DoD Manufacturing and Quality Initiatives: Evolving Role in Systems Engineering

27th Annual National Defense Industrial Association Systems and Mission Engineering Conference

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for Research and Engineering

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Overview

- What Systems Engineering and Architecture Does
  - Specialty Engineering's Manufacturing and Quality Role
- Key Policies Guidance for M&Q
- Priorities:
  - Digital Manufacturing Enterprise
  - Manufacturing & Quality CoP
  - Manufacturing & Quality BoK
  - Joint Strategic Quality Council (JSQC)
    - MBQ Working Groups
  - Quality Guide
- M&Q Service Leads

Systems Engineering & Architecture (SE&A) Manufacturing & Quality (M&Q)

POLICY
DoDI 5000.88 Engineering of Defense Systems
DoDI 5000.93 Use of Additive Manufacturing in the DoD
DoDI 5000.97 Digital Engineering

INITIATIVES
Quality Guide
Model-Based Quality Assurance
Additive Manufacturing Pilot Training
Digital Manufacturing Enterprise – Projects

GUIDANCE
Producibility & Manufacturability Engineering Guide
M&Q Body of Knowledge
Early M&Q Engineering Guide
MIL-HDBK-896 Manufacturing Management

WORKFORCE DEVELOPMENT
Engineering and Technical Management FIT
M&Q Credentials

STANDARDS
AS6500 Manufacturing Management
MIL-STD-31000 Technical Data Packages

TECHNOLOGY/PROGRAM SUPPORT
Additive Manufacturing Qualification/V&V
ITRAs as Required

CONGRESSIONAL/GAO TASKING
FY11/12 NDAA -- Manufacturing Readiness Assessments on MDAPs
FY17 NDAA ITRAs -- Manufacturing Maturity

COLLABORATION (LEAD)
M&Q Service Leads Forum
Digital Manufacturing Enterprise (DME) Working Group

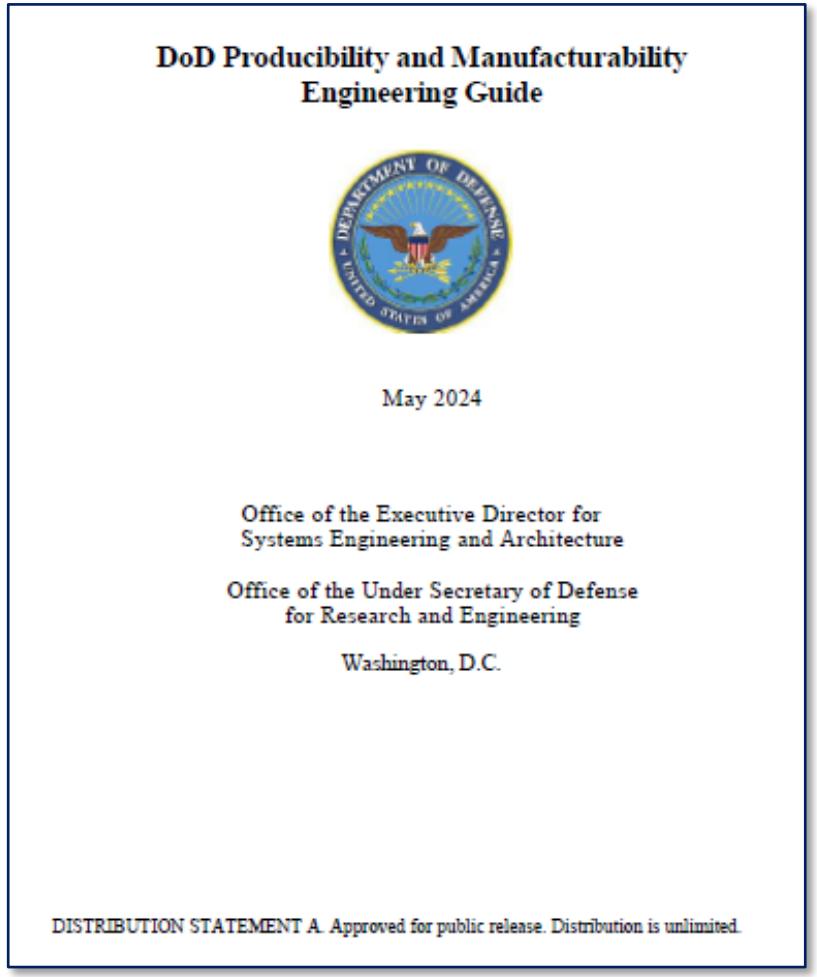
COLLABORATION (PARTICIPANT)
Joint Defense Manufacturing Council
Joint Additive Manufacturing Working Group
Manufacturing Readiness Level Working Group
SAE G-23 Committee (Manufacturing Management Standard)
Joint Strategic Quality Council
NDIA Digital Manufacturing Working Group
M&Q CoP (with DAU)

