pkg/PLAW-114publ328/html/PLAW-114publ328.htm

Quality Function Deployment, IEEE article, Kenneth Crow, DRM Associates, Los Angeles, CA
https://www.ieee.li/tmc/quality_function_deployment.pdf

Regulation EC 1907/2006. Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)
Regulation (EC) No 1907/2006 - Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) | Safety and health at work EU-OSHA (europa.eu)

Request for Proposal Evaluation Guide, Reform Support Network, no date, used by state and local education agencies to evaluate proposals
https://www2.ed.gov/about/inits/ed/implementation-support-unit/tech-assist/request-proposals-evaluation-guide.pdf

Requirements Traceability Matrix Guide, Jan 2012
https://www.dau.edu/cop/pqm/_layouts/15/WopiFrame.aspx?sourcedoc=/cop/pqm/DAU%20Sponsored%20Documents/CDD-CPD%20Writing%20Guide,%20Feb%202015.pptx&action=default

Requirements Traceability Matrix Tool (excel), DAU
https://www.dau.edu/tools/Documents/SAM/resources/RTM_Risk_Register.html

Risk, Issues and Opportunity Management Guide for Defense Acquisition Systems, DoD, Jan 2017
http://acqnotes.com/wp-content/uploads/2017/07/DoD-Risk-Issue-and-Opportunity-Management-Guide-Jan-2017.pdf
https://ac.cto.mil/erpo

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

R&M Body of Knowledge (BoK), Aug 2018
https://ac.cto.mil/wp-content/uploads/2020/10/RMBoK-2018-s.pdf

SAE EIA 649B-2011, Configuration Management Standard
https://webstore.ansi.org/Standards/SAE/SAEEIA649B2011EIA649B?gclid=EAIaIQobChMI6NS4yPOL6wIVxf7jBx0qGQxrEAAYAiAAEgLSmPD_BwE

SAE J1739, Potential Failure Mode and Effects Analysis in Design (Design FMEA) and Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA) Reference Manual, SAE International, Jan 2009
https://www.sae.org/standards/content/j1739_200006/

SD-5 Market Research, Defense Standardization Program, Jan 2008
http://acqnotes.com/wp-content/uploads/2014/09/SD-5-Market-Research.pdf

SD-22, DMSMS Guidebook
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_5280185_60384008

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

Should Cost Affordability Memo, Aug 2011
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)

Supply Chain Metrics Guide, Sep 2021
https://www.acq.osd.mil/log/LOG_SD/.policy_vault.html/Supply_Chain_Metrics_Guide_22Sep2021.pdf

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

Systems Engineering Guidebook, Feb 2022
https://ac.cto.mil/wp-content/uploads/2022/02/Systems-Eng-Guidebook_Feb2022-Cleared-slp.pdf

Technology Readiness Assessment (TRA) Deskbook, Jul 2009 (update forthcoming)
http://www.acqnotes.com/Attachments/Technology%20Readiness%20Assessment%20Deskbook.pdf

Technology Readiness Assessment Guide, GAO Report: GAO-20-48G, Jan 2020
https://www.gao.gov/assets/710/703694.pdf

Technology Transition Managers Guide, Real title is Manager's Guide to Technology Transition in an Evolutionary Acquisition Environment, DAU Press, Jun 2005
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)

Appendix C: Manufacturing and Quality Tools

Tools identified in the M&Q BoK are listed below alphabetically and many contain a link to the referenced tools that are 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

Acquisition Decision Memorandum (ADM) MDD Template, Milestone A
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

Acquisition Decision Memorandum (ADM) MDD Template, Milestone C
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=2ahUKEwiRsPqKmdXtAhULlKwKHZ_lBX4QFjAAegQIAxAC&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%20Asess%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 (AS) 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

Analysis of Alternatives (AoA) Study Plan Template
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

AoA Study Plan Template
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

Award Fee Plan Checklist
https://www.acq.osd.mil/dpap/ccap/cc/jcchb/Files/Topical/1Restricted/award.fee.oct08.pdf

Award Fee Plan 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

Capability Development Document (CDD) Template
http://acqnotes.com/acqnote/acquisitions/capability-development-document-cdd

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)
Note: User must register on the DCMA 360 portal to get access

Cost Analysis Requirements Description (CARD) Guidance (see CAPE website for tools)
http://acqnotes.com/acqnote/careerfields/cost-analysis-requirements-description

Cost Analysis Requirements Description (CARD) Template
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)

DMCA Engineering Surveillance Plan
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-207.pdf

DCMA Industrial Capability Assessment Survey
Note: User must register on the DCMA 360 portal

DCMA Manufacturing and Production Surveillance Plan
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-204.pdf

DCMA Manufacturing Systems Risk Assessment (MSRA) Checklist
Note: User must register on the DCMA 360 portal

DCMA Material Management and Accounting System (MMAS) Audit
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-211.pdf

DCMA Pre-Award Survey System (PASS) review
https://www.dcma.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.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-204.pdf

DCMA Program Assessment Report
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-MAN-3101-02.pdf

DCMA Program Support Plan (DCMA-ANX 205-02)
Note: *User must register on the DCMA 360 portal*

DMCA QA Surveillance Plan
https://www.dcma.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 Performance-Based Payments
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

