Implementing a Model Based Conformance approach to DOD 5000.97 and IEEE 15288.1

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GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

BOEING ELYSIUM NORTHROP GRUMMAN Parker PDES, Inc.® Connecting the Digital Enterprise

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Presenters Bio

Fredwilliam Esguerra
The Boeing Company
Product Owner – Model Based Architecture and Integration Team
Currently leading a Boeing Global team to transform unstructured data to structured data to support MBSE analyses

Background:

- 3 Years – System Engineer - Business Architect
- 12 Years – System Engineer - Reliability and Maintainability Engineer

Memberships:

- AIAA - Digital System Model subcommittee member
- AIAA Member
- INCOSE Member
- Industry CAB Facilitator for Dassault Magic Systems of System Software

Professional Interests: Process Modeling, Business Architecture, Data Modeling and Leveraging AI solutions to inform MBSE products

Education: B.S. Electrical Engineering at California State University, Long Beach
- Enjoys recreational pickleball at the 3.0 level, hiking and playing guitar
- 16 years married (Natasha) with 2 kids (William and Harper)

Presenters Bio

Dixit, Anupama Subramanya
Systems Engineer
Team Coach – Model Based Architecture and Integration Team
Boeing India

Background: Systems Engineer with 5+ years of experience spanning across areas of Enterprise Architecture, Model Based Systems Engineering and Model Based Development. Have had previous experience of working with Flight Controls, Flight Mechanics and Computational Fluid Dynamics (CFD).

Professional Interests: Process Modeling, Data Modeling, Simulation Models (6 DoF Models, Mechanical Models etc.) in MATLAB, Project Management, Agile Methodology

Education: Bachelors of Technology in Aerospace Engineering from Jain University, Bangalore, India and an MSc. Aerospace Dynamics from Cranfield University, United Kingdom
Professionally trained in an Indian Classical Dance – Bharatanatyam, enjoy sketching, painting and doodling!
Married for 2.5 years

Agenda

- **Why Model based System Engineering?**
- **Model Based Conformance Approach**
- **Leveraging Unified Architecture Framework (UAF)**
- **Using Requirements View Specification to describe DOD 5000.97**
- **Using Standards Domain View Specification to describe ISO/IEC/IEEE 15288.1**
- **Conclusion**

Model Based System Engineering (MBSE): A Powerful Approach for Designing Complex Systems

According to the International Council on Systems Engineering (INCOSE), MBSE is the formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases

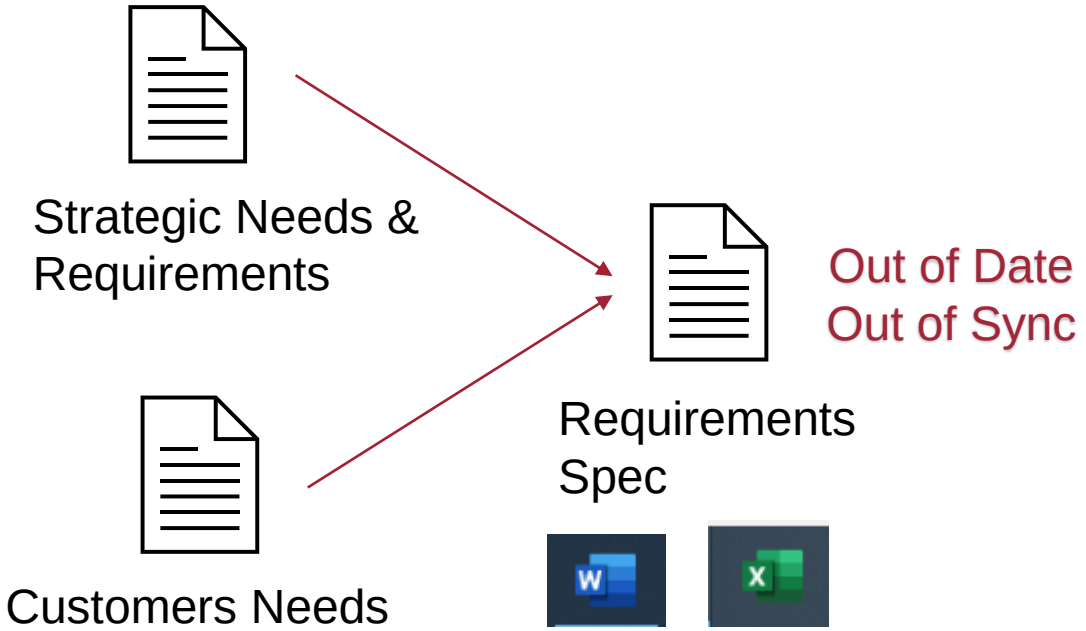
Benefits:

- **Increased Productivity:**
  - MBSE streamlines the design process, saving time and cost.
  - Examples: Reduced design iterations, improved collaboration, and faster decision-making.
- **Reduction in Risk:**
  - MBSE helps identify and mitigate risks early in the design phase.
  - Examples: Improved system reliability, reduced project delays, and enhanced safety.

