33rd Annual INCOSE international symposium

hybrid event

Honolulu, HI, USA
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Model-Based Acquisition (MBAcq): Uniting Government and Industry around a Common Standard

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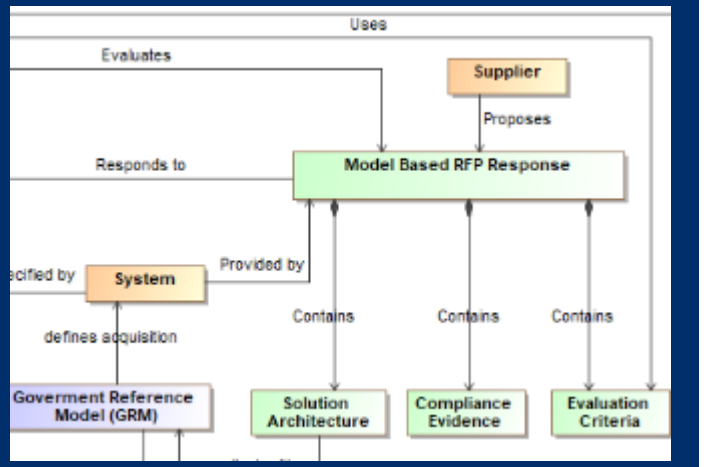
Matthew C Hause: System Strategy, Inc. SSI

Model-Based Acquisition (MBAcq) User Group Introduction

About MBAcq

Model-based acquisition is the Technical approach to acquisition that uses models and other digital artifacts as the primary means of information exchange, rather than document-based information exchange.

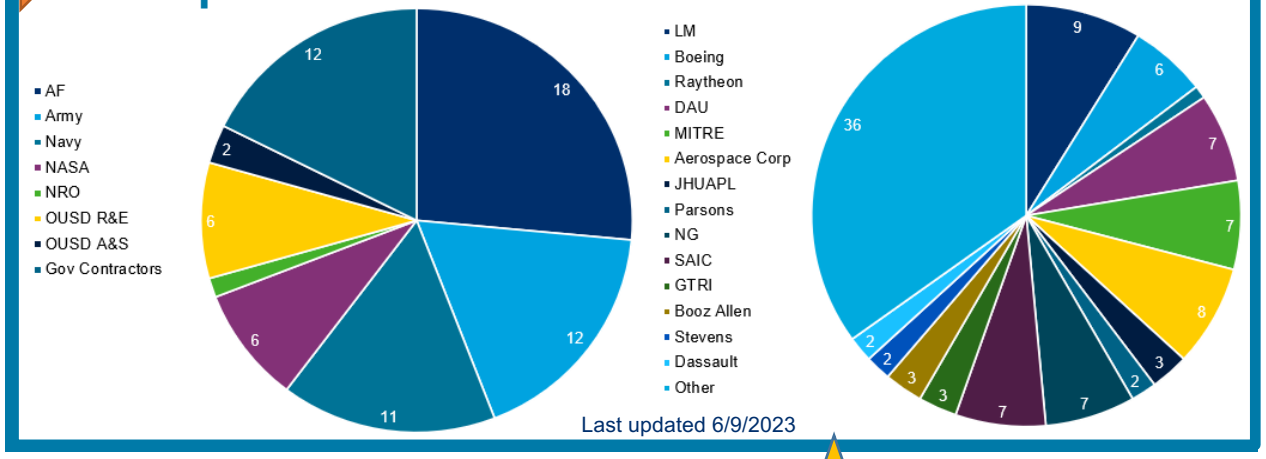


Why MBAcq Matters

Customers are increasingly specifying MBSE in RFPs
Customers are increasingly requiring models in proposals
Lack of standardization raises proposal learning curves & compliance risk

- **Model Based Acquisition will be disruptive**
- **Increased interest to organize around the MBAcq UG to define and standardize approach**
- **Broad government and industry participation**
- **Gov & Industry have an opportunity to shape future MB Acquisitions & Compliance together**

Participation



Expected Timeline

2022: Formed Team & Framework
2023: Q4 Govt Ref Arch
2024: Q2 Acquisition Users Guide
Q2/3 DAU Acquisition Training
Q4 Acquisition Model Example
Ongoing: Curate and Create Reusable Content (Reference Architectures, Domain Overlays, …)

