Introduction to Manufacturing Readiness Levels (MRLs)

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Industrial Engineer

CBT Code: MFGDL006
CLPs: 1
Approx. Length:
Agenda

• Purpose of Manufacturing Readiness Levels (MRLs)
  • About this Course
  • Benefits AS6500
  • Overview
• What are Manufacturing Readiness Levels (MRLs)
  • MRL Evaluation Criteria
  • Definitions / Descriptions / Considerations
  • Experience in DOD / Commercial Environment
• SAE AS6500
• MRLs and Surveillance Process
  • Manufacturing Readiness
  • MRL Relationship to System Acquisition Milestone
• Manufacturing Program Support
• Manufacturing Development Program Surveillance
  • MRA / Deliverables
  • Benefits
  • Findings and Concussions
• MRL/MRA Resources
• Questions
• Upon completion of this course, you will be able to comprehend how the MRL process is a critical step to ensure programs has both the required manufacturing capability and resources to achieve program success. During the surveillance process; assessing manufacturing maturity and risk; involving technology, and resources. Understanding how cost and schedule are directly impacting the program viability and success.

• Intended Audience:
  • Industrial Specialist (1150)
  • Industrial Engineers (0896)
  • Any other DCMA employee wanting to gain knowledge of MRLs
Purpose

- Promote basic understanding of the Manufacturing Readiness Levels
- Providing an additional tool for risk determination under Manufacturing Development Program Surveillance
- Develop a proactive and aggressive approach to accurately conduct risk determination for Cost, Schedule, and Program Success
Benefits AS6500

A Manufacturing Management standard will benefit both DoD and Industry:

• **Provides a quick “Snapshot, Consistency, and Insight to Accurately track the Program Performance**
• Provides a vehicle to contractually communicate manufacturing requirements
• Promotes more consistent customer requirements
• Better enables contractors to implement best manufacturing practices by providing a customer requirement against which to budget
• More consistent application of best practices will result in reduced costs, higher schedule confidence, and more robust products
MRLs Overview

An Opportunity:

- An Experienced Industrial Specialist to use the MRLs tool in a Program Environment

- A new Industrial Specialist to use the MRL tool in a Geographic Environment ("Mom and Pop shops")

- Use MRLs as a tool to manage and mitigate Manufacturing Risk
Are you ready? It’s a matter of Maturity….

Manufacturing Maturity!

Knowing what you need to know….

at specific knowledge points!

Source: GAO-05-301 "Defense Acquisitions: Assessments of Selected Major Programs"
MRLs Overview

Is the Design ready?

Is the Design Stable?

Is it Producible?

Have Key Design Characteristics been identified?
Are Materials ready?

Are Materials Available?

Have they been Characterized?

Are there any Special Handling issues?
MRLs Overview

Are resources and cost ready?

Are all Production Costs understood?

Have Design-to-Cost Goals been established?

Is Funding in place to cover production maturation?
Are Processes ready?

Have Critical Processes been identified?

Have Critical Processes been demonstrated?

Are those Processes Stable and In Control?
Are Manufacturing Personnel ready?

Are there any Special Skills required?

Are your folks Trained and Certified?

Is the Workforce Stable?
MRLs Overview

Are Facilities ready?

Are the Facilities in place?

Can the Facilities support production rate?

Will the Facilities Layout support Lean Production?
MRLs Overview

Is the Manufacturing Planning ready?

Has a Manufacturing Plan been completed?

Is the Supply Chain integrated into the plan?

Have Long Lead items been identified?
MRLs Overview

Can help manage cost, schedule and performance risk by examining the maturity of:

- Design Producibility (“The measure of the relative ease of manufacturing”) and Stability – Example: Ford Model T
- Can be built to a predictable program schedule
- Can be built at predictable cost
- Manufacturing processes and tooling
- Workforce skills and training
- Supply chain capabilities
What are MRLs?

- **MRLs** were designed to provide a maturity model based on well developed criteria and are patterned after TRLs (method of estimating technology maturity of Critical Technology Elements) that will in identifying the maturity of their manufacturing efforts on a program or a technology.

- Common language and standard for:
  - Assessing the manufacturing maturity of a technology or product and plans for its future maturation.
  - Understanding the level of manufacturing risk in trying to produce a weapon system or transition technology into a weapon system application.