Solves Traceability Challenges

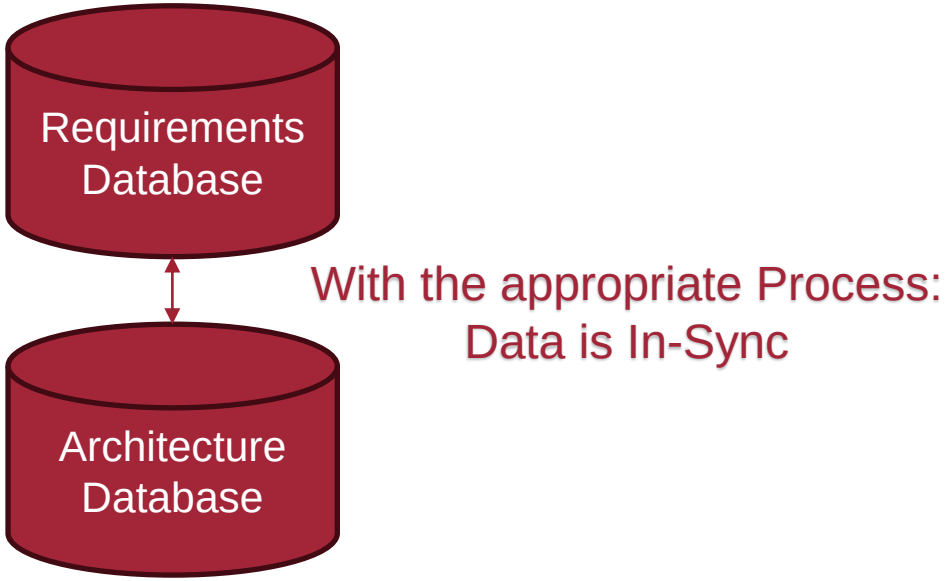
Paper Based Approach

Unstructured Data



Model Based Approach

Structured Data



Model Based Conformance Approach

Systems

«OperationalArchitecture» Generate Lift

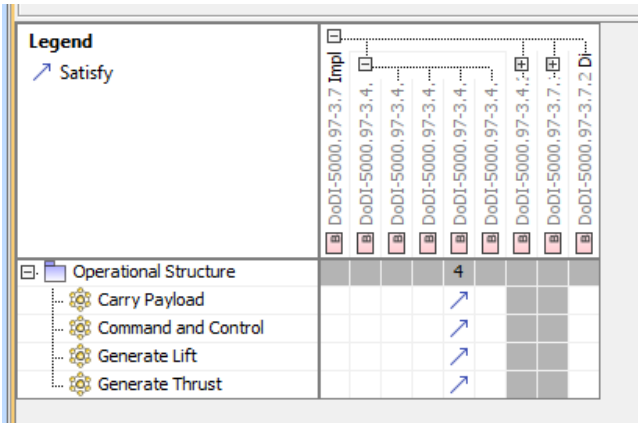
«OperationalArchitecture» Command and Control

«OperationalArchitecture» Generate Thrust

«OperationalArchitecture» Carry Payload

Model of the Systems

Conformance Link



DOD 5000.97

3.4. IMPLEMENTATION OF DIGITAL ENGINEERING.

a. The PM must implement digital engineering procedures as early in program planning as possible and across the system life cycle.

(1) Major Capability Acquisition.

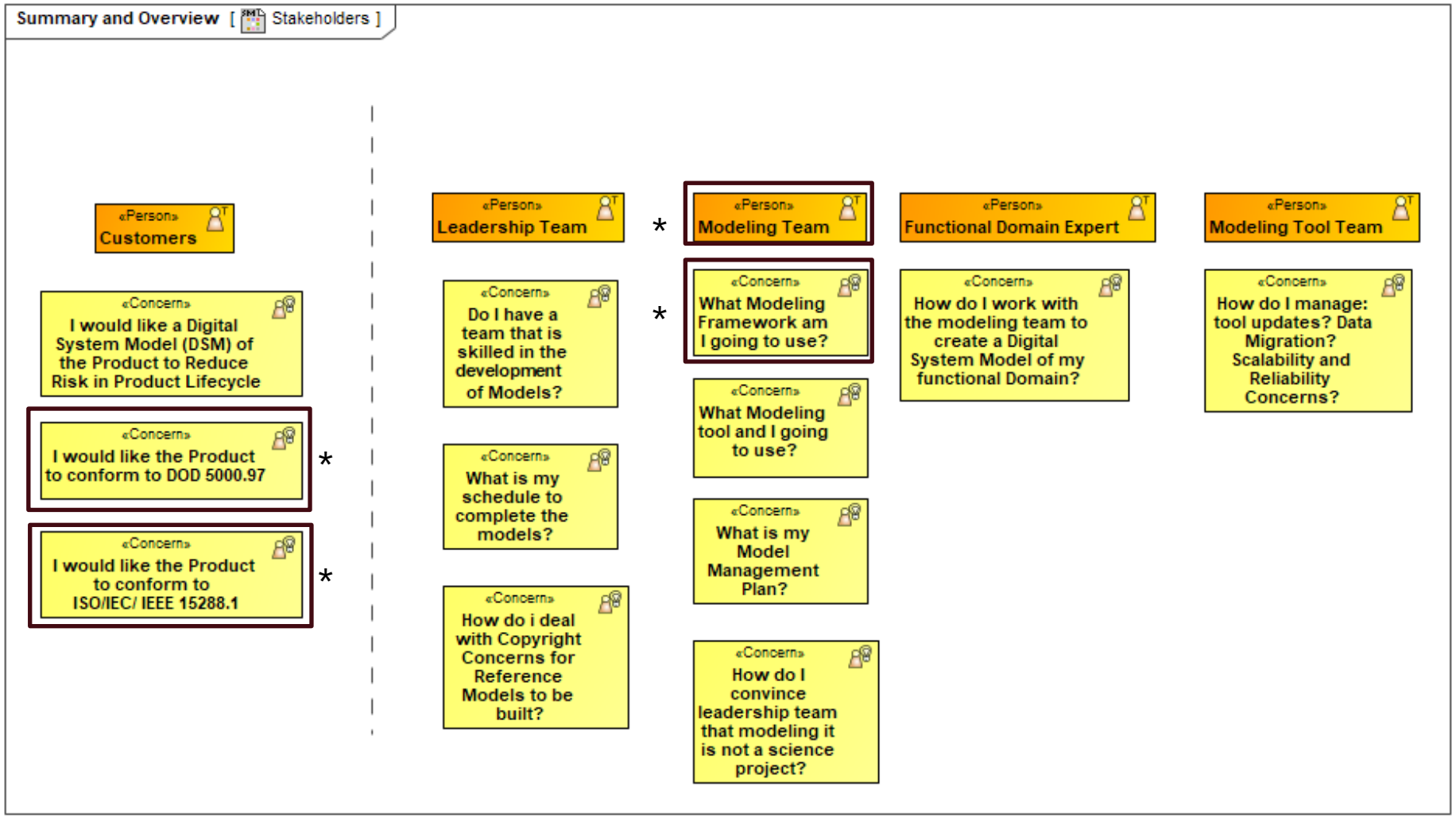
At each milestone defined in DoDI 5000.85, the PM will present the digital engineering approach for the program.