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

Earned Value Management
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.dcma.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-sbnsAhVHuVkKHaU5Di0QFjAAegQIAhAC&url=http%3A%2F%2Fwww.secnav.navy.mil%2Frda%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

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), all threads
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 Environmental Management System (EMS) Gap Analysis Checklist
Internet Search

ITAR Compliance Checklist
Internet Search

Lead Time Estimator
Internet Search

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

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

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/

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

Material Requirements Planning (MRP I)
Internet Search

Materials Requirements Planning (MRP) Assessment
Internet Search

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

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

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

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/armyesoh/DAU%20Sponsored%20Documents/MIL-STD-882E.pdf

Preliminary Hazards Analysis (PHA) (*See* MIL-STD-882E, Task 202)
https://www.dau.edu/cop/armyesoh/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/

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

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

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

Shop Floor Manufacturing Plan Analysis
Internet Search

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&usg=AOvVaw0v19l6mRlO1PqWG6r6zOWY

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.

Taguchi Loss Function Analysis
Internet Search

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%2013.pdf

Test and Evaluation Master Plan (TEMP) template
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
Internet Search

Appendix D: Sample Manufacturing and Quality Assurance Request for Proposal Input

Sample Manufacturing and Quality Assurance Request for Proposal Input

Office of the Under Secretary of Defense for Research and Engineering

2021

Developed in coordination with Air Force Life Cycle Management Center and industry representatives following the 2017 Defense Manufacturing Conference Manufacturing and Quality Roundtable, which identified the need for more consistent manufacturing and quality contracting approaches across the Department of Defense.

Contents

Introduction

This document provides examples for Manufacturing and Quality Request for Proposal (RFP) inputs, including the Statement of Work (SOW), Sections L and M for competitive acquisitions, and Federal Acquisition Regulation (FAR)/Defense Federal Acquisition Regulation (DFAR) requirements.

The Core SOW requirements should be used on all Acquisition Category (ACAT) I programs. They may be used on other programs but should be tailored as needed to match the scope and needs of each program. For all of the requirements and other inputs in this guide, program team with input from manufacturing and quality specialist should conduct specific tailoring to ensure requirements are appropriate to meeting the unique needs and circumstances of each program.

If possible, developing contractual requirements should be a collaborative process between the government program office and the prime contractor.

Data Item Descriptions (DIDs):

- Prior to using a DID, ensure the most current version is being referenced.
- Use caution when calling out DIDs: Some requirements in the SOW do not have DIDs that directly correspond to them. In those cases, the closest, related DID is suggested. In other cases, some DIDs may be significantly outdated. They were provided to serve as a potential starting point and may need to be tailored. These will be discussed in each section, if applicable.

Manufacturing and Quality RFP Guide Summary Applicability Matrix

The following table is provided for general guidance only. Specific determinations of program and contract applicability should be made on a case-by-case basis.

All requirements are applicable to land, sea, air, and space-based systems. The only exception is for Aviation Critical Safety Items, which are applicable only to air and space systems.

Where checkmarks are shown, that requirement should be considered for inclusion in a SOW. Requirements may still be tailored to meet program needs.

Manufacturing and Quality Input to RFP

Manufacturing/Quality RFP Inputs	MSA	TMRR	EMD	P&D	O&S	Design Change	NDI/COTS
Core SOW Inputs							
Manufacturing Management Program		✓	✓	✓	✓	✓	
Quality Management System Requirements		✓	✓	✓	✓	✓	✓
Manufacturing Readiness Levels and Assessments (MRLs)	✓	✓	✓	✓	✓	✓	✓
Quality and Manufacturing Metrics		✓	✓	✓	✓	✓	✓
Counterfeit Parts Prevention		✓	✓	✓	✓	✓	✓
First Article Inspections/First Article Tests			✓	✓	✓	✓	✓
GIDEP Participation			✓	✓	✓	✓	
Production Readiness Review			✓	✓		✓	✓
Other SOW requirements to consider							
Aviation Critical Safety Items		✓	✓	✓	✓	✓	
Manufacturing Modeling and Simulation		✓	✓	✓	✓	✓	
Calibration			✓	✓	✓	✓	
Configuration Management		✓	✓	✓	✓	✓	
Risk Management		✓	✓	✓	✓	✓	
Parts, Materials, and Processes Control Program		✓	✓	✓	✓	✓	
Environmental Stress Screening		✓	✓	✓	✓	✓	
Key Characteristics and Variation Reduction		✓	✓	✓	✓	✓	
Advanced Product Quality Planning (APQP) & Production Part Approval Process (PPAP)			✓	✓	✓	✓	

1. Core SOW Inputs

1.1. Manufacturing Management Program

The contractor shall establish and maintain a Manufacturing Management Program that meets the requirements of SAE AS6500A and flow this requirement down to major/critical suppliers. The contractor shall document this program as part of their Manufacturing Plan. The contractor shall include its plans for Production Readiness Reviews (PRRs) and Manufacturing Readiness Level (MRL) Assessments in the Manufacturing Plan.

