Strategic Standardization: Model-Based First Article Inspection

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

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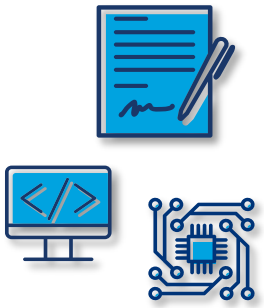
Norfolk, Virginia
October 2024

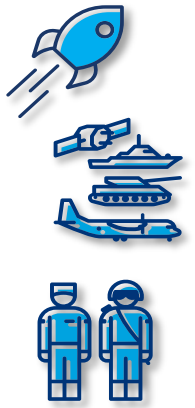
Model-Based Manufacturing/Quality Assurance Pilot Sub-Team

- **Problem:** Digital models do not include integration of standardized quality data throughout the product life cycle
- **Vision/Charter:** Industry standardization of quality data integrated within the digital model throughout the product life cycle reducing the risk burden contributed by quality and enabling optimization of customer oversight.
- **Scope:** The pilot program leverages Quality Information Framework (QIF) methodology and AS9102 FAI Forms 1, 2, and 3 data requirements to characterize a model to validate “as built” to the “as designed” source of truth.
- **Long-Term Deliverable:** DID, SysML MBQ FAI Profile, MS Excel MBQ FAI Input and Export Forms, Guidebook, and White Paper

Sources of Truth and the Digital Thread



As-Designed	As-Built	As-Fielded
• Drawings • Specifications • Contractual Requirements • Technical Data Package	• Inspection Data • Test Data • Actual data from fabrication and assembly	• Field/Theater data • Repair data • Retrofit data



Digital Thread

[3] Ensor, H., McMaier, F. (2024, March 13) *Model-Based Quality & Mission Assurance* [Workshop presentation]. 2024 Collaboration on Quality in the Space & Defense Industries Forum, Cape Canaveral, FL, USA.

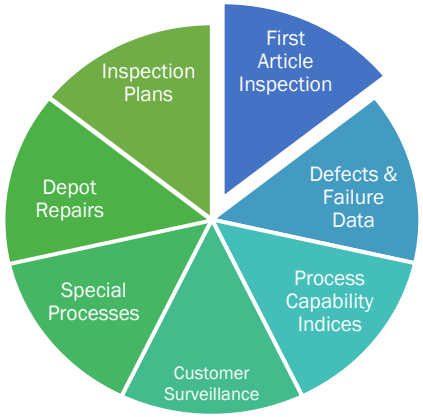
The digital thread weaves the data of all models together into one unified picture

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)*

JSQC MBQ Working Group Representation:

- Department of Defense (DoD)
- Defense Contract Management Agency (DCMA)
- BAE
- Lockheed Martin
- Raytheon Technologies (RTX)
- National Aeronautics & Space Administration (NASA)
- Aerospace Industries Association (AIA)
- AIQG/SAE
- Pratt & Whitney
- Northrop Grumman
- Others

Key contributors to this presentation:
Hannah Ensor (Lockheed Martin), Fred McMaier (Lockheed Martin), Doug Cartney (Northrop Grumman), John Fordyce (RTX), Cindee Gagnon (RTX), Patrick Candelaria (BAE), Brent Lewis (SAIC for OSD R&E), Laura Hart (Lockheed Martin), Leslie McKay (SAE)

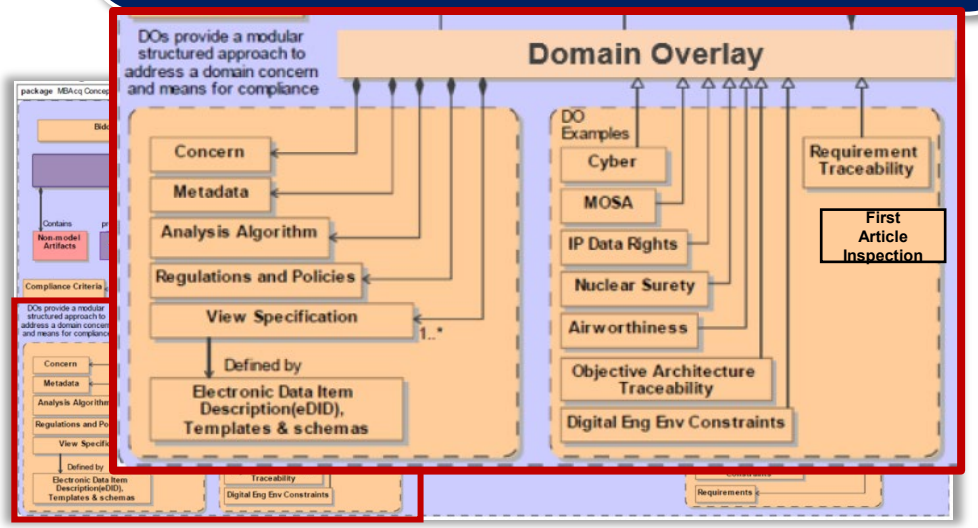
SE&A assisting with digitization of quality standards in a serial manner over time to support achieving goals of the DoD Digital Engineering Strategy