Requirements

11.2 Digital Engineering
- DoDI-5000.97-3.1.1 Digital Models for Communication
- DoDI-5000.97-3.1.2 Critical Practice
- DoDI-5000.97-3.1.3 Computer Systems Usage
- DoDI-5000.97-3.1.4 Expands on Engineering Practices

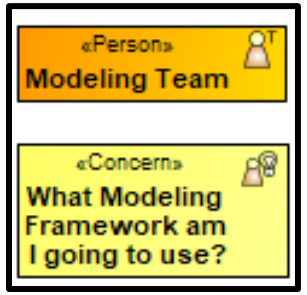
Model of the Requirements

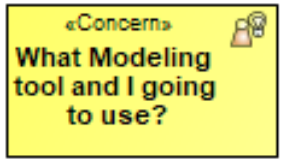
Stakeholder Engagement: The key to developing Effective Models that Comply with Strategic Requirements

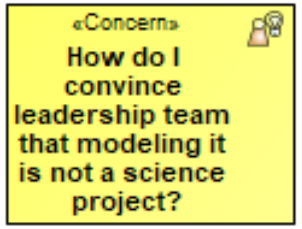


*** Presentation Focus**

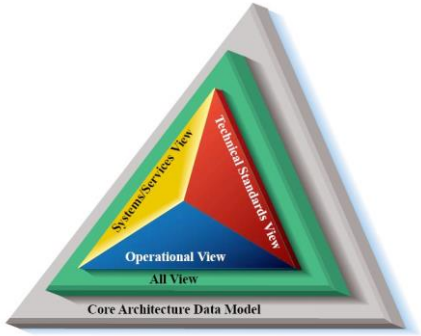
Which Framework was chosen?







Source: OMG



Department of Defense Architecture Framework (DoDAF)

Source: Wikipedia

The TOGAF® Library

Source: OMG

Source: Google Images

Source: UAF Wiki

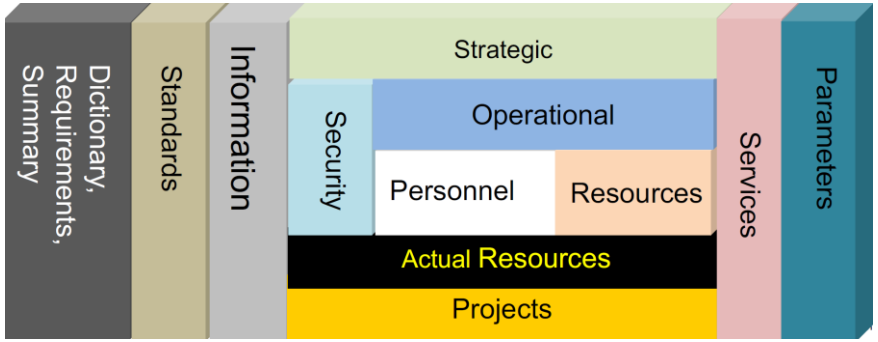
Benefits of UAF-Based Requirements and Standards Approach