Suggested Data Item Description (DID):

- DI-MGMT-81889B, Manufacturing Plan

Guidance:

1. Major and critical suppliers are defined in AS6500A:

Critical Supplier: A contractor whose performance could seriously jeopardize the successful achievement of a program's cost, schedule, technical, or supportability requirements if not satisfactorily managed (e.g., a sole source supplier or supplier of critical parts, strategic and critical materials, or unique or special processes.)

Major Supplier: A supplier, distributor, vendor, or firm that furnishes supplies or services to or for the prime contractor whose total costs are a significant portion of the total purchased value for the program.

2. While the requirement for a manufacturing management system is applicable during the TMRR phase, it may be too early to require a deliverable manufacturing plan.

3. The DID for a Manufacturing Plan, DI-MGMT-81889B, was updated to be consistent with AS6500A.

1.2. Quality Management System Requirements

The contractor shall establish and maintain a Quality Management System (QMS) that meets the requirements of AS9100. The quality system shall ensure delivery of product that complies with all technical requirements. The Contractor shall document how the QMS is implemented with any unique requirements within the Quality Assurance Program Plan. Major/critical suppliers and suppliers with design authority shall be required to establish and maintain a Quality Management System (QMS) in accordance with requirements of AS9100. Suppliers without design authority shall be compliant to SAE AS9003, Inspection and Test Quality System, as a minimum.

Suggested DID:

- DI-QCIC-81794A, Quality Assurance Program Plan, contractor format acceptable

Guidance:

1. AS9100 is the preferred requirement for a Quality Management System for ACAT I programs in Aviation, Space, and Defense Organizations. The Federal Acquisition Regulation, Part 46, also recognizes overarching quality management system standards such as ISO 9001, ASQ/ANSI E4; ASME NQA-1, SAE AS9003, and ISO/TS 16949. If applying any of these other standards, ensure they are appropriate to the complexity and criticality of the product.

2. The most recent version of AS9100 (or equivalent standard) shall be specified.

3. While the requirement for a quality management system is applicable during the TMRR phase, it may be too early to require a deliverable quality plan.

1.3. Manufacturing Readiness Levels and Assessments (MRLs)

The contractor shall conduct assessments of manufacturing readiness in accordance with AS6500A and use the definitions, criteria, and processes defined in the Manufacturing Readiness Level Deskbook as a guide. Assessments will be conducted at the locations and frequencies specified in Appendix TBD. They will be led by the government program office at the prime contractor's facilities. The prime contractor shall lead the assessments at suppliers and include government participants. The selection of supplier assessments should be determined by the government and prime contractor using the MRL Deskbook, Section 4.3 as a guide. The contractor shall develop and implement Manufacturing Maturation Plans or their equivalent for criteria in which the MRL is lower than the target MRL. The contractor shall monitor and provide status at all program reviews for in-house and supplier MRLs and shall re-assess MRLs in areas for which design, process, source of supply, or facility location changes have occurred that could impact the MRL.

Suggested DIDs:

- DI-SESS-81974, Assessment of Manufacturing Risk and Readiness
- DI-ADMIN-81249B, Conference Agendas
- DI-ADMIN-81250B, Conference Minutes
- DI-MISC-80508B, Technical Report – Study/Services

Guidance:

1. Ensure DIDs are current and appropriate.

1.4. Quality and Manufacturing Metrics

In accordance with AS6500A, the contractor shall maintain a manufacturing surveillance process. The contractor shall submit quality and manufacturing metrics at the agreed upon frequency that report the contractor's and major/critical suppliers' performance and progress. Metrics shall include cost, schedule, and quality metrics to monitor the effectiveness of the contractor's manufacturing, quality, and supplier management programs. Metrics shall be

presented at design, technical, and program management reviews. The contractor shall provide on-line access of these metrics to the government.

Suggested DIDs:

- DI-QCIC-82323, Manufacturing and Quality Assurance Status Report

Guidance:

1. Tailor the list of metrics in the DID to meet your specific program needs.

2. On-line access to contractor metrics may be desired, but not feasible. Discuss this with the prime contractor before including this as a requirement.

1.5. Counterfeit Parts Prevention

The contractor shall develop and implement a Counterfeit Parts Prevention (CPP) program in compliance with SAE AS5553 and AS6174 to prevent the inclusion of counterfeit parts or parts embedded with malicious logic into products intended for sale to the Government. These requirements shall be flowed to suppliers to ensure requirements are met. As part of CPP, the contractor shall make available to the government Certificates of Conformance (CoC) as well as supply chain traceability for all electronic part purchases.

Suggested DID:

- DI-MISC-81832, Counterfeit Prevention Plan

Guidance:

1. The RFP could request the elements of DI-MISC-81832 be included in the contractor's Program Protection Implementation Plan (PPIP), DI-ADMN-81306. Another good reference source is SAE-AS6081; Parts, Electronic, Fraudulent/Counterfeit: Avoidance, Detection, Mitigation, and Disposition.

2. The DID may be significantly out of date. Review for appropriateness prior to use.

1.6. First Article Inspections (FAI)/First Article Tests (FAT)

The contractor shall establish an FAI/FAT process and perform FAIs/FATs on new and modified product in accordance with AS9102, "Aerospace First Article Inspection Requirement." First article inspections shall be conducted on new products representative of the first production run and when changes occur that invalidate the original results (e.g., engineering changes, manufacturing process changes, tooling changes). The contractor shall notify the Government program office, and designated representative(s) of first article inspection events to allow for participation. An FAI/FAT report shall be generated for each product as evidence that the engineering requirements have been met.