Key Manufacturing & Quality Related Policy and Guidance

- DoDI 5000.88 Engineering of Defense Systems (2020)
- DoDI 5000.93 Use of Additive Manufacturing in the DoD (2021)
- DoDI 5000.94 Use of Robotics for Manufacturing and Sustainment (2022)
- Engineering of Defense Systems Guidebook (2022)
- Systems Engineering Guidebook (2022)
- M&Q Body of Knowledge (2022) – Version 2.0 coming in 2024
- Manufacturing Readiness Level Deskbook and Criteria (2022)
- System Engineering Plan Outline V4.1 (2023)
- DMSMS (SD-22); Parts Management Guide (SD-19) (2023)
- Early Manufacturing and Quality Engineering Guidebook (2023)
- DoDI 5000.97 Digital Engineering (2023)
- Producibility & Manufacturability Engineering Guide (**R. June 2024**)
- MIL-HDBK-896 Manufacturing Management (Update—2024)

Most M&Q Policy & Guidance updated since 2020

DoD Producibility and Manufacturability Guide


DoD Producibility and Manufacturability Engineering Guide

May 2024

Office of the Executive Director for Systems Engineering and Architecture

Office of the Under Secretary of Defense for Research and Engineering

Washington, D.C.

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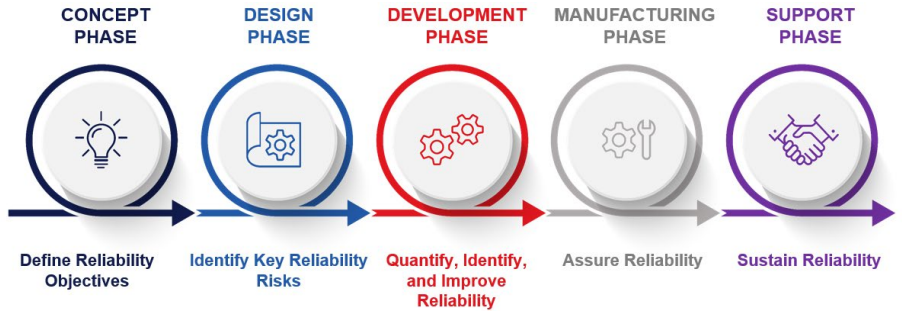
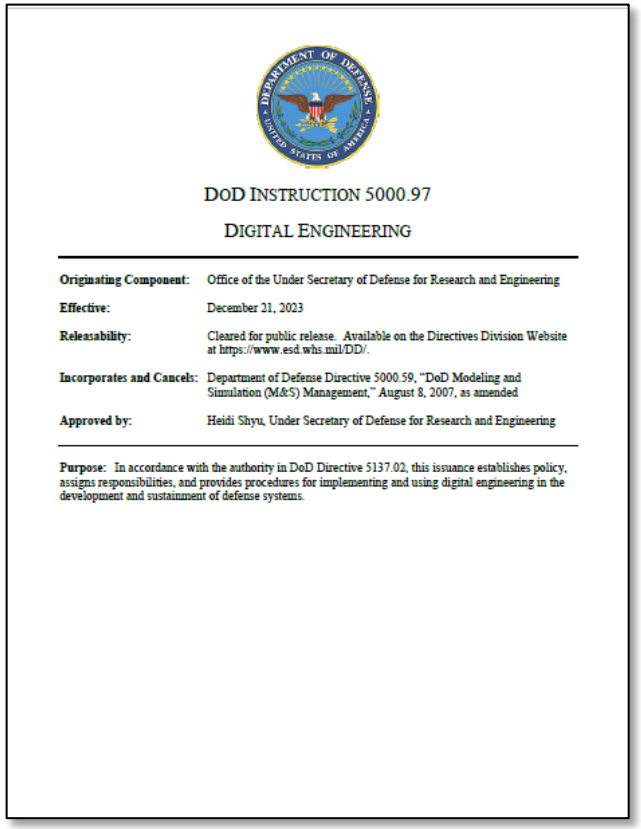