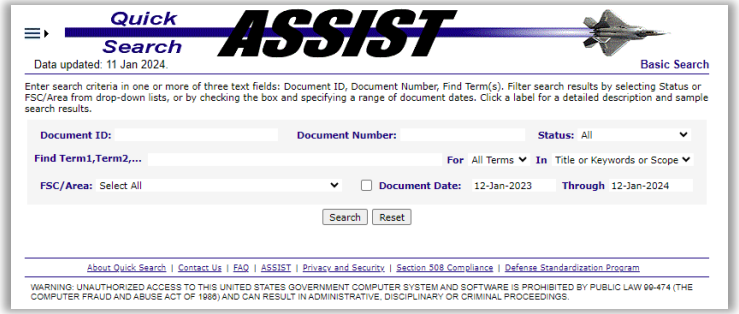
The Execution

- The Joint Strategic Quality Council Model-Based Quality & Mission Assurance working group is drafting a DID
- Goal of the DID is to require contractors to submit FAI data via a CDRL in the standardized DID-defined model format
- Plan is to get this DID on a pilot contract by FY 2025

The DID will be structured to allow for integration into the Object Management Group (OMG) Model-Based Acquisition (MBAcq.) efforts as a Domain Overlay.

Domain Overlay: A collection of constructs needed to support analysis for a domain specific concern using a standardized framework.





DLA DID Repository: https://quicksearch.dla.mil/qsSearch.aspx

Ongoing work from the Object Management Group (OMG) Model-Based Acquisition (MBAcq.) effort

Hart,L., Actionable Architecture Using Aspect Modeling, 2018; Hart, L., Anderson, R., *OMG UAF Model-based Acquisition Analytic Viewpoint Overlays*, 2022; Ongoing work from the Object Management Group (OMG) Model-Based Acquisition (MBAcq) effort

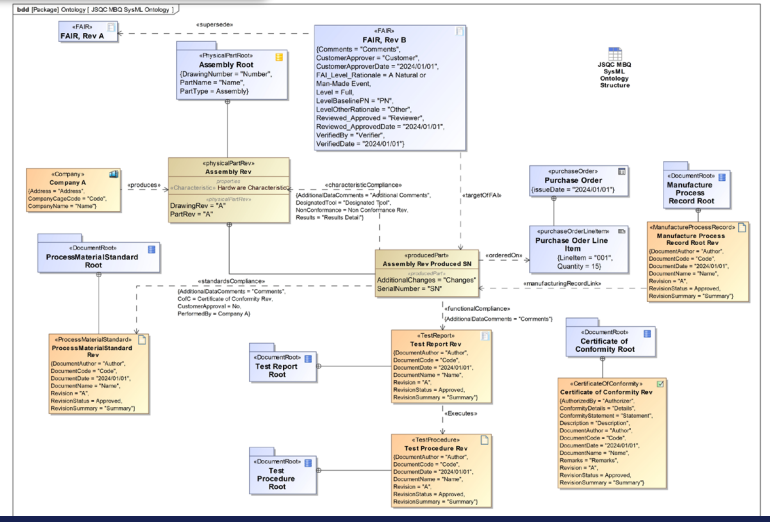
[3] Ensor, H., McMaier, F. (2024, March 13) *Model-Based Quality & Mission Assurance* [Workshop presentation]. 2024 Collaboration on Quality in the Space & Defense Industries Forum, Cape Canaveral, FL, USA.