VIEWPOINTS

DOMAINS

	Taxonomy Tx	Structure Sr	Connectivity Cn	Processes Pr	States St	Interaction Scenarios Is	Information If	Parameters Pm	Constraints Ct	Roadmap Rm	Traceability Tr
Metadata Md	Metadata Taxonomy Md-Tx	Architecture Viewpoints [a] Md-Sr	Metadata Connectivity Md-Cn	Metadata Processes [a] Md-Pr	-	-			Metadata Constraints [a] Md-Ct		Metadata Traceability Md-Tr
Strategic St	Strategic Taxonomy St-Tx	Strategic Structure St-Sr	Strategic Connectivity St-Cn	-	Strategic States St-St	-			Strategic Constraints St-Ct	Strategic Deployment, St-Rm Strategic Phasing St-Rm	Strategic Traceability St-Tr
Operational Op	Operational Taxonomy Op-Tx	Operational Structure Op-Sr	Operational Connectivity Op-Cn	Operational Processes Op-Pr	Operational States Op-St	Operational Interaction Scenarios Op-Is			Operational Constraints Op-Ct	-	-
Services Sv	Service Taxonomy Sv-Tx	Service Structure Sv-Sr	Service Connectivity Sv-Cn	Service Processes Sv-Pr	Service States Sv-St	Service Interaction Scenarios Sv-Is	Conceptual Data Model,	Environment Pm-En	Service Constraints Sv-Ct	Service Roadmap Sv-Rm	Service Traceability Sv-Tr
Personnel Pr	Personnel Taxonomy Pr-Tx	Personnel Structure Pr-Sr	Personnel Connectivity Pr-Cn	Personnel Processes Pr-Pr	Personnel States Pr-St	Personnel Interaction Scenarios Pr-Is	Logical Data Model,		Competence, Drivers, Performance Pr-Ct	Personnel Availability, Personnel Evolution, Personnel Forecast Pr-Rm	Personnel Traceability Pr-Tr
Resources Rs	Resource Taxonomy Rs-Tx	Resource Structure Rs-Sr	Resource Connectivity Rs-Cn	Resource Processes Rs-Pr	Resource States Rs-St	Resource Interaction Scenarios Rs-Is	Physical schema, real world results	Measurements Pm-Me	Resource Constraints Rs-Ct	Resource evolution, Resource forecast Rs-Rm	Resource Traceability Rs-Tr
Security Sc	Security Taxonomy Sc-Tx	Security Structure Sc-Sr	Security Connectivity Sc-Cn	Security Processes Sc-Pr	-	-			Security Constraints Sc-Ct	-	-
Projects Pj	Project Taxonomy Pj-Tx	Project Structure Pj-Sr	Project Connectivity Pj-Cn	Project Activity Ps-Pr	-	-			-	Project Roadmap Pj-Rm	Project Traceability Pj-Tr
Standards Sd	Standard Taxonomy Sd-Tx	Standards Structure Sd-Sr	-	-	-	-			-	Standards Roadmap Sr-Rm	Standards Traceability Sr-Tr
Actuals Resources Ar		Actual Resources Structure, Ar-Sr	Actual Resources Connectivity, Ar-Cn	Simulation [b]					Parametric Execution/ Evaluation [b]	-	-
Dictionary * Dc											
Summary & Overview SmOv											
Requirements Rq											

UAF Grid (Source: OMG UAF Wiki)



UAF Domain Interrelation (Source: OMG UAF Wiki)

- ✓ UAF offers clear semantics and stereotypes for requirements and standards.
- ✓ Traceability is improved across domains, promoting cross-functionality and seamless integration.
- ✓ UAF lowers the barrier of translation between teams.
- ✓ It provides a common language and framework for understanding and communicating requirements and standards.