Approved and Released June 2024

- Guidance for DoD engineers and attain producible systems, assemblies, components, and parts.
- Principles and concepts
- Tools
- Role to influence the product design
- Industry 4.0 considerations
- Contracting for producibility
- Producibility Plan content

DoDI 5000.97 Digital Engineering



DoD INSTRUCTION 5000.97

DIGITAL ENGINEERING

Originating Component:	Office of the Under Secretary of Defense for Research and Engineering
Effective:	December 21, 2023
Releasability:	Cleared for public release. Available on the Directives Division Website at https://www.esd.whs.mil/DD/.
Incorporates and Cancels:	Department of Defense Directive 5000.59, "DoD Modeling and Simulation (M&S) Management," August 8, 2007, as amended
Approved by:	Heidi Shyu, Under Secretary of Defense for Research and Engineering

Purpose: In accordance with the authority in DoD Directive 5137.02, this issuance establishes policy, assigns responsibilities, and provides procedures for implementing and using digital engineering in the development and sustainment of defense systems.

Issued December 2023

www.esd.whs.mil/Directives/issuances/dodi/

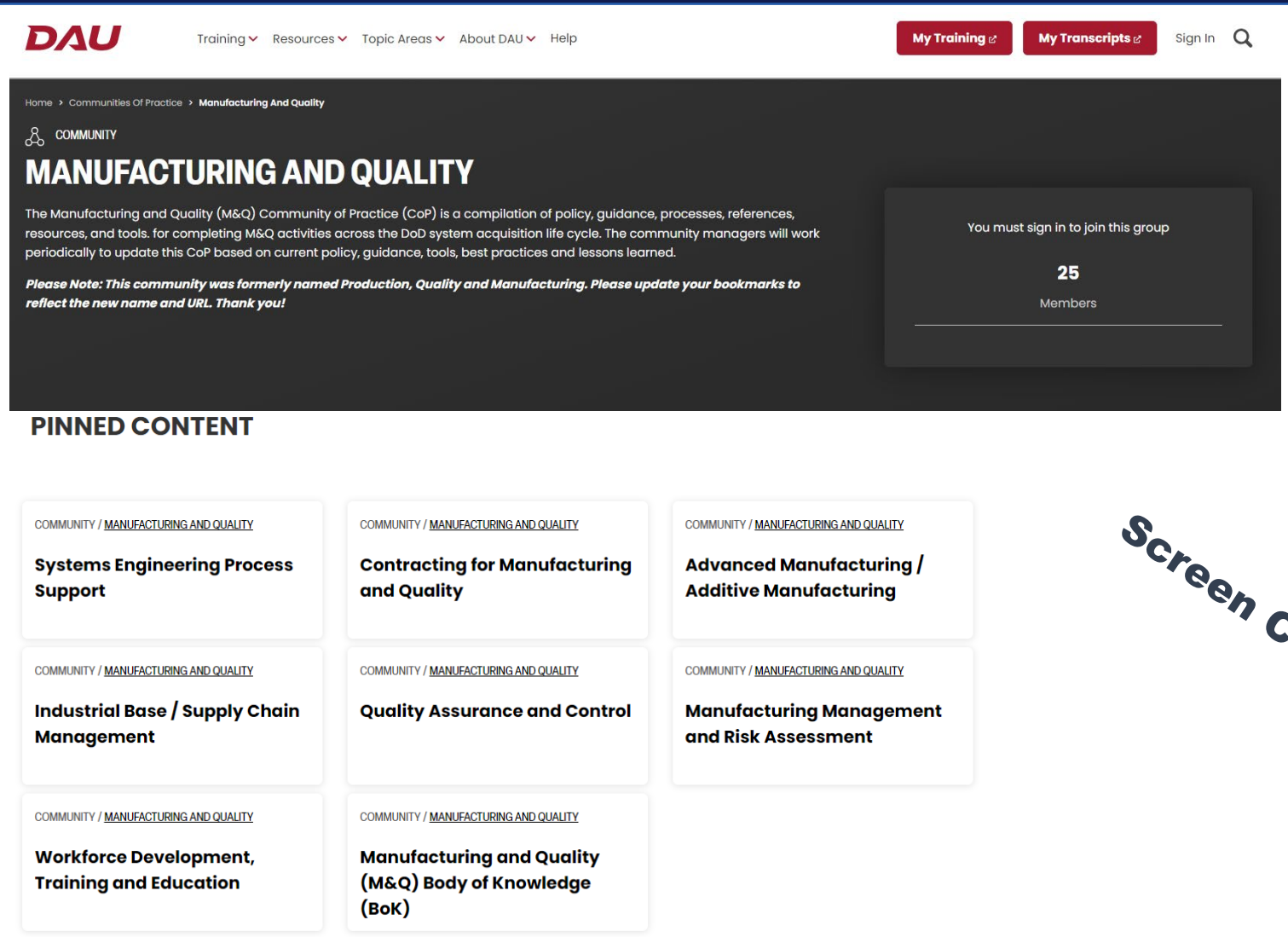
- Incorporates and cancels DoDD 5000.59, "DoD Modeling and Simulation Management" (2007)
- Establishes policy, assigns responsibilities, and provides procedures for implementing digital engineering in the development and sustainment of defense systems
- Digital Engineering (DE):
  - Must be addressed in the Acquisition Strategy and Systems Engineering Plan
  - Including how and when digital engineering will be used in the system life cycle and expected benefits of its use