- Designed to:
  - Complement TRLs.
  - Help set the agenda for manufacturing risk mitigation.
  - Establish an expectation of achieving manufacturing maturity at critical decision points.

**NOTE:** FY04 - Joint Defense Manufacturing Technology Panel (JDMTP) formed MRL Working Group to develop basic MRL definitions and criteria.
Nine areas were developed to help assess the current MRL:

- A - Technology and Industrial Base
- B - Design
- C - Cost and Funding
- D - Materials
- E - Process Capability and Control
- F - Quality Management
- G - Manufacturing Workforce
- H - Facilities
- I - Manufacturing Management
<table>
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<th>MRL</th>
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<td>Manufacturing Feasibility Assessed</td>
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<tr>
<td>2</td>
<td>Manufacturing Concepts Defined</td>
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<tr>
<td>3</td>
<td>Manufacturing Concepts Developed</td>
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<tr>
<td>4</td>
<td>Capability to produce the technology in a laboratory environment.</td>
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<tr>
<td>5</td>
<td>Capability to produce prototype components in a production relevant environment.</td>
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<tr>
<td>6</td>
<td>Capability to produce a prototype system or subsystem in a production relevant environment.</td>
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<tr>
<td>7</td>
<td>Capability to produce systems, subsystems or components in a production representative environment.</td>
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<tr>
<td>8</td>
<td>Pilot line capability demonstrated. Ready to begin low rate production.</td>
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<tr>
<td>9</td>
<td>Low Rate Production demonstrated. Capability in place to begin Full Rate Production.</td>
</tr>
<tr>
<td>10</td>
<td>Full Rate Production demonstrated and lean production practices in place.</td>
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MRL Consideration

MRLs 1 & 2

Research

- Manufacturing Concepts Identified
- Basic Research
- Advance Research
- Advance Technology Development
MRL Consideration

MRL 3
Produce in Lab. Environment

- Mfg. Feasibility Determined
- Mfg. Process Identified
- Key Processes Identified
- Producibility Assessments Initiated
MRL 4
Produced Components in Relevant Environment

- Mfg. Process Emerging
- Producibility Assessment On-going
- Mfg. Cost Drivers Identified
MRL 5
Produced System in a Relevant Environment

- Mfg. Processes Demonstration in a Relevant Environment
- Cost Drivers Analyzed
- Log Terms Items Identified
- Equipment in a Relevant Environment
MRL Consideration

MRL 6
Production Representative Environment

• Mfg. Processes in Development
• Producibility Improvement Underway
• Trade Studies
• Supply Chain Management in Place
MRL 7
Pilot Line Demo, Ready for LRIP

• Process Maturity Demonstrated
• All Materials Ready for LRIP
• Mfg. Processes Proven
• Supply Chain Stable for LRIP
MRL 8
LRIP in Place, Ready for FRP

• Mfg. Processes Operating at Target Quality, Cost and Performance

• Supply Chain Established and Meeting Lead Times
MRL Consideration

MRL 9 & 10
FRP, Lean

- Lean/Six Sigma Production in Place
- Meeting or Exceeding Cost, Schedule and Performance Goals
### MRL Definitions

<table>
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<tr>
<th>MRL</th>
<th>Description</th>
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<td>MRL 1</td>
<td>Manufacturing feasibility assessed</td>
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<tr>
<td>MRL 2</td>
<td>Manufacturing concepts defined</td>
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<td>MRL 10</td>
<td>Full rate production demonstrated and lean production practices in place</td>
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**Production relevant environment:**
An environment normally found during **MRL 5 and 6** that contains key elements of production realism not normally found in the laboratory environment (e.g. uses production personnel, materials or equipment or tooling, or process steps, or work instructions, stated cycle time, etc.). May occur in a laboratory or model shop if key elements or production realism are added.

**Production representative environment:**
An environment normally found during **MRL 7** (probably on the manufacturing floor) that contains most of the key elements (tooling, equipment, temperature, cleanliness, lighting, personnel skill levels, materials, work instructions, etc) that will be present in the shop floor production areas where low rate production will eventually take place.