Pop

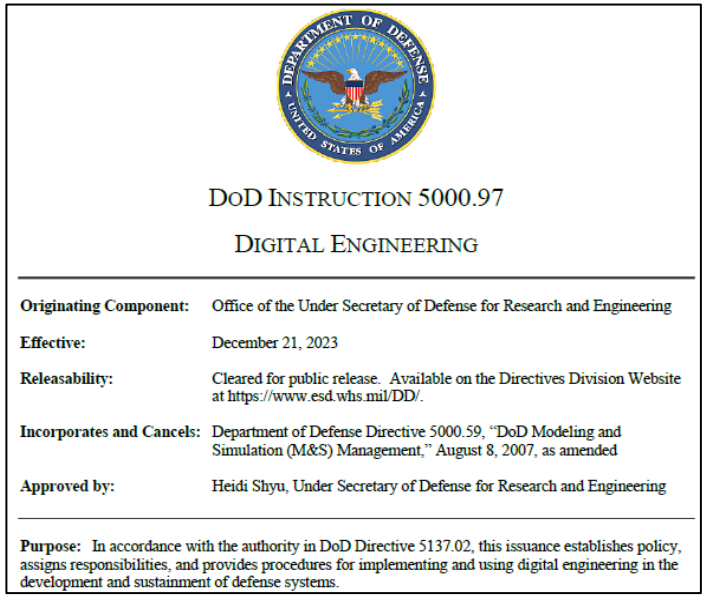
Coke

Soft Drink

Soda Water

Carbonated Beverage

Unified Architecture Framework (UAF) and DOD 5000.97

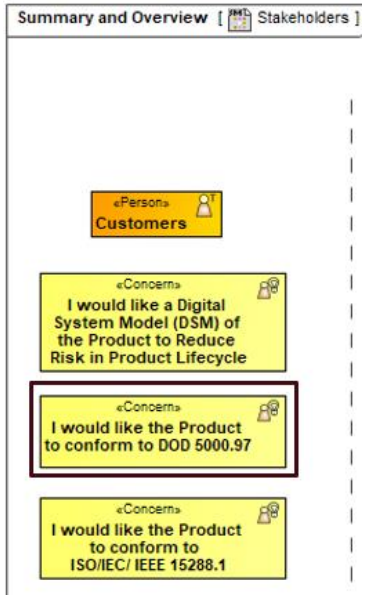


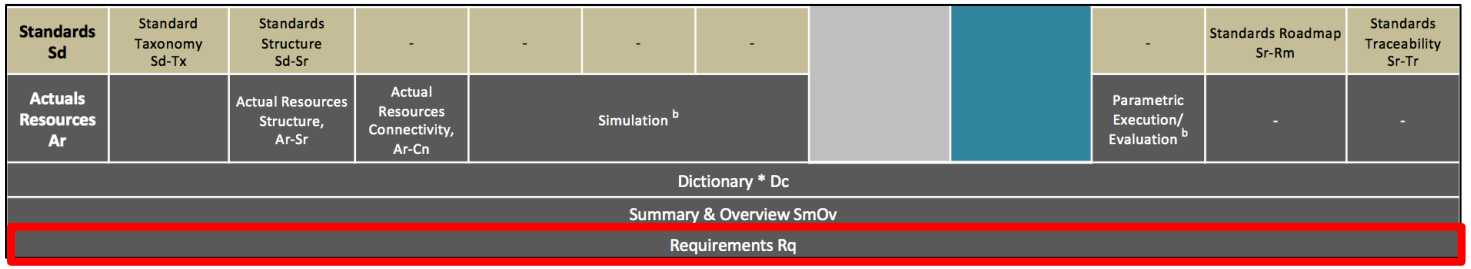
DoD Instruction 5000.97

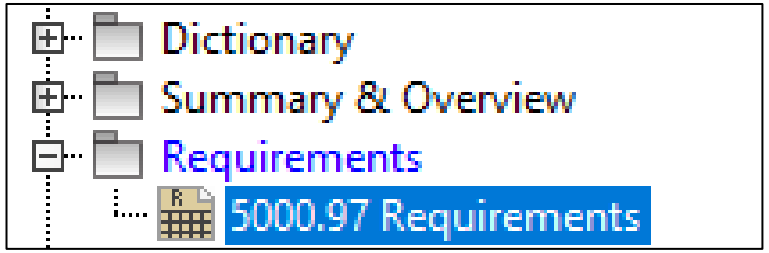
Digital Engineering

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.

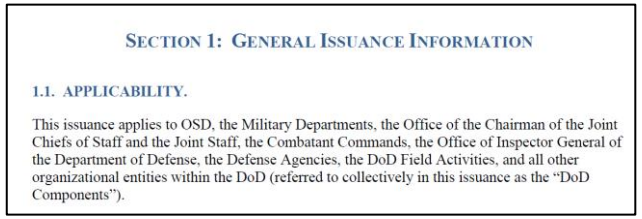






- DoD Instruction 5000.97 establishes policies and procedures for managing and overseeing the Defense Acquisition System.
- The goal is to ensure effective and efficient acquisition of defense capabilities to support national security objectives.
- UAF (Unified Architecture Framework) allows capturing the requirements in a structured manner.
- Architectural artifacts can demonstrate conformance to individual requirements.
- The use of a single digital platform for all requirements enables better traceability.

Unified Architecture Framework (UAF) and DOD 5000.97

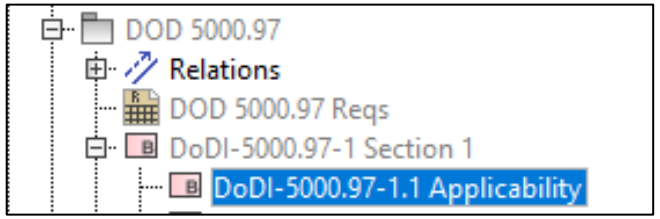


SECTION 1: GENERAL ISSUANCE INFORMATION

1.1. APPLICABILITY.

This issuance applies to OSD, the Military Departments, the Office of the Chairman of the Joint Chiefs of Staff and the Joint Staff, the Combatant Commands, the Office of Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all other organizational entities within the DoD (referred to collectively in this issuance as the "DoD Components").