- Programs initiated after December 2023 will incorporate digital engineering for the capability in development unless the program's decision authority provides an exception
- OUSD(R&E) oversees implementation of DE technical activities including manufacturing and quality

Digital Engineering is a critical practice in an environment of dynamic threats, system complexity, and rapidly evolving technologies

Manufacturing & Quality Community of Practice (CoP)

- SE&A is collaborating with DAU to create a new Manufacturing and Quality (M&Q) CoP
- Objective is to provide active and relevant forum to share M&Q knowledge
- Replacing former Production, Quality, and Manufacturing (PQM) CoP
- DAU also hosts other M&Q forums – may consolidate with M&Q CoP (e.g., Additive Manufacturing)
- Retaining Quality Assurance (DCMA) CoP

Updated DAU M&Q Community of Practice



Screen Capture: 10 July 2024

Manufacturing & Quality Body of Knowledge

The forthcoming M&Q BoK 2.0 adds the following Topics/Areas:

- Digital Engineering / Modeling & Simulation
- Digital Manufacturing
- Industry 4.0/ eManufacturing
- Manufacturability / Producibility
- Advanced Product Quality Planning (APQP)
- Production Part Approval Process (PPAP)
- Measurement System Analysis and Gage R&R
- Calibration
- Learning Curves added where missing
- Workforce requirements planning
- Define, Measure, Analyze, Improve, and Control (DMAIC) as part of Lean

Expected release by end of calendar 2024

Current version is at https://www.cto.mil/sea/mq/ and accessible from Defense Acquisition University (DAU) M&Q CoP