Suggested DIDs:

- DI-NDTI-81307A, First Article Qualification Test Plan and Procedures
- DI-NDTI-80809, Test/Inspection Report

Guidance:

1. The DIDs may be out of date or not related exactly to the SOW requirement. Review for appropriateness prior to use.

2. Applicability to O&S phase is based on new designs, suppliers, or other changes.

1.7. Government Industry Data Exchange Program (GIDEP) Participation

The contractor shall implement procedures and processes for their participation in GIDEP, including the submission of alerts/advisories to GIDEP when warranted. The processes and procedures shall describe how the contractor (a) receives alerts and advisories from GIDEP and other sources, (b) determines any impact to their product design and already manufactured hardware, (c) implements corrective action procedures when design and/or produced hardware are affected, and (d) includes supplier participation.

Suggested DID:

- DI-QCIC-80125B, Government Industry Data Exchange Program (GIDEP) Alert/Safe-Alert Report
- DI-QCIC-80126B, Government Industry Data Exchange Program (GIDEP) Alert Response

1.8. Production Readiness Review (PRR)

The contractor shall perform PRRs in support of the Milestone C/FRP Decision in accordance with IEEE 15288.2. These requirements shall be flowed to the contractor's major and critical suppliers.

Suggested DIDs:

- DI-ADMIN-81249B, Conference Agendas
- DI-ADMIN-81250B, Conference Minutes
- DI-MISC-80508B, Technical Report – Study/Services

Guidance:

1. The requirement for a PRR is a Core requirement for contracts that will result in a Milestone C or FRP Decision

2. Ensure deliverable plans, minutes, etc., are not already required in another section of the SOW for technical reviews and audits. Ensure DIDs are compatible with IEEE 15288.2 requirements, if imposed.

2. Other SOW Requirements to Consider

2.1. Aviation Critical Safety Items (CSIs)

The contractor shall identify, establish and manage aviation CSIs using the Joint Aeronautical Logistics Commanders (JALC) Critical Safety Item Management Handbook and SAE AS9017, "Control of Aviation Critical Safety Items," as guides. The contractor shall develop a list of Critical Safety Items, their Key or Critical Characteristics (KCs/CCs), and associated Critical Manufacturing Processes. The contractor shall identify, measure and reduce variability of KCs/CCs and provide a formal method to manage and monitor all critical processes associated with CSIs. The contractor shall flow requirements to the lowest level of the supply chain.

Suggested DIDs:

- DI-SAFT-81932, Critical Safety Item (CSI) / Critical Application Item (CAI) List
- DI-SAFT-80970A, Critical Safety Item, Characteristic and Critical Defect Report

Guidance:

1. Requirements for CSI management should be balanced against the costs.

2. The DIDs may be out of date. Review for appropriateness prior to use.

2.2. Manufacturing Modeling and Simulation

The contractor shall analyze manufacturing processes using Modeling & Simulation (M&S) techniques to identify potential bottlenecks or constraints and confirm the achievability of planned cycle times, etc., and provide the government access to the model and data. The model should use commercially available simulation software used to evaluate scenarios and impacts of process variabilities, plant optimizations, production rate changes, capacity planning, and estimate required quantities of tooling, personnel, and inventory. The contractor shall update the production simulation model for facility modifications and other significant changes.

Suggested DID:

DI-MISC-80508B, Technical Report – Study/Services

Guidance:

1. While AS6500A requires the use of Modeling & Simulation, this additional requirement should be imposed if the government program office needs to obtain the contractor's manufacturing model(s) as a deliverable item. This would enable the program office to conduct independent capacity and schedule assessments and to better identify risks independently from the contractor.

2. The DID may be out of date. Review for appropriateness prior to use.

2.3. Calibration

The contractor shall maintain a calibration system in accordance with ANSI/NCSL Z540.3. The calibration system shall control the accuracy of measuring and test equipment, and measurement standards, used to ensure that products delivered to the Government comply with all contract technical specifications. The calibration system shall prevent inaccuracy by ready detection of deficiencies and timely positive action for their correction. Contractors who operate and maintain calibration laboratories or subcontract to outside calibration laboratories shall ensure compliance with requirements of ISO/IEC 17025:2017, General Requirements for the Competence of Testing and Calibration Laboratories.

2.4. Configuration Management

The contractor shall establish, document, and maintain a Configuration Management (CM) system for control of all configuration documentation, physical media, and physical parts representing or comprising the product, which includes all hardware, software, and firmware. The contractor's configuration management system shall consist of these elements:

a. Configuration management and planning.
b. Configuration identification.
c. Configuration change management.
d. Configuration status accounting.
e. Configuration audit.
f. Configuration management of digital data.

The contractor may use MIL-HDBK-61A as additional guidance for CM.

Guidance:

1. Applicability during TMRR should be determined on a case-by-case basis. Consult Configuration Management Subject Matter Experts for guidance.

2.5. Risk Management

The contractor shall establish and maintain a risk management program to continuously identify, analyze, mitigate, monitor, and report systems engineering process, product, technology, cost, schedule, and other program risks. Risk management process results shall be used for continual improvement and risk reduction. Program risks must be assessed and managed at the appropriate level. The contractor shall establish and maintain risk management programs consistent with the DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs.