**Pilot line environment:**
An environment normally found during **MRL 8** in a manufacturing floor production area that incorporates all of the key elements (equipment, personnel skill levels, materials, components, work instructions, tooling, etc.) required to produce production configuration items, subsystems or systems that meet design requirements in low rate production. To the maximum extent practical, the pilot line should utilize rate production processes.
### Acquisition Phase

#### Technical Reviews

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<th>Thread</th>
<th>Sub-Thread</th>
<th>MRL 1</th>
<th>MRL 2</th>
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<tr>
<td>A.1 - Industrial base</td>
<td>Technology Maturity</td>
<td>Should be assessed at TRL 1.</td>
<td>Should be assessed at TRL 2.</td>
<td>Should be assessed at TRL 3.</td>
<td>Should be assessed at TRL 4.</td>
<td>Should be assessed at TRL 5.</td>
<td>Should be assessed at TRL 6.</td>
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### Pre Materiel Solution Analysis (Pre MSA)

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<th>ASR</th>
<th>SRR/SFR</th>
<th>PDR</th>
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#### Design

| B.1 - Productivity Program | Manufacturing research opportunities identified. | Applications defined. Broad performance goals identified that may drive manufacturing. | Top level performance requirements defined. Trade-offs in design options assessed based on experiments. Product lifecycle and technical requirements evaluated. | SEI and Test and Evaluation Strategy recognize the need for the establishment/validation of manufacturing capability and management of manufacturing risk for the product lifecycle. Initial potential Key Performance Parameters (KPPs) identified for preferred systems concept. System characteristics and measures to support required capabilities identified. Form, fit, and function constraints identified and manufacturing capabilities identified for preferred systems concepts. | Lower level performance requirements sufficient to proceed to preliminary design. All enabling/critical technologies and components identified and considered the product lifecycle. Evaluation of Design Key Characteristics (KCs) initiated. Product data required for prototype component manufacturing released. | System allocated baseline established. Product requirements and features are well enough defined to support preliminary design review. Product data essential for subsystem/system prototyping has been released, and all enabling/critical component have been prototyped. Preliminary design KCs have been identified and mitigation plans in development. |
| B.2 - Design Maturity | Manufacturing research opportunities identified. | Applications defined. Broad performance goals identified that may drive manufacturing. | Top level performance requirements defined. Trade-offs in design options assessed based on experiments. Product lifecycle and technical requirements evaluated. | SEI and Test and Evaluation Strategy recognize the need for the establishment/validation of manufacturing capability and management of manufacturing risk for the product lifecycle. Initial potential Key Performance Parameters (KPPs) identified for preferred systems concept. System characteristics and measures to support required capabilities identified. Form, fit, and function constraints identified and manufacturing capabilities identified for preferred systems concepts. | Lower level performance requirements sufficient to proceed to preliminary design. All enabling/critical technologies and components identified and considered the product lifecycle. Evaluation of Design Key Characteristics (KCs) initiated. Product data required for prototype component manufacturing released. | System allocated baseline established. Product requirements and features are well enough defined to support preliminary design review. Product data essential for subsystem/system prototyping has been released, and all enabling/critical component have been prototyped. Preliminary design KCs have been identified and mitigation plans in development. |

### Material Solution Analysis (MSA)

#### Technology Development (TD)

Industrial base capabilities assessment for MSL B has been completed. Industrial capability in place to support manufacturing of development articles. Plans to minimize sole/foreign sources and obsolescence issues complete. Need for sole/single/foreign sources justified. Potential alternative sources identified.

Full MRL criteria matrix can be found at www.dodmrl.com
Industry Associations and companies are supportive of DoD Manufacturing Readiness efforts and support policy
- Participated in Three DoD-Industry Workshops

OEMs and Second Tier Suppliers are using the first or second generation definitions, published in the Technology Readiness Assessment Guide

Many companies have developed their own manufacturing maturity measures.
- Rockwell Collins Manufacturing Maturity Index
- Sikorsky Production Readiness Index

Other companies have adopted our MRLs, and are using them within the company’s gated development process.
- Lockheed Martin Missiles and Fire Control
- Raytheon (Tucson)
- Pratt & Whitney
- General Electric Power Systems
- Boeing (EMRLs for MDA, MRLs for FCS)
- Goodrich
- ... and the list is growing
Implementation: MRL/MRA Experience in DoD