For more information contact:
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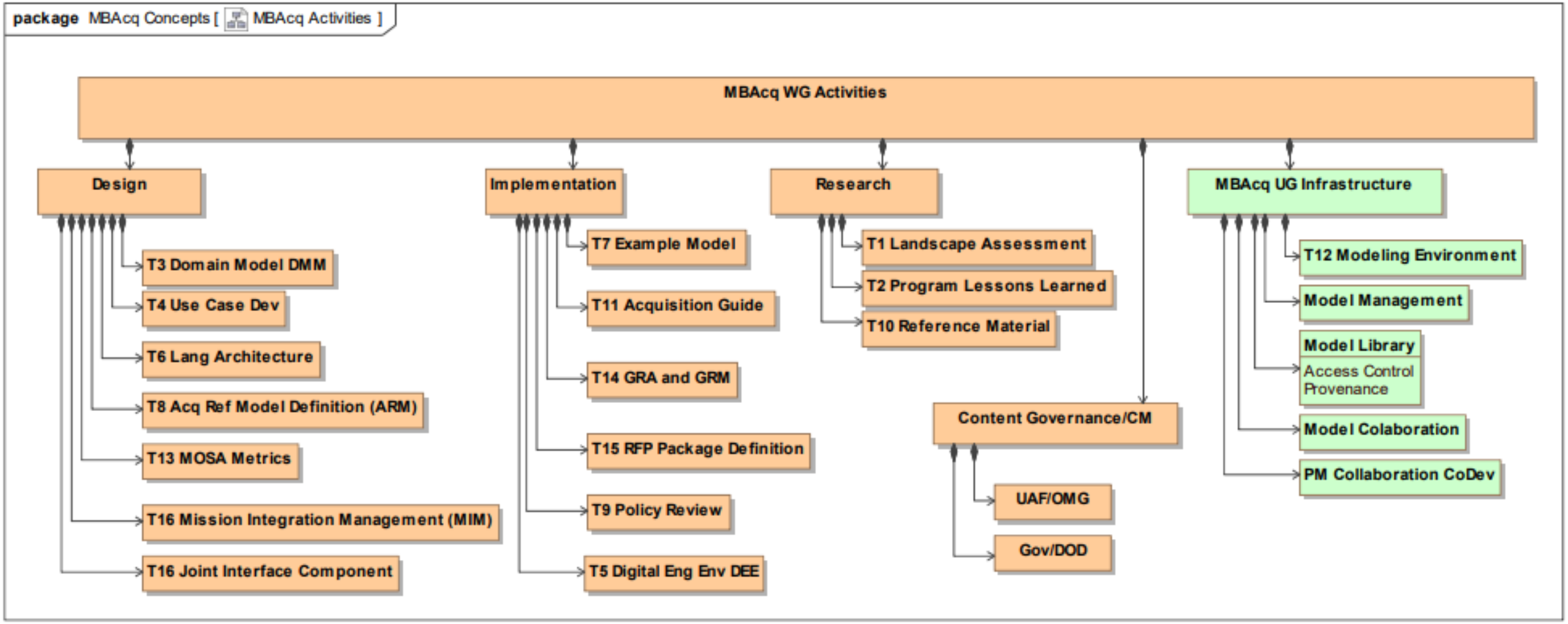
Full lifecycle should be addressed during Acquisition!

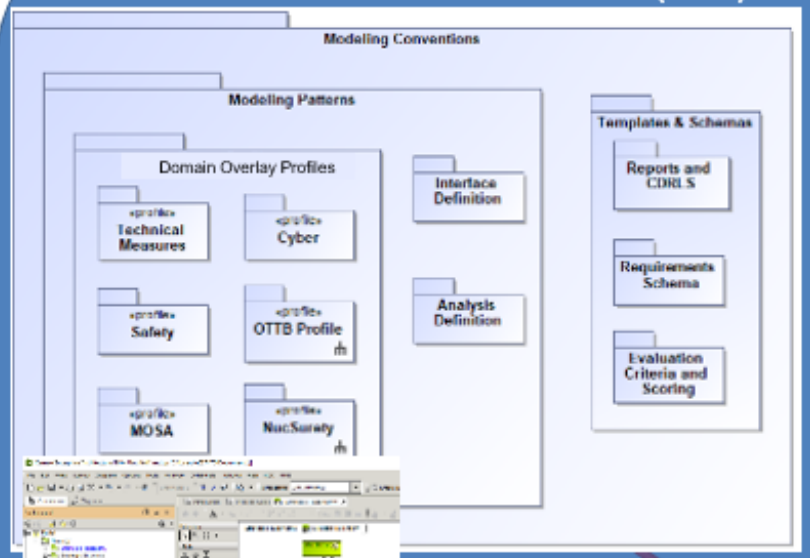
MBAcq – UG Activities

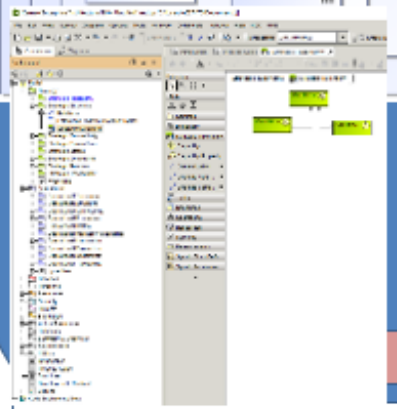


OMG Standards Development Organization.