2.6. Parts, Materials, and Processes Control Program

The contractor shall establish, document, and maintain a Parts, Materials, and Processes Control Program (PMPCP) to ensure selection and use of parts, devices, and materials, including commercial and non-developmental items, meet specified performance, quality, reliability, safety, supportability, and configuration management requirements throughout the life cycle of

the system. The program shall include provisions for mitigating the impact of counterfeit parts and parts obsolescence on product integrity.

The contractor shall flow down applicable PMPCP requirements to applicable lower-tier suppliers.

The contractor may use SD-22, MDA-QS-003-PMAP, MIL-STD-3018, or SMC Standard SMC-S-009 as additional guidance for control of Parts, Materials, and Processes.

Suggested DID:

- DI-MGMT-81949, DMSMS Implementation Plan

2.7. Environmental Stress Screening

The contractor shall implement an Environmental Stress Screening (ESS) program to surface defects by stressing the item without degrading its inherent reliability. Environmental stresses (i.e., thermal cycling and random vibration) may be applied in sequence or in combination, with the intent of stimulating hardware defects. The ESS program should not be used to simulate an operational environment. Results of ESS shall be used to continually improve manufacturing processes. The contractor may use MIL-HDBK-344 as additional guidance for planning, controlling, and measuring the effectiveness of the ESS program.

Guidance:

1. Imposing ESS requirements should be a joint determination by engineering, manufacturing, Quality, and Reliability functional experts. Consider using ESS on major and critical suppliers of electrical, electronic, electro-optical, electromechanical or electrochemical components in demonstration & validation, engineering & manufacturing development and production phases.

2.8. Key Characteristics and Variation Reduction

The contractor shall identify Key Characteristics and implement a Variation Reduction program in accordance with AS9103.

2.9. Advanced Product Quality Planning (APQP) & Production Part Approval Process (PPAP)

The contractor shall implement APQP and PPAP programs in accordance with AS9145.

3. Suggested Section L and M inputs

3.1. Instructions to Offerors Guidance (Section L):

1. Manufacturing Readiness Level Demonstration. The offeror's proposal shall identify those elements (systems, subsystems, suppliers, and/or processes) being assessed for manufacturing risk and their current Manufacturing Readiness Levels using the criteria and process identified in the Manufacturing Readiness Level Deskbook (Link http://www.dodmrl.com). The contractor shall describe the approach used to assess the MRLs. For any element that is assessed to be below the target MRL of 'X', the offeror shall identify the current MRL and the plan to achieve the target MRL.

(Note: DFARS Subpart 215.304 requires that the manufacturing readiness of offerors be considered during source selection for ACAT I programs.)

2. Manufacturing Plan. The offeror shall describe:

a. How their manufacturing management system meets the requirements of AS6500A.
b. The major assembly sequence chart and anticipated manufacturing process flow.
c. The manufacturing build schedule, including drawing release; tooling design, build, and proofing; key supplier deliveries; and fabrication, assembly, and delivery schedules.
d. Facility requirements and layouts.
e. The offeror's plans to provide the needed manpower, facilities, and equipment for expected delivery rates.

3. Quality Systems. The offeror shall describe how their quality system assures product quality; achieves stable, capable processes; prevents defects; and employs effective methods for conducting root cause analyses and implementation of corrective actions.

4. Supplier Management. The offeror shall describe their:

a. Approach to selecting and managing key suppliers.
b. Processes for integration of key supplier activities into the overall program plan to assure that supplier activities support the overall program performance.
c. Specific supplier risks to the program and plans for mitigating those risks.
d. Plan for preventing the intrusion of counterfeit parts in factory equipment and delivered products.

3.2. Evaluation Criteria Guidance (Section M):

1. Manufacturing Readiness Level Demonstration. The offeror's proposal will be evaluated on the maturity of their proposed manufacturing capability, the adequacy of their supporting documentation to justify this capability, and the adequacy of the offeror's process and plans to achieve the target MRL as described in the Manufacturing Readiness Level Deskbook.

This sub-factor is met when the offeror's proposal identifies the elements being assessed for manufacturing readiness and their current MRLs. As described in the proposal, the offeror's

MRL assessment process is consistent with the MRL Deskbook. For elements that are below the target MRL, the proposal describes an achievable plan to meet the target MRL.

2. Manufacturing Plan. This sub-factor evaluates the proposed methods, schedules, and resources for producing the required products. This sub-factor is met when the offeror's proposal:

a. Describes how their manufacturing management system meets the requirements of AS6500A.
b. Describes the major assembly sequence and manufacturing process flows.
c. Includes an integrated, achievable schedule incorporating design, tooling, supplier, fabrication, assembly, and delivery milestones.
d. Describes facility requirements and layouts.
e. Describes achievable plans to provide the needed manpower, facilities, and equipment for expected delivery rates.

3. Quality Systems. This sub-factor evaluates the offeror's planned quality assurance system. This sub-factor is met when the offeror's proposal describes policies and practices that will:

a. Assure product quality.
b. Achieve stable, capable processes.
c. Prevent defects.
d. Result in effective root cause analyses and corrective actions.