- **Air Force**
  - MRAs completed on 19 Air Force Advanced Technology Demonstrations using the manufacturing readiness level (MRL) criteria; additional 13 are in process
  - Used MRL criteria to perform MRAs on two ACAT 1 Programs

- **Army**
  - Uses MRLs on all 6.3 Programs that have manufacturing or producibility issues tied to Army Technology Objectives- Manufacturing (ATO-M)
  - Army also uses MRLs and MRAs on selected SBIR Projects
  - Army to incorporate MRLs and MRAs into the management aspect of planned Commercialization Pilot Program.

- **MDA**
  - Applies related scale (EMRLs) to manage high risk prototype- production technologies
• The standard provides common definitions for 36 manufacturing-related terms with sources identified:
  - DoD
  - Commercial
  - Mixture
• Definitions represent consensus agreements between government and industry
• Consistency across programs, services, and companies
AS6500 – Manufacturing Management System

- AS6500 is the manufacturing equivalent or supplement to AS9100 and ISO9000
- Covers all aspects of Production and includes requirements for quality assurance and Engineering with the manufacturing functional community.
- Includes requirements from development thru production and requires the use of manufacturing readiness levels (MRLs)
- The Air Force is requiring its use on all ACAT1 programs and it is highly recommended on all others
- It will be required as a contract line item and not as a DFARS requirement
AS6500 – Manufacturing Management System

Manufacturing Management System
Program, Policies, Objectives

Manufacturing Planning
- Manufacturing Plan
- Supply Chain materiel management
- Manufacturing technology
- Cost
- System Verification
- Workforce
- Tooling/Test Equipment/Facilities

Design Analysis for Manufacturing
- Producibility analysis
- Key Characteristics
- Process FMEAs

Manufacturing Operations Management
- Scheduling & control
- Surveillance
- Continuous Improvement
- Process control plans
- Process capabilities
- Production Process
- Verification
- Supplier Management
- Supplier Quality

Manufacturing Risk Identification
Feasibility assessments, MRLs, PRRs
Why Manufacturing Readiness?

- Consensus among Congress, OSD, CSAF, GAO: “Advanced weapon systems cost too much, take too long to field, and are too expensive to sustain”
- GAO study of 54 weapons programs:
  - Core set of 26 programs: RDT&E costs up by 42% ($42.7B total) and schedule slipped by 20% (2.5 years on average)
  - V-22 Osprey:
    - The development budget was first planned for $2.5 billion in 1986
      - Increased to a projected $30 billion in 1988.
      - Between 2008 and 2011, the estimated lifetime cost for maintaining the V-22 grew by 61 percent, mostly allocated to maintenance and support
    - Composite Materials make up 43% of the airframe, including wings prop rotor blades.
    - New technology not available to manufacture composite wings
Why Manufacturing Readiness?

- Products made by immature manufacturing processes generally:
  - Cost more
  - Are prone to quality problems
  - Experience schedule delays
  - May not perform the same
  - Are less reliable in service
MRL Relationship to System Acquisition Milestones

Manufacturing Readiness Levels

- MRL Level 1: Research
  - Manufacturing Concepts Identified
  - Basic Research
  - Advanced Research
  - Advanced Technology Development

- MRL Level 2: Produced in a Lab Environment
  - Mfg. Feasibility Determined
  - Mfg. Processes Identified
  - Key Processes Identified
  - Producibility Assessments Initiated

- MRL Level 3: Produced Components in a Relevant Environment
  - Mfg. Processes Emerging
  - Producibility Assessments On-going
  - Mfg. Cost Drivers Identified

- MRL Level 4: Produced System in a Relevant Environment
  - Mfg. Processes Demo’d in a Relevant Environment
  - Cost Drivers Analyzed
  - Long Lead Items Identified
  - Equipment in a Relevant Environment

- MRL Level 5: Production Representative Environment
  - Mfg. Processes in Development
  - Producibility Improvement Underway
  - Trade Studies
  - Supply Chain Management in Place