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

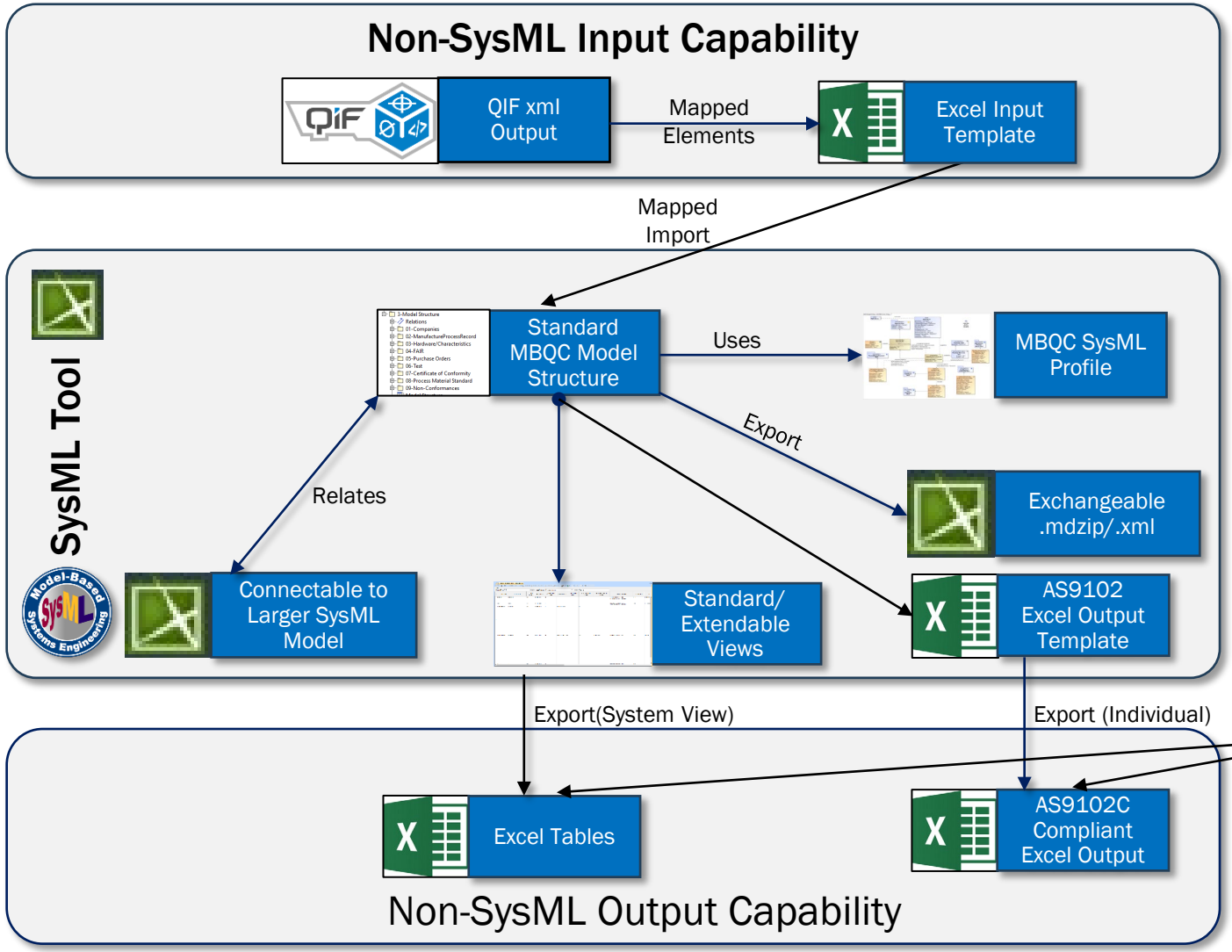
SysML Profile and Ontology

#	Name	Documentation	Stereotypes	Enumerations	Customizations	Profile Dependency
1	JSQC MBQ Common Profile	Profile provides the foundational elements commonly used across multiple areas of MBQ. It includes the basic building blocks that are shared with other profiles.	Company [Class] DocumentRevision [Artifact] DocumentRoot [Package] ManufactureProcessRecord [Artifact] ProcessMaterialStandard [Artifact] supersede [Dependency]	RevisionStatus YesNoNA	Company Customization DocumentRoot Customization ManufactureProcessRecord Customization ProcessMaterialStandard Customization	
2	JSQC MBQ Compliance Profile	Profile focuses to the compliance portion of MBQ.	CertificateOfConformity [Artifact] characteristicCompliance [Usage] complianceUsage [Usage] functionalCompliance [Usage] NonConformance [Artifact] standardsCompliance [Usage]	NC_Classification NC_Disposition	CertificateOfConformity Customization CharacteristicCompliance Customization FunctionalCompliance Customization NonConformance Customization StandardsCompliance Customization	JSQC MBQ Common Profile
3	JSQC MBQ FAI Profile	Profile focused on providing the first article inspection that ensures that the initial product samples meet predefined quality and design standards before proceeding with full-scale production.	FAIR [Artifact] targetOfFAI [Dependency]	FAILevel FAILevelRationale	FAIR Customization	JSQC MBQ Physical Hardware Profile
4	JSQC MBQ Physical Hardware Profile	Profile is designed to model the physical aspects of systems, capturing the intricacies of hardware components, their attributes, and their production lineage, to ensure integrity and traceability of physical elements.	Characteristic [Property] manufacturingRecordLink [Dependency] physicalPartRev [Class] PhysicalPartRoot [Package] producedPart [Class] produces [Dependency]	PhysicalPartType	Characteristic Customization PhysicalPartRev Customization PhysicalPartRoot Customization ProducedPart Customization	JSQC MBQ Common Profile JSQC MBQ Testing Profile JSQC MBQ Compliance Profile JSQC MBQ Procurement Profile
5	JSQC MBQ Procurement Profile	Centered on the acquisition processes, this profile is instrumental in tracking and managing the procurement activities within system development, from order placements to delivery and integration into the system model.	orderedOn [Dependency] purchaseOrder [Artifact] purchaseOrderLineItem [Artifact]		orderedOn Customization PurchaseOrder Customization PurchaseOrderLineItem Customization	JSQC MBQ Common Profile
6	JSQC MBQ Testing Profile	Focused on the verification and validation activities, this profile facilitates the organization and documentation of testing procedures, ensuring that system testing is thorough and traceable throughout the development lifecycle.	Executes [Dependency] TestProcedure [Artifact] TestReport [Artifact]		Executes Customization TestProcedure Customization TestReport Customization	JSQC MBQ Common Profile