4. Supplier Management. This sub-factor evaluates the offeror's proposed supplier management program. This sub-factor is met when the offeror's proposal:

a. Describes how key suppliers are selected and managed.
b. Describes how supplier activities will be integrated into the overall program plan.
c. Lists specific supplier risks and achievable plans for mitigating those risks.
d. Describes effective plans for preventing the intrusion of counterfeit parts in factory equipment and delivered products.

4. FAR/DFARS Clauses

Although the Contracting Officer is ultimately responsible for applying the appropriate FAR and DFARS clauses to the contract, the following sections address topics relevant to the Manufacturing and Quality function. Manufacturing and Quality Subject Matter Experts should be familiar with the requirements of these sections and offer their support and recommendations to the Contracting Officer.

4.1. Higher Level Quality Requirements

FAR Part 46, "Quality Assurance," prescribes the use of various FAR clauses that address quality and inspection requirements, depending upon the nature of the contract. For critical or complex items, clause 52.246-11 must be included in the contract. This clause requires the identification of a specific higher-level contract quality standard. Section 46.202-4 lists examples, such as ISO 9001 and AS9100. The Manufacturing/Quality Subject Matter Expert should work with the Contracting Officer to ensure the appropriate clause is included in the contract and the appropriate higher-level quality requirement is included in 52.246-11.

4.2. Counterfeit Parts Prevention

DFARS 246.870-3 prescribes the use of clauses 252.246-7007, "Contractor Counterfeit Electronic Part Detection and Avoidance System," and 252.246-7008, "Sources of Electronic Parts" when procuring electronic parts or end items that contain electronic parts.

4.3. First Article Approvals

FAR Subpart 9.3 governs First Article Testing and Approval and describes when this testing is required. When it is required, Subpart 9.3 requires either FAR clause 52.209-3 for contractor testing or 52.209-4 for government testing.

4.4. Contract Administration Functions

FAR Subpart 42.302, "Contract Administration functions," lists the activities performed by the Contract Administration Office (typically DCMA.) Manufacturing & Quality-related functions include activities such as performing production surveillance and status reporting, conducting pre-award surveys, monitoring industrial labor relations, ensuring contractor compliance with contractual quality assurance requirements, and reviewing waivers and deviations.

4.5. Labor Relationships

FAR Part 22 describes the government's policies and practices regarding labor relations at contractor facilities. Subpart 22.103-5 prescribes the use of Clause 52.222-1 to require the contractor to notify the government of labor disputes.

4.6. Government Property

FAR Part 45 governs the use of government property. Subpart 45.107 prescribes the use of Clause 52.245-1 when government property is being used.

4.7. Records Retention

FAR Subpart 4.7 governs records retention. Many Manufacturing and Quality-related items, such as receiving and inspection reports, purchase orders, and quality control and inspection records must be retained for four years.

4.8. Contractor Debarment, Suspension, and Ineligibility

FAR Subpart 9.4 discusses reasons that contractors may not be allowed to obtain government contracts. This includes limitations on subcontracting (Subpart 9.405-2). Most contracts must include Clause 52.209-6 that protects the government's interests when subcontracting with debarred (or soon to be debarred) or suspended suppliers.

Acronyms

3D	Three-Dimensional
A_o	Operational Availability
AAF	Adaptive Acquisition Framework
AFRL	Air Force Research Laboratory
AM	Additive Manufacturing
AoA	Analysis of Alternatives
ASR	Alternative Systems Review
CARD	Cost Analysis Requirements Description
CBA	Capabilities-Based Assessment
CCTD	Concept Characterization and Technical Description
CDD	Capability Development Document
CoI	Community of Interest
CONOPS	Concept of Operations
COTS	Commercial Off-the-Shelf
Cpk	Process Capability
CSI	Critical Safety Item
CTE	Critical Technology Element
DARPA	Defense Advanced Research Projects Agency
DID	Data Item Description
DCMA	Defense Contact Management Agency
DTIC	Defense Technical Information Center
DE	Digital Engineering
DFARS	Defense Federal Acquisition Regulation Supplement
DFMA	Design for Manufacturing and Assembly
DFMEA	Design Failure Modes and Effects Analysis
DIU	Defense Innovation Unit
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DoD	Department of Defense
DoDD	DoD Directive
DoDI	DoD Instruction
DP	Development Planning
DTRAM	Defense Technical Risk Assessment Methodology
EMD	Engineering and Manufacturing Development
ESOH	Environment, Safety, and Occupational Health
FFRDC	Federally Funded Research and Development Center
FMEA	Failure Modes and Effects Analysis
FOC	Full Operational Capability
FRP	Full-Rate Production
GAO	Government Accountability Office