- MRL Level 6: Pilot Line Demo Ready for LRIP
  - Process Maturity Demonstrated
  - All Materials Ready for LRIP
  - Mfg. Processes Proven
  - Supply Chain Stable for LRIP

- MRL Level 7: LRIP in Place Ready for FRP
  - Mfg. Processes Operating at Target Quality, Cost and Performance
  - Supply Chain Established and Meeting Lead Times

- MRL Level 8: FRP / Lean
  - Lean/Six Sigma Production in Place
  - Meeting or Exceeding Cost, Schedule and Performance Goals
Some Thoughts on MRLs

- MRLs are not a report card
  - MRL 7 might not be meeting the program milestone
  - MRL 3 might be on track with the program’s milestone
- MRLs are a tool to manage and mitigate manufacturing risk
  - A common language used to assess manufacturing maturity
  - Provide insight not oversight
• **Requirement:** Instruction 204 paragraphs 3.2.5 and 3.2.9 require the manufacturing specialist to support the Program Support Plan (PSP) and Development Plan surveillance respectively.

• **Regulations:**
  
  • FAR 42.302(a)(67)
    • “Support the program, product, and project offices regarding program reviews, program status, program performance and actual or anticipated program problems”
  
  • FAR 42.302(a)(40)
    • “Perform engineering surveillance to assess compliance with contractual terms for schedule, cost, and technical performance in the areas of design, development, and production.”
• **Major Programs in DCMA:** 209 as of 12 September, 2014

• **DAES Programs in DCMA:** 78 as of 12 September, 2014
  • 15 currently rated high risk
  • 13 currently rated moderate risk
  • 16 are software only

• Of the 62 current DAES programs in DCMA with a manufacturing component, approximately 45 percent are rated moderate to high risk.
MANUFACTURING PROGRAM SUPPORT

• Development Program Activities
  • Milestone A
    • Program starts Technology Development
    • Up to 50 percent of costs are set
  • Milestone B
    • Program is initiated
    • Program starts Engineering and Manufacturing Dev.
    • 75 to 80 percent of costs are set
    • Budget is set
  • Milestone C
    • LRIP Starts
    • 95 of costs are set
MANUFACTURING PROGRAM SUPPORT

• Development Program Risks
  1. Is the technology mature enough to build the product?
  2. Does the contractor have experience with this type of product?
  3. Does the contractor have the resources to build the product?
     • Facilities
     • Equipment
     • Personnel
     • Financial
  4. Does the contractor have a reasonable plan to manufacture the product?
  5. Can the subcontractors answer questions 1-4 successfully
MANUFACTURING PROGRAM SUPPORT

• How does this affect me?
  • Schedule
  • Cost
  • Program Viability/Success

• What can we do?
  • Be an active member of the PST.
  • Contact ACO – If required.
  • Know your program
  • Be an honest broker of risks and information on the program
  • Start early
  • Be aggressive
  • Accurately complete your sections of the PAR
How do I know if a program is at risk?

- Does their plan look reasonable?
- Are they meeting their internal schedules?
- Is the buying office, contractor and the contract in synch?
- Can the contractor answer your questions comfortably and with confidence. If not why not? Is there something not being said?
- Has the program/contractor met all of the goals outlined in the following Manufacturing Readiness Level (MRL) timeline? (Even if MRLs are not called out in the contract, the MRLs can be used accurately for risk determination)
MANUFACTURING DEVELOPMENT PROGRAM SURVEILLANCE

5000.02

Pre-MSA  Material Solution Analysis  Technology Development  Engineering & Manufacturing Development  Production & Deployment  Operations & Support

A

MDD

Component  System

Post CDR Assessment

FRP Decision

B

C

Manufacturing Readiness Levels

MRL Level

1  2  3  4  5  6  7  8  9

Research  Produced in a Lab Environment  Produced components in a Relevant Environment  Produced system in a Relevant Environment  Production Representative Environment  Pilot Line Demo Ready for LRIP  LRIP in Place Ready for FRP  FRP / Lean