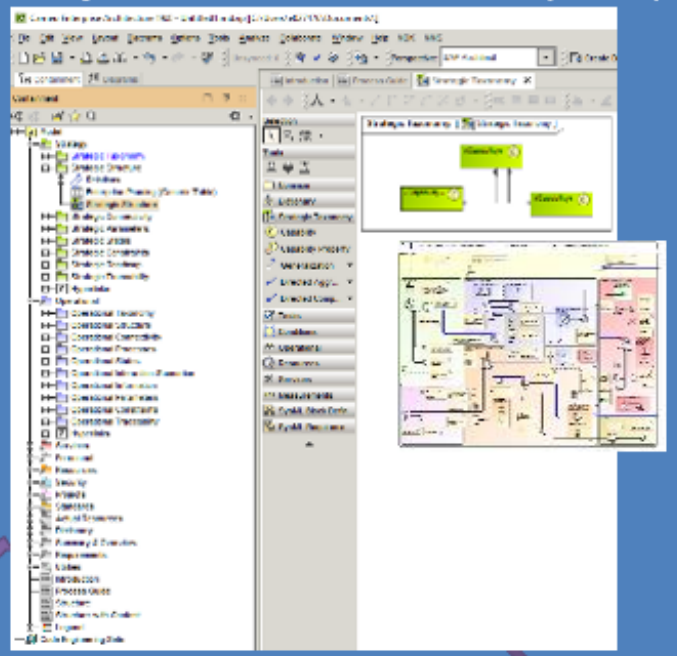
Model-Based Acquisition

1. Architecture Evaluation Criteria (AEC)

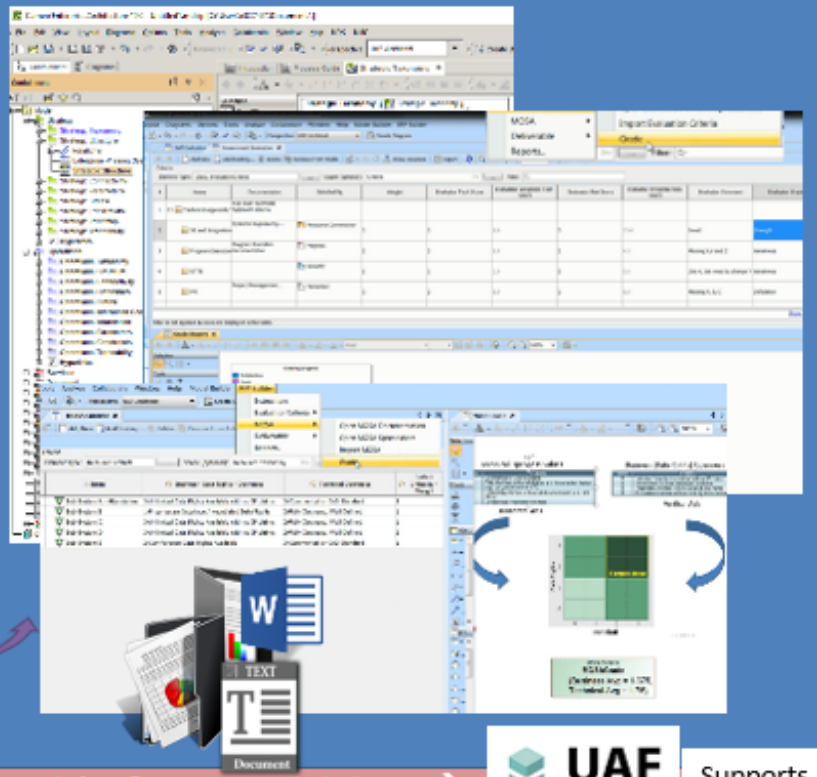




2. Objective Architecture Description (OAD)



3. Model-based RFP Package



AEC & (OAD)

Populated with Program & contract Data

← 4. Unified Architecture Framework (UAF) Process Guide for Acquisition →

UAF OMG UNIFIED ARCHITECTURE FRAMEWORK

Supports DoDAF

1. The AEC provides model structure for RFP content and evaluation tools:
- Modeling Patterns
  - DO Profiles (i.e. MOSA, Data Rights, certs)
  - Interface & Analysis Definitions
- Templates & Schemas
  - Evaluation Criteria & Scoring (Section K, L, M)
  - Reports & CDRLS

2. The OAD is a descriptive model containing the program requirements, constraints and context
- High-level Capabilities, mapped to Operational scenarios, traced to requirements (e.g. CDD, SRD, Conops)
- Technical performance measures (i.e. KPPs, KSAs, MOEs..)
- Any required architectural partitioning including structural and functional

(Based on UAF acquisition process guide and template)

3. The Model-based RFP model contains the populated OAD&AC providing **RFP evaluation content**, **CDRL definitions** for documentation generation and **scoring tools** for solution validation and evaluation

4. UAF Process Guide provides the Acquisition Guidance for using MBAcq **to create, respond and evaluate a Model-based RFP.**