Digital Manufacturing Enterprise (DME) Initiatives

Gap	Project	Deliverable
Digital 3D Technical Data Packages (TDPs); Secure, Interoperable Data Flow	TDP Lifecycle Useability	ID Digital TDP; native to neutral file format; secure data exchange; updates to standards and metrics
	Ontology	Ontology data and lessons learned from focused SCRM and plant machinery CBM pilots
	Acknowledge CMMC is critical to the DIB	CIO collaboration with other JDMC members on DIB cybersecurity activities
Workforce Development: Knowledge of Digital Manufacturing	Digital Manufacturing Credential	Business case to justify Defense Acquisition University (DAU) credential development
	M&Q CoP: Knowledge Assets & Collaboration	Updated M&Q CoP available to DME Ecosystem
	Access to MII Learning Assets	Advertise Manufacturing Innovation Institute (MII) training in M&Q CoP
	Collaboration Among Broader Digital Engineering Communities	Planned outreach to related communities such as: NDIA Systems & Mission Engineering Conference, Defense Manufacturing Conference, Digital Engineering BoK, Digital Engineering Working Group

DME Initiatives (continued)

Gap	Project	Deliverable
Need for ecosystem-wide mapping of DME activities, artifacts, and lessons learned	DoD-Wide Digital Manufacturing Knowledge Sharing	• DoD-wide view of projects, their objectives, and links or information on how to access POCs and useful artifacts • Map projects to DME stakeholder needs • Leverage existing databases where possible
	MxD 5-year Plan	• Include DME gaps in MxD action plans • Map prior, current, and planned MxD projects to DME gaps • Report progress
Lack of standardized DoD approach to assess digital manufacturing needs, maturity, capabilities, and risks	Develop Digital Manufacturing Maturity Framework	Digital Manufacturing Maturity Framework and assessment criteria

M&Q Engineering Credentials at the Defense Acquisition University

Quality Assurance	
Credential	**Status**
Quality Surveillance	In Design
Process Capability and Control	Analysis / Planning
Quality Management	Analysis / Planning

Manufacturing Engineering	
Credential	**Status**
Manufacturing Surveillance	In Design
Manufacturing Readiness Assessment	Analysis / Planning

Digital Manufacturing	
Credential	**Status**
Advanced / Digital Manufacturing	Proposal & Justification in pre-review
Additive Manufacturing	Future proposal

Model-Based Quality Assurance

- Joint Strategic Quality Council is sponsoring the Model-Based Quality (MBQ) Team
- The MBQ Team has chosen the First Article Inspection (FAI) process as a pilot to standardize and digitize quality data

Model-Based Quality (MBQ)

The application of quality parameters to the digital model(s) throughout the product and process lifecycle.

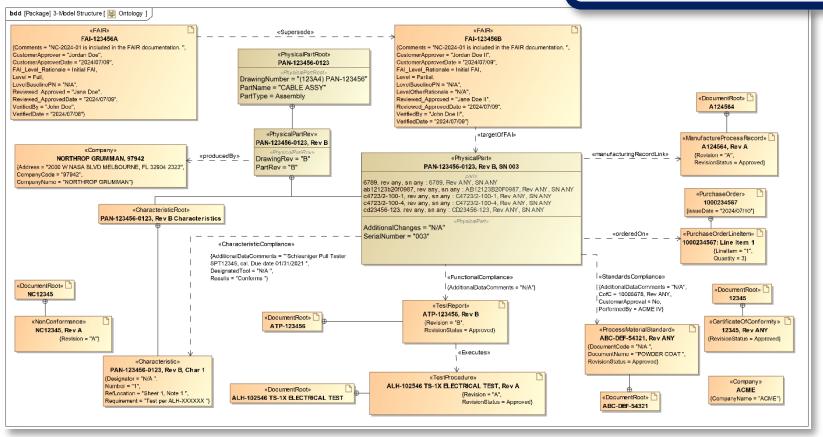
The MBQ Vision is an ***industry standardization of quality data*** *(parameters)* ***integrated within the digital model throughout the product lifecycle*** *(focus: early quality engagement)* ***reducing the risk burden contributed by quality and enabling optimization of customer oversight.*** *(providing "quality view" guidance / requirements)*