GFE	Government Furnished Equipment
GOTS	Government off-the-shelf
IB	Industrial Base
IBA	Industrial Base Assessment or Industrial Base Analysis
ICA	Industrial Capability Assessment
ICD	Initial Capabilities Document
IMP/IMS	Integrated Master Plan/Integrated Master Schedule
IoT	Internet of Things
IIOT	Industrial Internet of Things
IOC	Initial Operational Capability
IPT	Integrated Product Team
ISO	International Organization for Standardization
IT	Information Technology
ITRA	Independent Technical Risk Assessment
JCIDS	Joint Capabilities Integration and Development System
KC	Key Characteristic
KPP	Key Performance Parameter
KSA	Key System Attribute
LCSP	Life Cycle Sustainment Plan
LRIP	Low-Rate Initial Production
M&S	Modeling and Simulation
M&Q	Manufacturing and Quality
ManTech	Manufacturing Technology
MBE	Model-Based Engineering
MBSE	Model-Based Systems Engineering
MCA	Major Capability Acquisition
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MDD	Materiel Development Decision
ME	Mission Engineering
MFA	Manufacturing Feasibility Assessment
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOS	Measure of Suitability
MOSA	Modular Open Systems Approach
MTBF	Mean Time Between Repair
MTTR	Mean Time To Repair
MMP	Manufacturing Maturation Plan
MRA	Manufacturing Readiness Assessment
MRL	Manufacturing Readiness Level

MS A	Milestone A
MS B	Milestone B
MS C	Milestone C
MSA	Materiel Solution Analysis
MS&T	Manufacturing Science and Technology
MTA	Middle Tier of Acquisition
NDAA	National Defense Authorization Act
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NRL	Naval Research Laboratory
NTIB	National Technology and Industrial Base
O&S	Operations and Support
OT	Operational Technology
OT&E	Operational Test and Evaluation
PDR	Preliminary Design Review
PESHE	Programmatic Environmental, Safety, and Occupational Health Evaluation
PFMEA	Process Failure Modes and Effects Analysis
PM	Program Manager or Program Management
Ppk	Process Performance
PPP	Program Protection Plan
Pre-MDD	Pre-Materiel Development Decision
P&D	Production and Deployment
PRR	Production Readiness Review
QA	Quality Assurance
QMS	Quality Management System
R&D	Research and Development
RAM	Reliability, Availability and Maintainability
RCO	Rapid Capability Office
RCT	Requirements Correlation Table
RFP	Request for Proposal
RIO	Risk, Issue, and Opportunity
ROI	Return on Investment
SBIR	Small Business Innovation Research
SE	Systems Engineering
SEMP	Systems Engineering Management Plan
SEP	Systems Engineering Plan
SETR	Systems Engineering Technical Review
SFR	System Functional Review
SME	Subject Matter Expert
SRD	System Requirements Document

SRR	System Requirements Review
STTR	Small Business Technology Transfer
S&T	Science and Technology
TAPP	Technology Area Protection Plan
T&E	Test and Evaluation
TEMP	Test and Evaluation Master Plan
TMRR	Technology Maturation and Risk Reduction
TPM	Technical Performance Measure
TRA	Technology Readiness Assessment
TRL	Technology Readiness Level
UCA	Urgent Capability Acquisition
WBS	Work Breakdown Structure

Bibliography

Resources related to the guide are listed below 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. Readers may need to conduct an Internet search to find the most recent version.

10 USC 2440, DFARS Subpart 207.1, Technology and Industrial Base Plans.
https://www.govinfo.gov/app/details/USCODE-2011-title10/USCODE-2011-title10-subtitleA-partIV-chap144-sec2440

10 USC 2448b, Independent Technical Risk Assessments.
https://www.govinfo.gov/content/pkg/USCODE-2016-title10/html/USCODE-2016-title10-subtitleA-partIV-chap144B-subchapIII.htm

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 2521, Manufacturing Technology Program.
https://www.govinfo.gov/content/pkg/USCODE-2010-title10/pdf/USCODE-2010-title10-subtitleA-partIV-chap148-subchapIV-sec2521.pdf

48 CFR 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting.
https://www.law.cornell.edu/cfr/text/48/252.204-7012

Acquisition Process/Acquisition Strategy, Defense Acquisition University.
www.acqnote/acquisitions/acquisition-strategy

Adaptive Acquisition Framework, Defense Acquisition University.
https://aaf.dau.edu

Air Force Digital Campaign—Contracting Approaches (AFMC)
https://wss.apan.org/af/aflcmc (request user account and password)

Air Force Materiel Command (AFMC), Development Planning Guide, June 17, 2010.

Analysis of Alternatives, Defense Acquisition University.
www.acqnote/acquisitions/analsis-of-alternatives

Analysis of Alternatives (AoA) Handbook, Office of Aerospace Studies, August 2017.
https://afacpo.com/AQDocs/AoAHandbook.pdf

CJCS. Manual for the Operation of the Joint Capabilities Integration and Development System (JCIDS Manual), Chairman of the Joint Chiefs of Staff, J-8, October 30, 2021.

CJCSI 3100.01E, Joint Strategic Planning System, Chairman of the Joint Chiefs of Staff, May 21, 2021.

CJCSI 5123.01I, "Charter of the Joint Requirements Oversight Council (JROC) and Implementation of the Joint Capabilities Integration and Development System (JCIDS)," Chairman of the Joint Chiefs of Staff, J-8, October 30, 2021.