SOURCE: Laura Hart, MITRE 2017

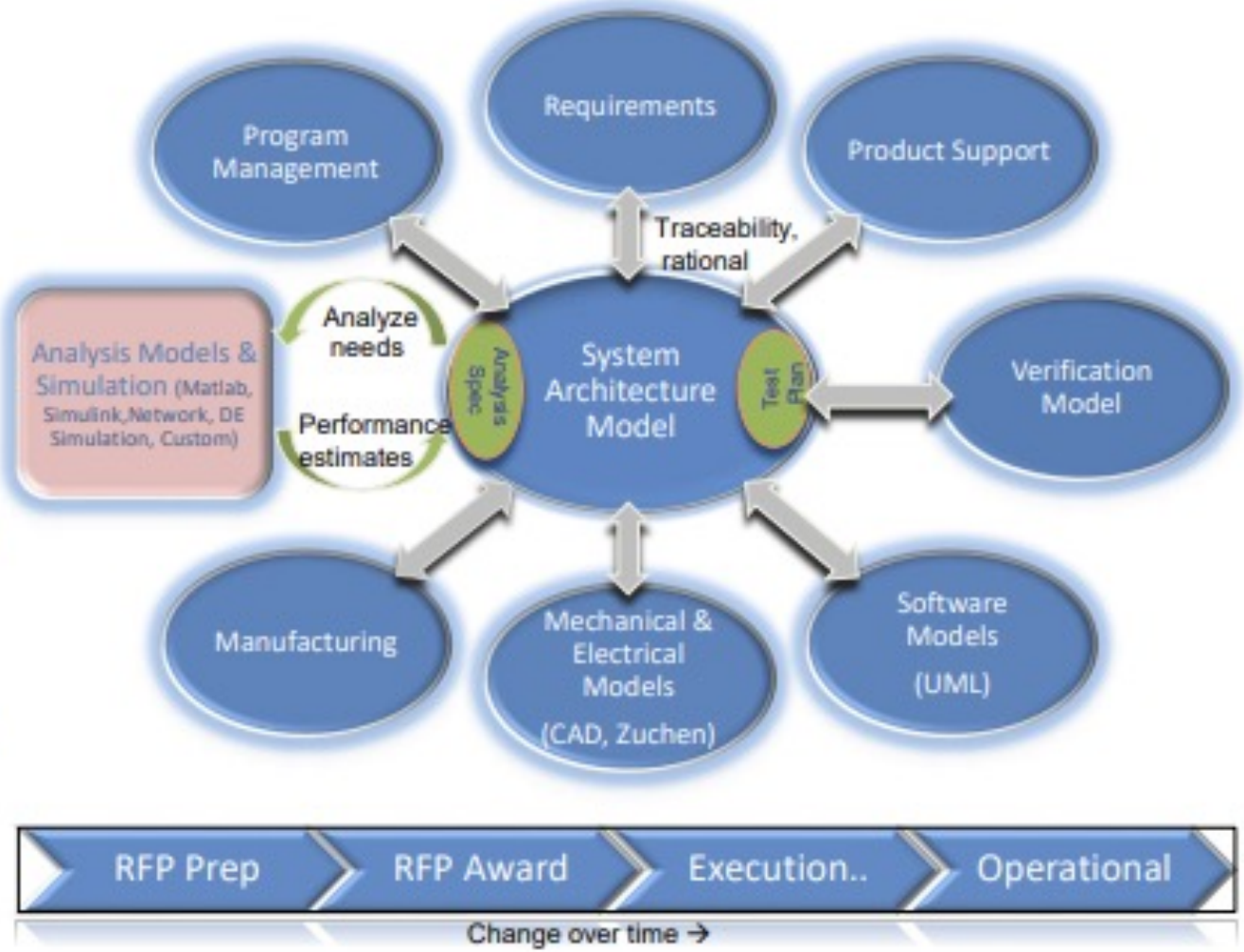
Descriptive vs Analytical Models

System Architecture Model (SAM)

- Descriptive in nature
- Emphasizes how pieces fit together into a *consistent* whole
- Provides context for analysis