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

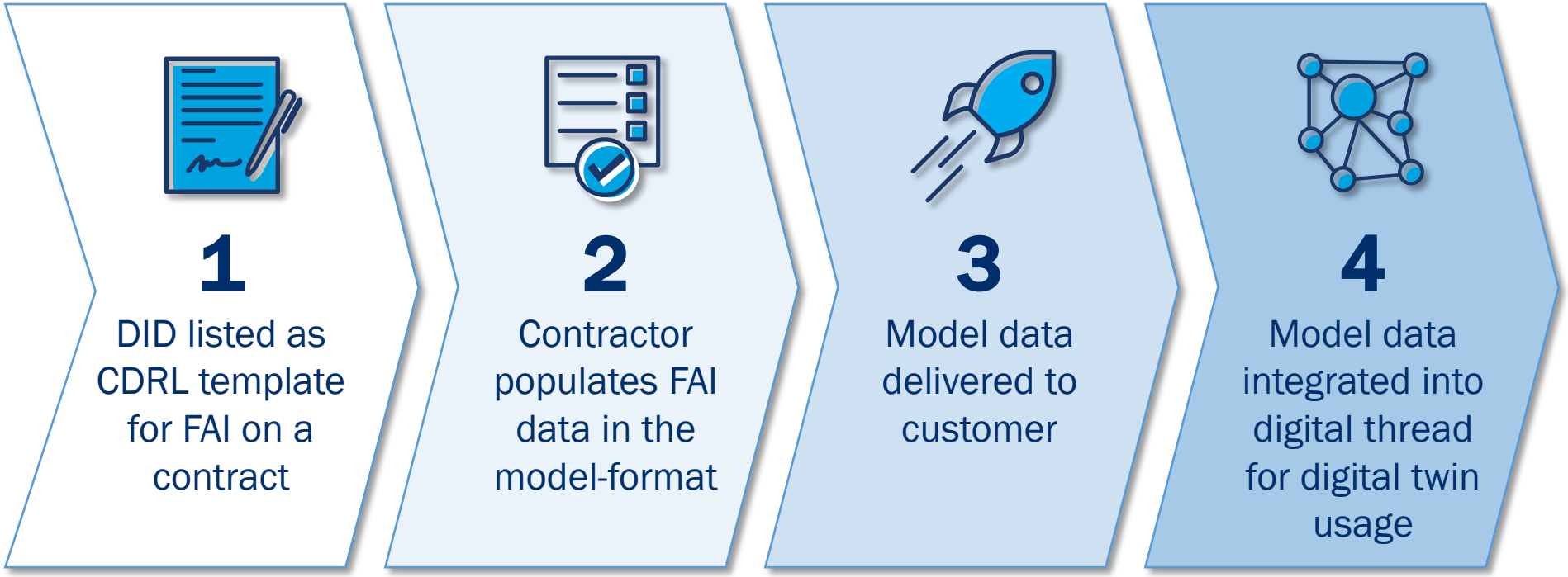
First Article Inspection Profile Input and Output Process Video Demonstration



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.

Output provides both traditional individual output and system view outputs

MBQ FAI Process



Ensor, H., Lewis, J. (2024, June 10) *Model-Based Quality & Mission Assurance Joint Strategic Quality Council Working Group* [PowerPoint Slides] MBMA Leads Mtg - Special Topic - MBQA Briefing, Virtual.

Planning Ahead

- The FAI DID is an initial stream feeding the digital thread. The team is aiming to get the DID on a pilot contract by FY 2025.
- In the future, more strategic DIDs will allow reuse of defined data sets to feed the digital thread.
- Machine-readable quality reporting can help shift the focus from detection to prevention.

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