DCMA-INST-3401, Defense Industrial Base Mission Assistance.
https://www.dcma.mil/Portals/31/Documents/Policy/DCMA-INST-3401.pdf

Defense Technical Risk Assessment Methodology (DTRAM) Tier 0-1 Criteria.
https://ac.cto.mil/wp-content/uploads/DTRAM-0-1.pdf

Design for Manufacturing and Assembly (DFMA).
https://www.dau.mil/cop/pqm/DAU%20Sponsored%20Documents/DFMA%20new.doc

DFARS Clause 207.106, “Additional Requirements for Major Systems.”

DFARS Clause 252.204-7012, “Safeguarding Covered Defense Information and Cyber Incident Reporting.”

DoD Digital Engineering Body of Knowledge, February 2022.
https://www.dodtechipedia.mil/dodwiki/pages/viewpage.action?pageId=760447627

DoD Digital Engineering Strategy, Office of the Under Secretary of Defense for Research and Engineering, June 2018.
https://ac.cto.mil/wp-content/uploads/2019/06/2018-Digital-Engineering-Strategy_Approved_PrintVersion.pdf

DoD Directive 4200.15, “Manufacturing Technology (ManTech) Program,” October 15, 2018.

DoD Directive 5137.02, “Under Secretary of Defense for Research and Engineering, USD(R&E),” July 15, 2020.

DoD Directive 5000.01, “The Defense Acquisition System,” September 9, 2020.

DoD Handbook 5000.60H, “Assessing Defense Industrial Capabilities,” April 1996.

DoD Instruction 4245.15, “Diminishing Manufacturing Sources and Material Shortages Management,” November 5, 2020.

DoD Instruction 5000.02, “Operation of the Adaptive Acquisition Framework,” January 23, 2020.

DoD Instruction 5000.60, “Defense Industrial Capabilities Assessments,” July 2014.

DoD Instruction 5000.67, “Prevention and Mitigation of Corrosion on DoD Military Equipment and Infrastructure,” August 2018.

DoD Instruction 5000.80, “Middle Tier of Acquisition,” December 2019.

DoD Instruction 5000.81, “Urgent Capability Acquisition,” December 2019.

DoD Instruction 5000.83, “Technology and Program Protection to Maintain Technological Advantage, Change 1,” May 21, 2021.

DoD Instruction 5000.85, “Major Capability Acquisition,” August 6, 2020.

DoD Instruction 5000.88, “Engineering of Defense Systems,” November 18, 2020.

DoD Manual 4245.7-M “Transition from Development to Production,” September 1985.
https://apps.dtic.mil/dtic/tr/fulltext/u2/a303209.pdf

DoD Manufacturing and Quality Body of Knowledge, January 2021 (or latest version).
https://www.ac.cto.mil/maq/

DoD Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs, Office of the Deputy Assistant Secretary of Defense for Systems Engineering, January 2017.

DoD Systems Engineering Plan (SEP) Outline, Version 4.0, Office of the Under Secretary of Defense for Research and Engineering, September 2021.
https://ac.cto.mil/erpo/

Engineering of Defense Systems Guidebook, Office of the Under Secretary of Defense for Research and Engineering, February 2022.
https://ac.cto.mil/erpo/

GAO Report 09-665, Analysis of Alternatives, September 2009.

GAO Report 20-48G, Technology Readiness Assessment Guide: Best Practices for Evaluating the Readiness of Technology for Use in Acquisition Programs and Projects, January 2020.
https://www.gao.gov/assets/710/703694.pdf

IEEE 15288.2, Standard for Technical Reviews and Audits on Defense Programs, July 7, 2015.

Independent Logistics Assessment Guidebook, Defense Acquisition University, July 2011.
https://www.dau.edu/tools/t/Logistics-Assessment-Guidebook

Independent Technical Risk Assessment (ITRA) Resources, Office of the Under Secretary of Defense for Research and Engineering.
https://ac.cto.mil/itra/

Manufacturing Maturation Plan (See MRL Deskbook). MRL Working Group.
http://www.dodmrl.org

Manufacturing Readiness Level (MRL) Deskbook. MRL Working Group.
http://www.dodmrl.org

The Measures Handbook. Office of Aerospace Studies, Kirtland Air Force Base, August 2014.

MIL-HDBK-727, Design Guidance for Producibility.

MIL-HDBK-896, Department of Defense Handbook Manufacturing Management Program Guide.

Mission Engineering Guide, Office of the Under Secretary of Defense for Research and Engineering, November 2020.
https://ac.cto.mil/erpo/

NAVSO P-3687, Producibility Systems Guidelines, December 1999.
http://everyspec.com/USN/NAVY-General/NAVSO_P-3687_8510/

NIST SP 800-171 Rev 2, Protecting Controlled Unclassified Information in Non-Federal Systems and Organizations, February 2020.

Reliance 21 Operating Principles: Bringing Together the DoD Science and Technology Enterprise. Defense Science and Technology, January 2014. https://defenseinnovationmarketplace.dtic.mil/wp-content/uploads/2019/08/Reliance_21_Op_Principles_Jan_2014.pdf

SD-26, Defense Standardization Program Office DMSMS Contract Language Guidebook, October 2019.
https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=283456

Systems Engineering Guidebook, Office of the Under Secretary of Defense for Research and Engineering, February 2022.
https://ac.cto.mil/erpo/

Technology Readiness Assessment (TRA) Guidance. Assistant Secretary of Defense for Research and Engineering, April 2011.

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

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https://ac.cto.mil/engineering

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