Consideration


Development

Assess at TRL 1-3  Identify IB Sources  Characterize Basic Materials for Mfg.  Identify Material Concerns  Identify Funding  Identify Advanced ManTech Initiatives  Coordinate with Technology Plan  MDS should include Mfg./OA  Assess at TRL 4  Identify IB Gaps  Assess DFX  Baseline Materials & Issues  Funding/ Budgeting for Trade Studies  Identify ManTech or Other Initiatives  Coordinate with Technology Plan  MTS should include Mfg./OA  Assess at TRL 5  IB Analysis Finished  KPPs Allocated  Key Characteristics Identified  SEP includes Mfg./OA  Funding to meet next level  ManTech Initiatives Initiated  Early Supply Chain assessment  Assess at TRL 6  IB Capability Assessment  Initial Trade Studies  Quality Thresholds Established  Funding to meet next level  ManTech Solutions Developed in Relevant Env.  Early Supply Chain assessment  Assess at TRL 7  IB Monitored  PEP Completed  Materials Being Proven  Funding to meet next level  ManTech Solutions Demonstrated  Supply Chain Being Assessed  BOM Identified  QA Data Collected  Assess at TRL 8  Est. Multi-Sources  Pilot Line Builds Validated  Materials Proven  Funding to meet next level  ManTech Solutions Validated  Quality Characteristics Validated  BOM Supports LRIP  BOM Supports LRIP  Assess at TRL 9  IB Supports Sched.  CPI Ongoing  Materials in Control  Funding to meet next level  Quality Validated with LRIP Articles  Make/Buy Supports FRP  IB Capabilities Assessment  Monitor and Manage all Key Characteristics at a Six Sigma Level  Funding to Meet Six Sigma Goals  No Make/Buy Changes  Key/Critical Suppliers all meet Six Sigma Goals

Technology Plan

ACQUISITION INSIGHT™  GLOBAL ENGAGEMENT

DEFENSE CONTRACT MANAGEMENT AGENCY
**MANUFACTURING DEVELOPMENT PROGRAM SURVEILLANCE**

- **Why is this important?**
  
  - We are DoD's method of independently assessing program manufacturing risks – *(MRL is a tool to perform consistent evaluation)*
  
  - Performing this surveillance in the development program will payoff multiple times in production (schedule and cost)
  
  - DCMA’s history of where we did get involved in development surveillance has proven its value to DoD
What is an MRA?

Instruction 204, “3.2.9.2. When Program Offices utilize the Manufacturing Readiness Level (MRL) criteria and conduct Manufacturing Readiness Assessments (MRA) the Technical Specialist should formally request participation in the planning and execution of the assessments. When the Program Office does not utilize the MRL process and instead conduct other review such as Production Readiness Review, the Technical Specialist should formally request to participate in the planning and execution of such readiness reviews”
What is an MRA?

• Assessment of a program’s readiness to manufacture and produce to its intended design
• A tool to develop and implement:
  • Manufacturing risk mitigation plans
  • Business strategies
• Results in:
  • An assignment of MRLs to key system components
  • The development of a manufacturing maturation plan as required

Identifying manufacturing issues earlier in technology development
MRA Deliverables

Provide briefing and/or written report

- **Assess type and significance of risk to cost, schedule or performance**

- Identify current MRL/target MRL
- Identify key factors where manufacturing readiness falls short of target MRL
  - Define driving issues
- Identify programs and plans to reach target MRL

- Who needs this data?
  - Industrial Specialist
  - Quality Specialist
  - Engineering
  - CMOs
  - ACO / PCO
• Large programs can require multiple MRAs
A Manufacturing Management standard will benefit both DoD and Industry:

- Provides a quick “Snapshot, Consistency, and Insight” to Accurately track the Program Performance
- Provides a vehicle to contractually communicate manufacturing requirements
- Promotes more consistent customer requirements
- Better enables contractors to implement best manufacturing practices by providing a customer requirement against which to budget
- More consistent application of best practices will result in reduced costs, higher schedule confidence, and more robust products
Some MRA Lessons Learned

• Process is more effective if company is actively engaged in the assessment
• System integration and test operations are often ripe for maturation efforts
• Resources required to conduct an MRA will vary significantly
• Subject matter expertise is needed to “do it right”
Findings and Conclusions (review)