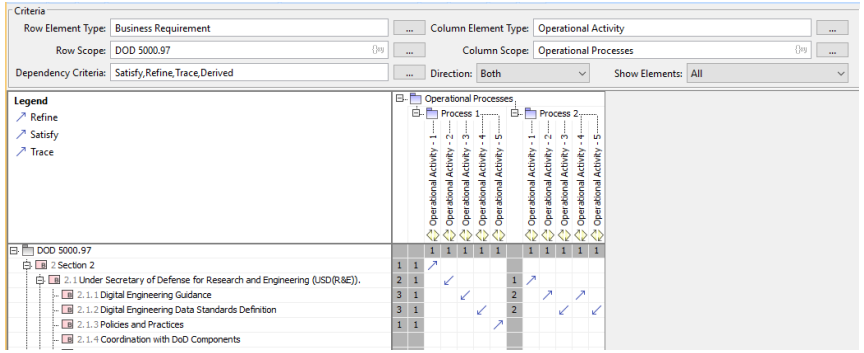
Source: DoDI 5000.97



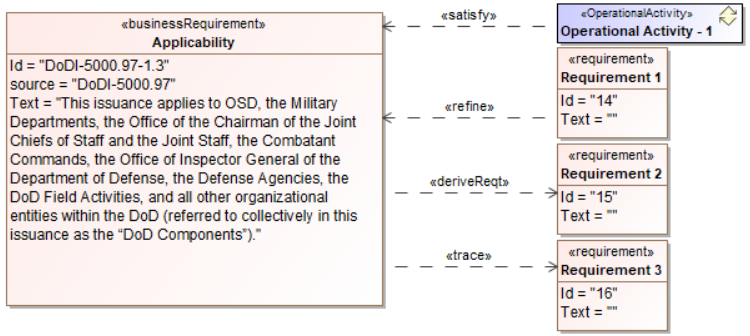
UAF Containment Tree

#	Id	Name	Text
8	DoDI-5000.97-1	DoDI-5000.97-1 Section 1	General Issuance Information
9	DoDI-5000.97-1.1	DoDI-5000.97-1.1 Applicability	This issuance applies to OSD, the Military Departments, the Office of the Chairman of the Joint Chiefs of Staff and the Joint Staff, the Combatant Commands, the Office of Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all other organizational entities within the DoD (referred to collectively in this issuance as the "DoD Components").

Requirements Table



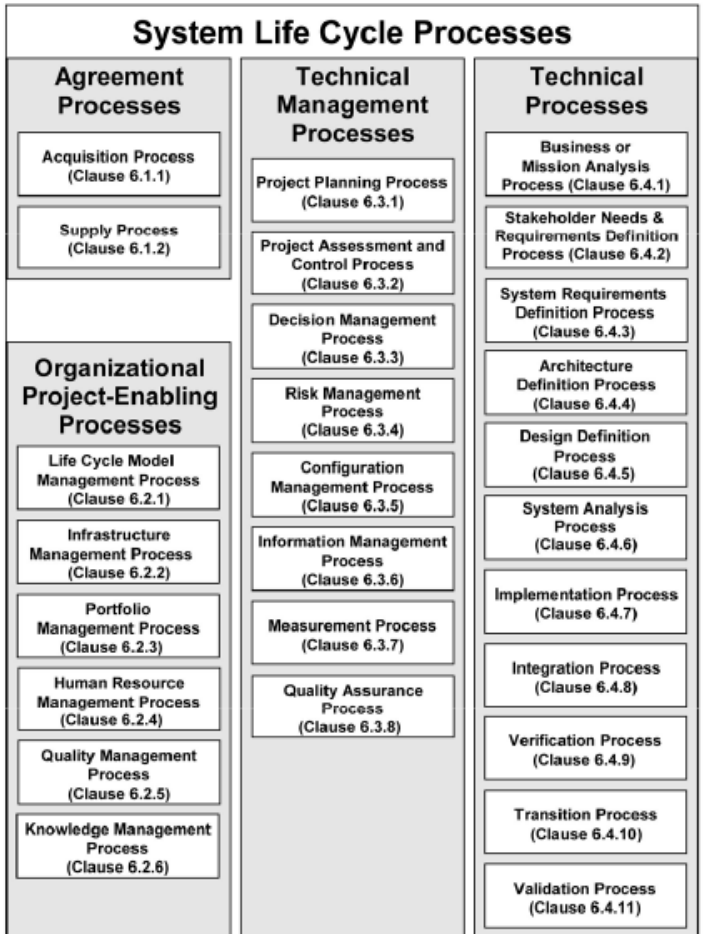
Dependency Matrix



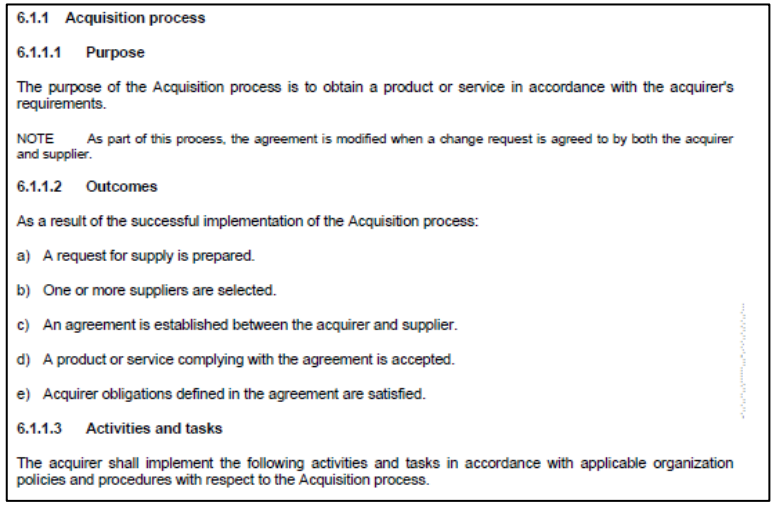
Requirements Diagram

- Requirements captured digitally enable architectural artifacts to demonstrate compliance in multiple ways.
- A Dependency Matrix showcases compliance of objects and allows for comments on requirement gaps or non-compliance.
- The artifacts can have relationships that describe how they commonly relate to each other:
  - ✓ Refine Requirements
  - ✓ Satisfy Requirements
  - ✓ Be Derived from Requirements
  - ✓ Trace to Requirements