Analysis Models and Simulation Models

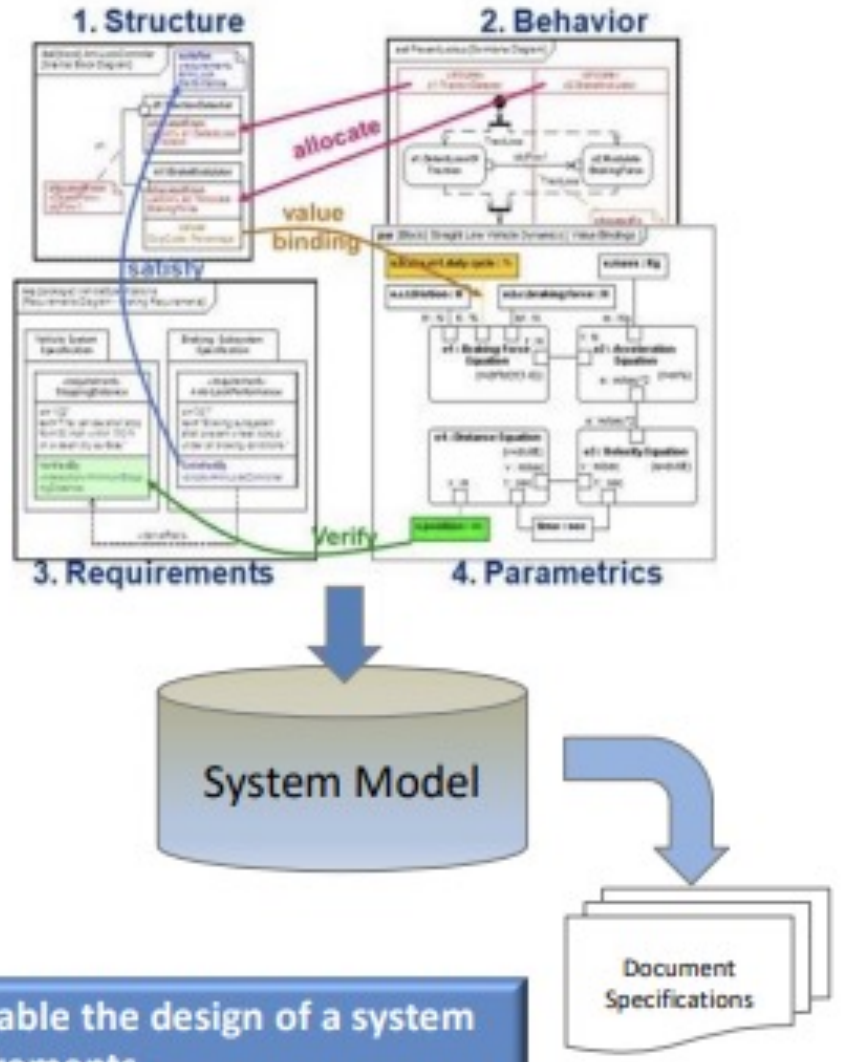
- Emphasize specific aspects of performance, *consistent* with the Architecture Model.
- Mathematically-based computation or simulation
- Reduces risks thru analysis, validation and optimization of:
  - MOE, MOP, KPP, TPM timing, probability of hit/survival reliability/availability, MTBF cost, total cost of ownership
- A vehicle to solve some problem or verify a solution



SAM provides a "hub" for data integration and transformation across the product lifecycle

What's in the System Architecture Model

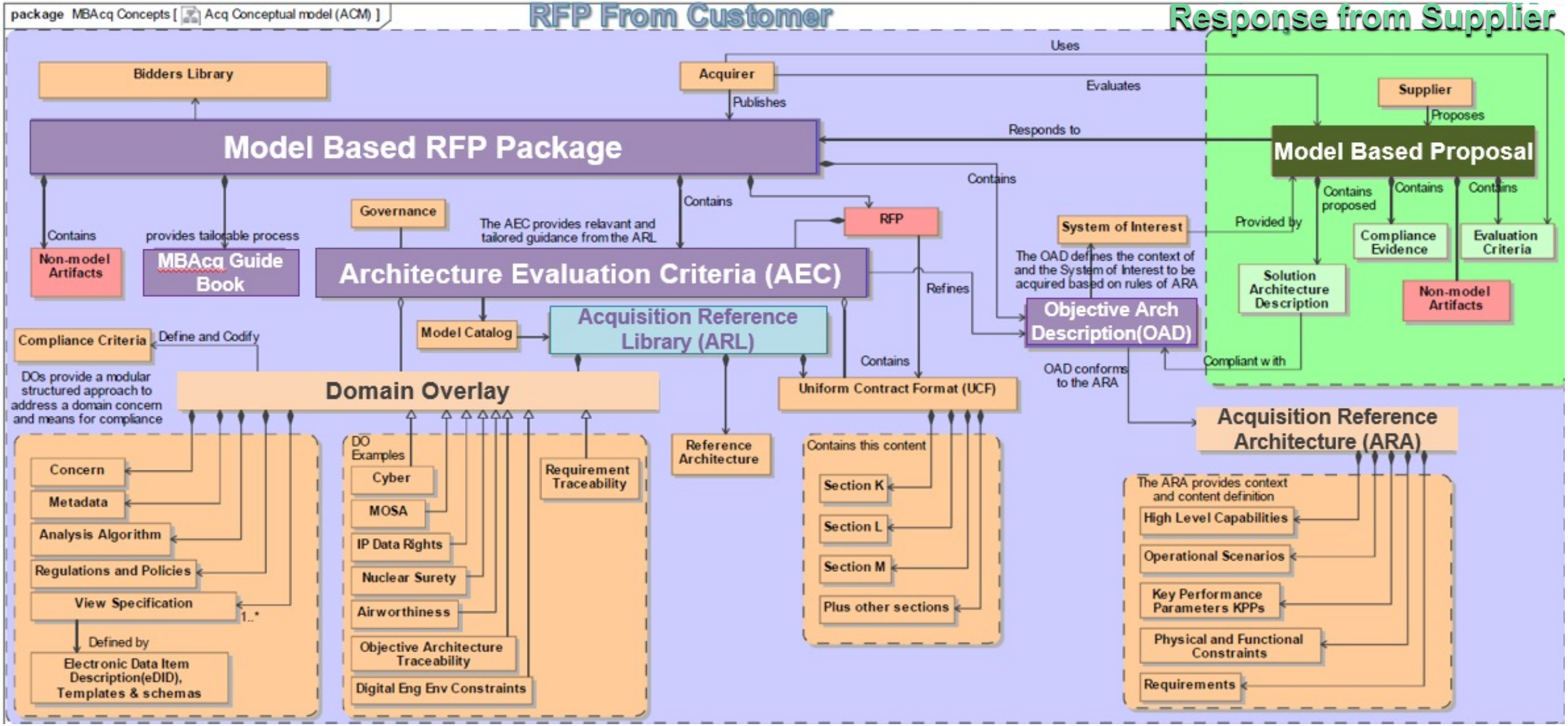
- **A System Architecture Model is an Integrated Structured Representation of the Requirements, Behaviors, Structure, Properties, and Interconnections**
  - Requirements
    - What are the mission operations, stakeholders' goals, purposes, and success conditions for the system?
  - Behavior
    - What the system needs to do to meet requirements
    - Transformation of inputs to outputs
    - Responses to External stimulus
  - Structure
    - The parts of the system that are responsible for the behaviors
    - The component hierarchy, elements and stores
  - Properties
    - The performance, physical characteristics and governing rules that constrain the structure and behaviors
  - Interconnections
    - The ability of the structured elements to exchange information and achieve their required behaviors