• Looking at transitioning technology to production
  – Must incentivize good decision-making processes;
  – Unlike TRLs, going backwards on MRLs might be productive
• A low MRL number may or may not meet the program’s milestone
  – Is there time to raise the level?
  – Is there a new manufacturing process being pursued?
  – Replacing a manual process with an automated process
• Encouraging repeatability, faster cycle time, etc.
• Identify opportunities to validate manufacturing processes
  – Avoid accepting analogous process claims during the design phase and claiming fabrication is maturing
• May never build enough units to reach MRL 10
  – Achieve a Six Sigma or equivalent process
  – Stable line, may require a multi-product factory
MRL/MRA Resources

Found at www.dodmrl.com or www.dodmrl.org

• MRL Deskbook – the “how to” of MRAs
• MRL Criteria
• MRL definitions
• MRL users guide (TBD)
• Under AF ManTech's MRA Tool
  • Air Force ManTech MRA Questions
• SAE- AS6500
Contact us: askmanufacturing@dcma.mil
Visit our 360: https://360.dcma.mil/directorate/EA/SitePages/EAM.aspx
BACKUP SLIDES
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<tr>
<td>PC&amp;C</td>
<td>Process Capability and Control</td>
</tr>
<tr>
<td>RDT&amp;E</td>
<td>Research Development Test &amp; Evaluation</td>
</tr>
<tr>
<td>SBIR</td>
<td>Small Business Innovation Research</td>
</tr>
<tr>
<td>TBD</td>
<td>To be determine</td>
</tr>
<tr>
<td>TRLS</td>
<td>Technology Readiness Levels</td>
</tr>
</tbody>
</table>
### DEFINITIONS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACAT</td>
<td>An acquisition program is categorized based on the criteria in the DoDI 5000.02.</td>
</tr>
<tr>
<td>AS6500</td>
<td>Manufacturing Management Program</td>
</tr>
<tr>
<td>AS9100</td>
<td>Aerospace standard based on the ISO 9001 quality system requirements</td>
</tr>
<tr>
<td>Cost</td>
<td>The value of money that has been used up to produce something</td>
</tr>
<tr>
<td>DFAR</td>
<td>A supplement to the FAR that provides DoD-specific acquisition regulations that DoD government acquisition officials</td>
</tr>
<tr>
<td>FAR</td>
<td>Federal Acquisition Regulation</td>
</tr>
<tr>
<td>FRP</td>
<td>Full Rate Production</td>
</tr>
<tr>
<td>Funding</td>
<td>The act of providing financial resources, usually in the form of money to finance a project.</td>
</tr>
<tr>
<td>LRIP</td>
<td>Low Rate Production</td>
</tr>
<tr>
<td>Milestone A</td>
<td>Milestone Decision Authority (MDA) led review at the end of the Materiel Solutions Analysis (MSA) Phase.</td>
</tr>
<tr>
<td>Milestone B</td>
<td>Milestone Decision Authority (MDA) led review at the end of the Technology Maturation &amp; Risk Reduction (TD) Phase.</td>
</tr>
<tr>
<td>Milestone C</td>
<td>Milestone Decision Authority (MDA) led review at the end of the Engineering and Manufacturing Development (EMD) Phase</td>
</tr>
<tr>
<td>MOM &amp; POP Shops</td>
<td>A small, independent, usually family-owned, controlled, and operated business that has a minimum amount of employees</td>
</tr>
<tr>
<td>MRA</td>
<td>Manufacturing Readiness Assessment</td>
</tr>
<tr>
<td>MRL</td>
<td>Manufacturing Readiness Levels</td>
</tr>
<tr>
<td>PC&amp;C</td>
<td>Process Capacity and Control</td>
</tr>
<tr>
<td>Producibility</td>
<td>Ease of manufacturing an item in large enough quantities</td>
</tr>
<tr>
<td>Producible</td>
<td>Able to produce</td>
</tr>
<tr>
<td>PST</td>
<td>Program Support team</td>
</tr>
<tr>
<td>RDT&amp;E</td>
<td>Research Development Test and Evaluation</td>
</tr>
<tr>
<td>Surveillance</td>
<td>the act of carefully watching someone or something</td>
</tr>
<tr>
<td>TRL</td>
<td>Technology Readiness Levels</td>
</tr>
</tbody>
</table>