UAF Alignment with IEEE 15288.1



Source: ISO/IEC/IEEE 15288



6.1.1 Acquisition process

6.1.1.1 Purpose

The purpose of the Acquisition process is to obtain a product or service in accordance with the acquirer's requirements.

NOTE As part of this process, the agreement is modified when a change request is agreed to by both the acquirer and supplier.

6.1.1.2 Outcomes

As a result of the successful implementation of the Acquisition process:

a) A request for supply is prepared.

b) One or more suppliers are selected.

c) An agreement is established between the acquirer and supplier.

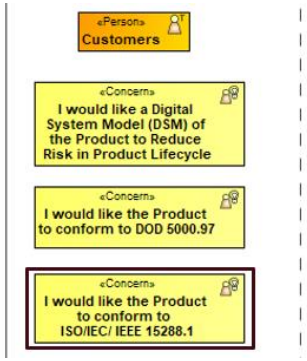
d) A product or service complying with the agreement is accepted.

e) Acquirer obligations defined in the agreement are satisfied.

6.1.1.3 Activities and tasks

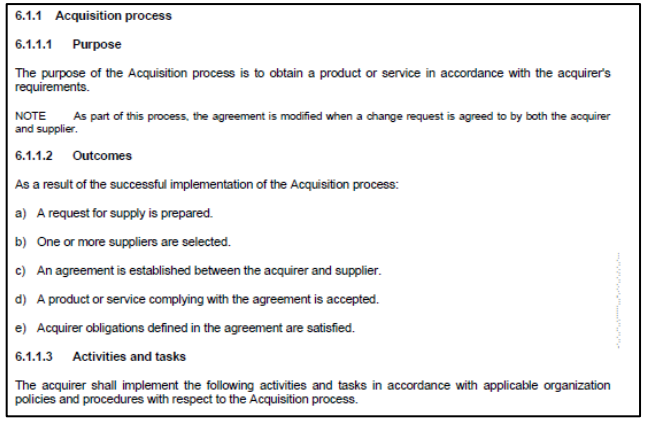
The acquirer shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Acquisition process.

Source: ISO/IEC/IEEE 15288



- IEEE 15288.1 is a standard that encompasses systems and software engineering.
- Its purpose is to offer guidance on the processes, activities, and tasks involved in the engineering of systems and software.
- The standard outlines various stages for each process requirement, such as acquisition and supply for the agreement process requirement.

UAF Alignment with IEEE 15288.1



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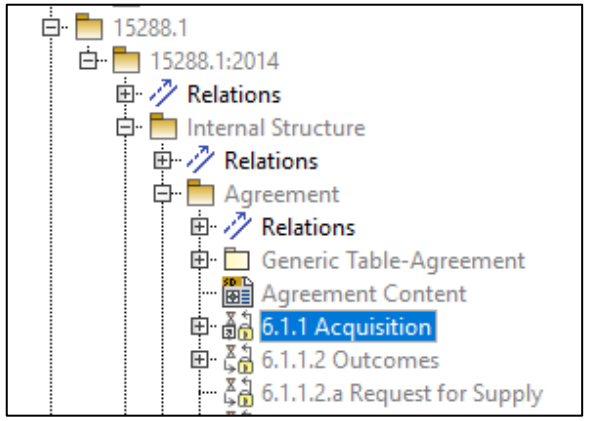
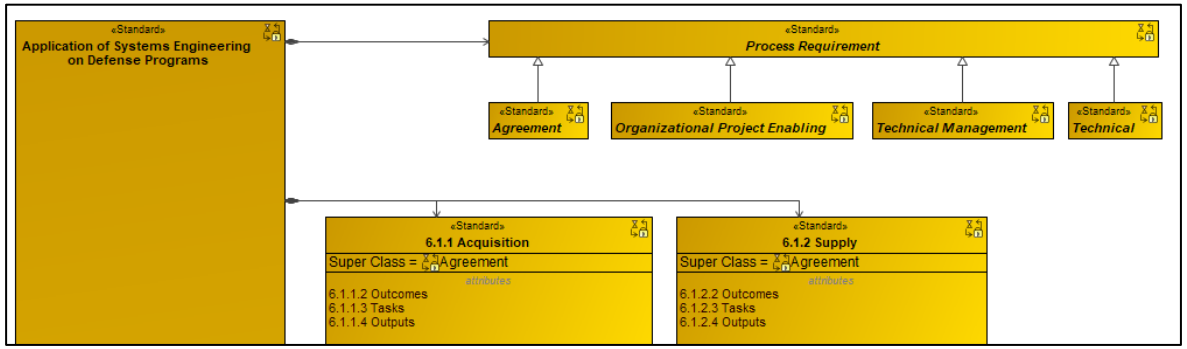