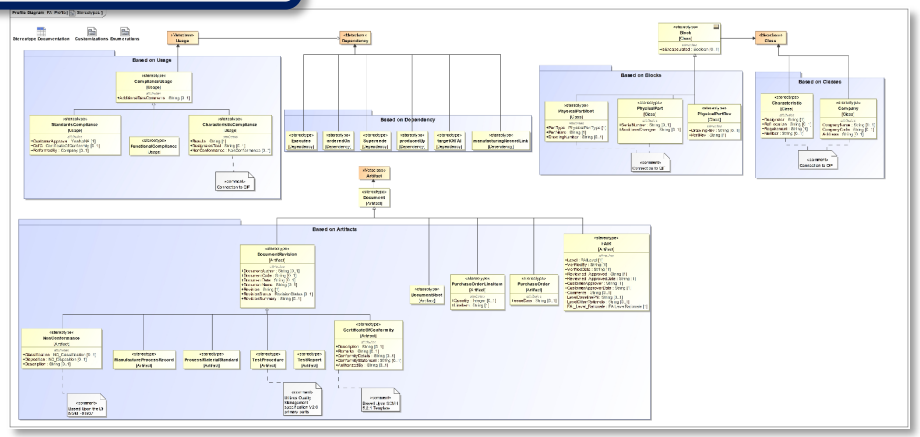
SE&A assisting with digitization of quality standards in a serial manner over time to support achieving goals of the DoD Digital Engineering Strategy

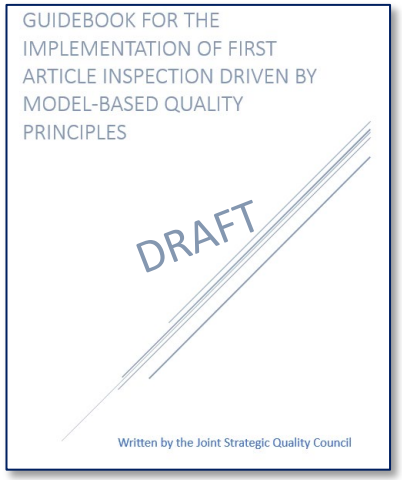
New Data Item Description (DID) Containing First Article Inspection Data

- New DID and Guidebook currently in review allows for contractually obligated standardization and digitization of FAI data
  - SysML Profile and ontology developed with broad leading industry group to capture FAI Data Elements in a System Architecture Model
  - Standardized views in compliance with current AS9102C required outputs