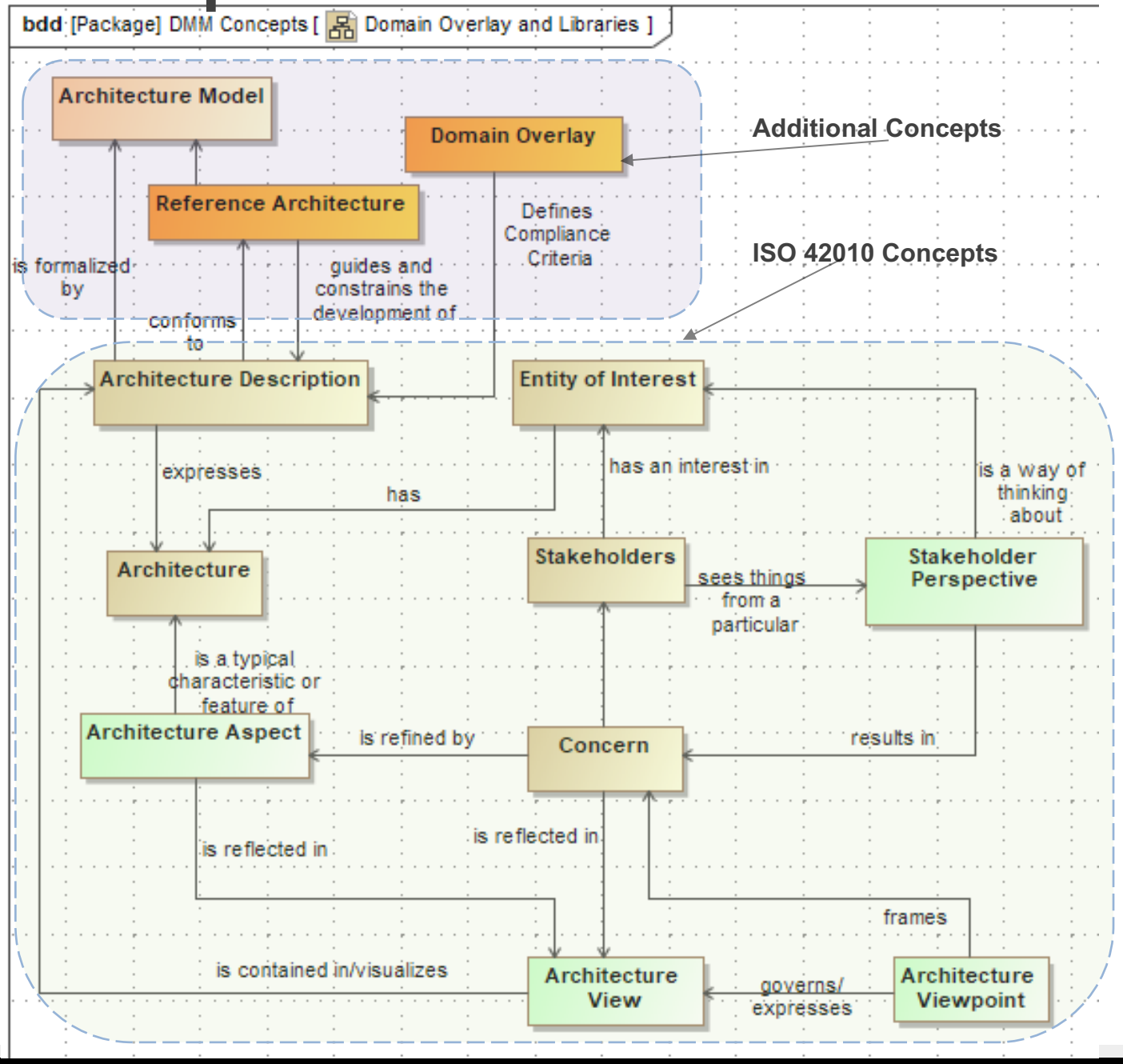
Primary use of the system model is to enable the design of a system that satisfies its requirements

MBAcq Future State

Bringing it all together!