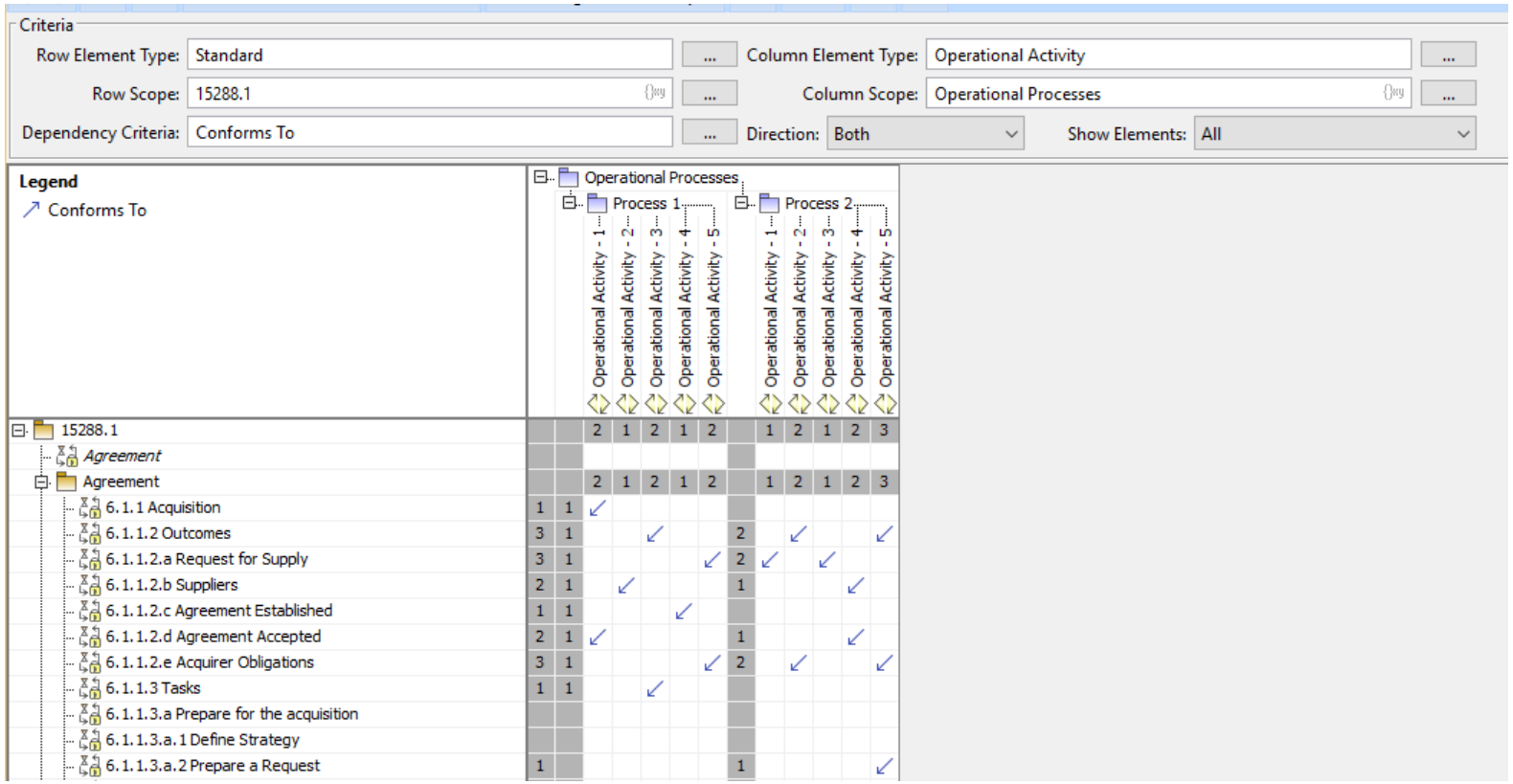
Standards Domain - UAF



15288.1 – Standards Structure

- In the modeling environment, the individual sections of IEEE 15288.1 are captured as Standards elements in the UAF standard domain.
- The document structure is represented in a standards structure diagram.
- The sub-sections of IEEE 15288.1 are captured as standards to allow users to demonstrate conformance to the individual sections of the standard.

UAF Alignment with IEEE 15288.1



Dependency Matrix

The Dependency Matrix enables users to demonstrate the conformance of the process or process steps to individual sections in the ISO 15288.1 Standard.

Conclusion

- Need for Digital Engineering based on DOD 5000.97 outlines a model based approach for traceability to downstream artifacts
- Choosing a framework like UAF reduces barrier of translations between audiences at scale
- Creating a method to convert needs into Requirements and/or Standards will be important and necessary to show conformance in a Model based way.
- Using and maintaining a Dependency Matrix to capture the requirements relationships will be a useful way to show model-based conformance
- Overall, the model-based approach enables the utilization of compliance matrices across multiple programs consistently through a project usage structure. This prevents the need to repeatedly revisit compliance rationale whenever customer requirements are imposed.

Thanks for your support!

- **BDS Digital Transformation Team**
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