SysML Profile and Ontology

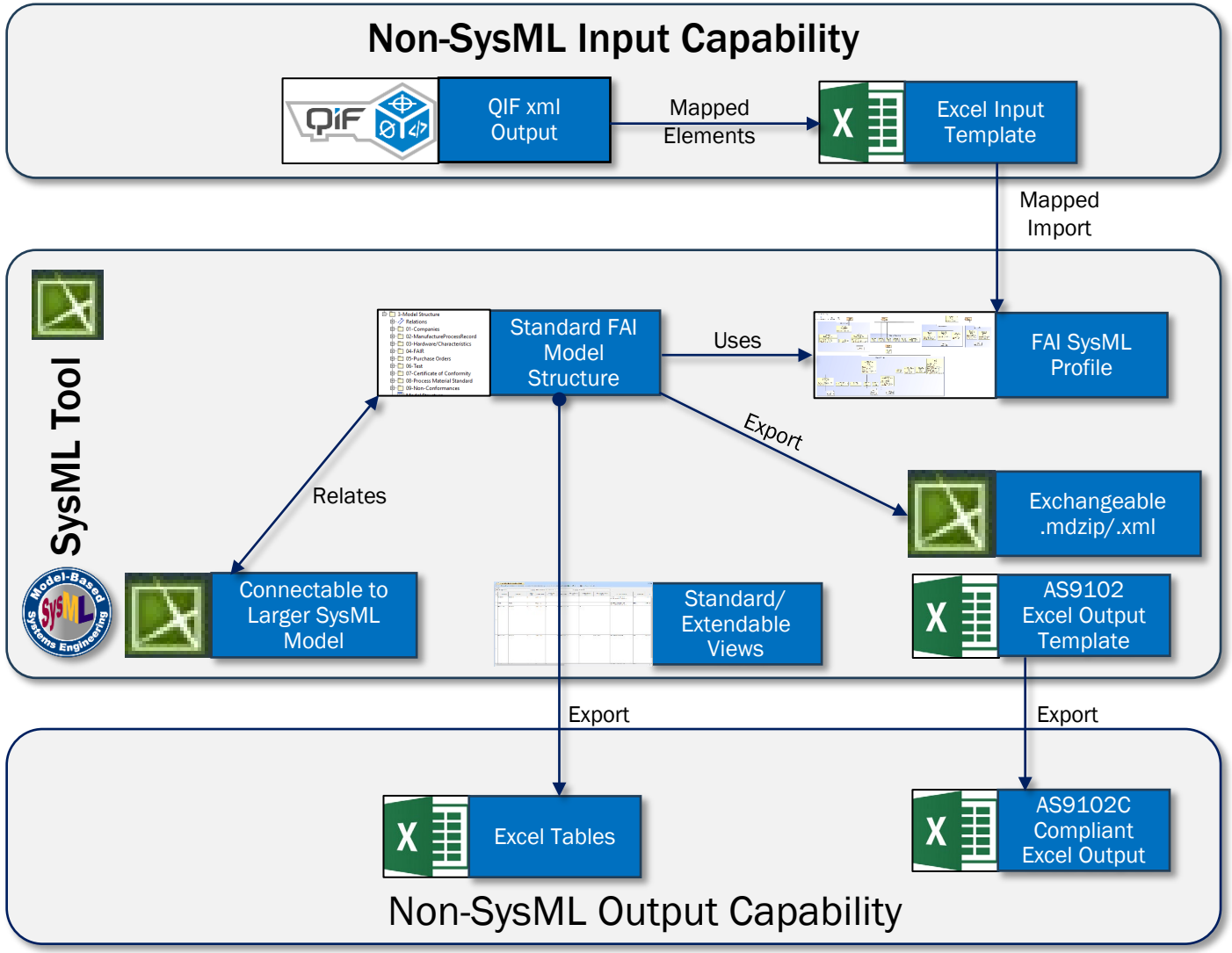






Standardized SysML Profile allows for the capture of FAI data into Digital Thread Enabling Broader Knowledge of Overall System and Machine Understandable Structure

First Article Inspection Profile



FAI SysML Profile lays the foundational framework for quality model-based practices, accelerating industry adoption through seamless integration and superior interoperability with mainstream tools, facilitating expansive collaboration within the SysML ecosystem.

Quality Guide(s)

- M&Q Service representatives identified a need for consolidated quality engineering and technical management guidance for the Defense Acquisition Workforce

- JSQC identified a need for industry guidance supporting NASA and DoD
  - Government Agencies/Department/DOD: OSD(R&E), DCMA, NASA, FAA, DLA
  - Industry Associations: AIA, IAQG/SAE, NDIA, major Prime contractor industry reps

- Way Forward
  - Team with JSQC on the industry handbooks:
    - NASA / Aerospace Guide in FY2025
    - DoD Guide in FY2026
  - Joint development team envisioned OSD(R&E), NASA, DCMA, AIA
  - Create consolidated Quality Engineering and Technical Management Guide as the opportunity for resourcing presents itself

Manufacturing & Quality Service Leads Forum

- Serves as an informal advisory body to OSD
  - Communicate within DoD regarding manufacturing and quality
  - Better connect policy, guidance, workforce development, and standards with component issues, priorities, and activities
- First Meeting Hosted March 2015
- Latest meeting, the 25th, hosted June 2024
- Primary Point-of-Contact from:
  - Air Force, Navy, Army
  - DAU
  - DCMA
  - DLA

Contact

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