Standardized Concepts for Reusable Content



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Domain Overlays (DOs)

Domain Overlay (DO) Description: A collection of constructs needed to support analysis for a **domain specific concern** using a standardized modular approach. Typical construct elements include:

Previously called Aspect Viewpoint Overlays (AVO)

- A set of regulations, constraints, rules…. driving the analysis (i.e. MOSA, safety, certification, airworthiness, Space …)These could be provided as an instrumented lib
- A set of Data/Metadata required to address or support analysis, compliance or fit-for-purpose. Implementation example (Domain model/profile)
- Logic/algorithm needed to perform analysis using the metadata and regulations
- A set of Viewpoints to support various analysis (Certification plan, coverage, design trades, schedule and resources…)

Characteristics

- Usually has associated regulations, governance that can be treated as pseudo requirements or constraints
- Cross-cutting both viewpoints/rows & aspects/columns
- Supports specific analysis associated with a Domain-Specific concern
- Can be created independent of a specific solution architecture description
- Can be applied or removed from a specific architecture description without impacting the AD, hence an overlay

Based on NDIA Actionable Architecture Using Aspect Modeling, L Hart 2018

Modular structured pattern to support standardization

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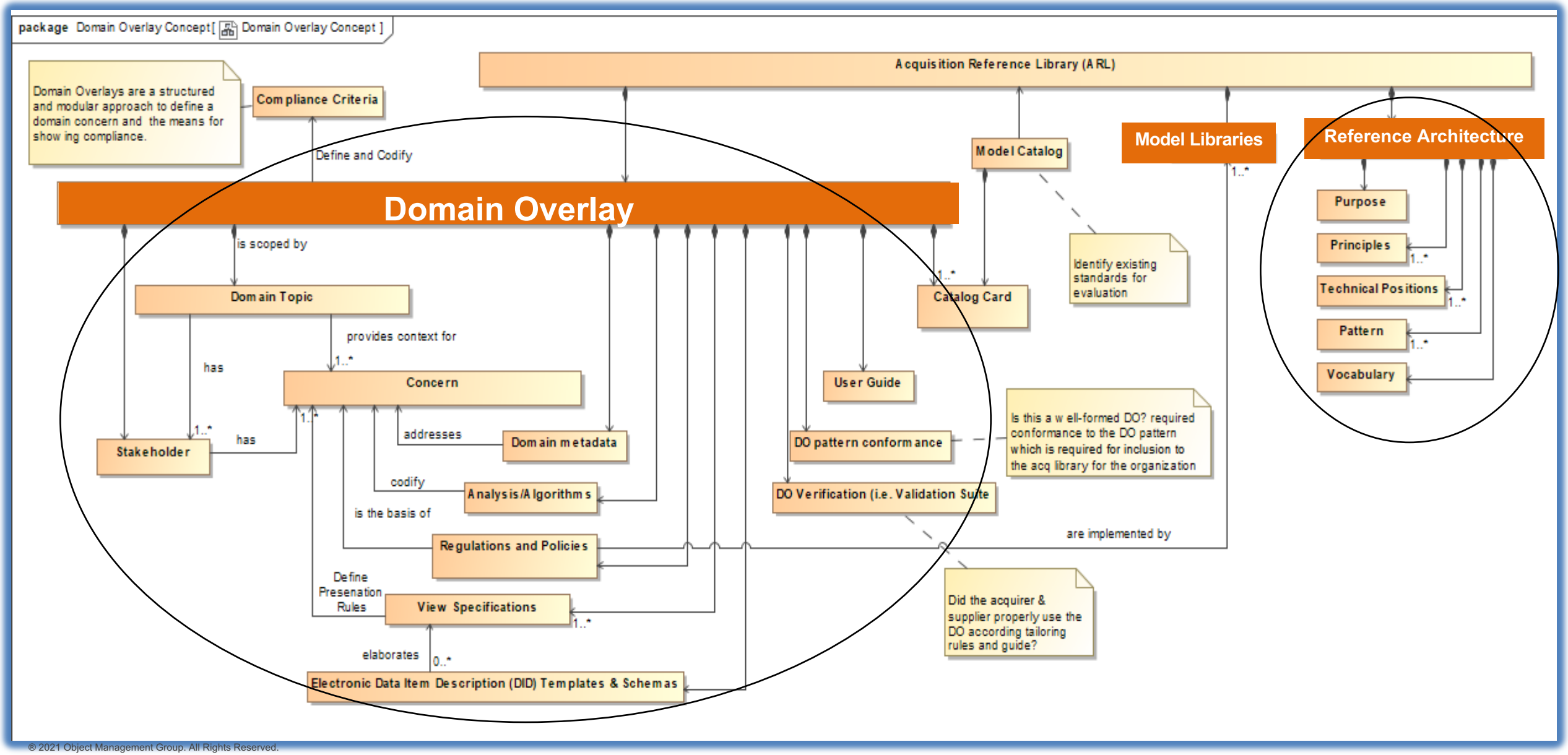
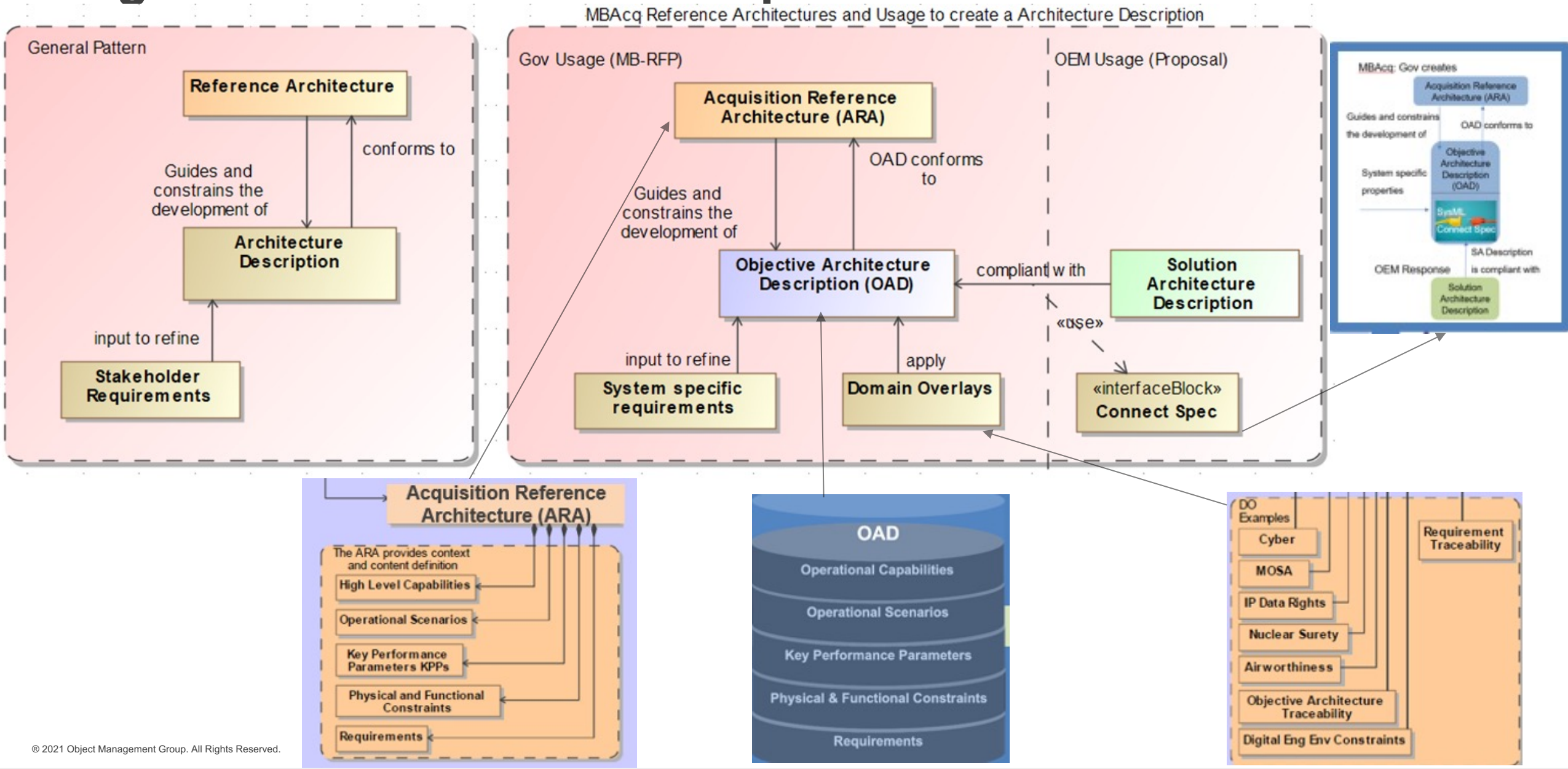
Standardized Concepts for Reusable Content

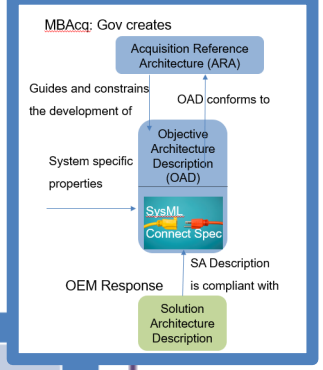


Usage of Standardized Concepts



The Architecture Continuum

Defining Guidance!



View Specifications

Views

Architecture Continuum

RFP

Proposal

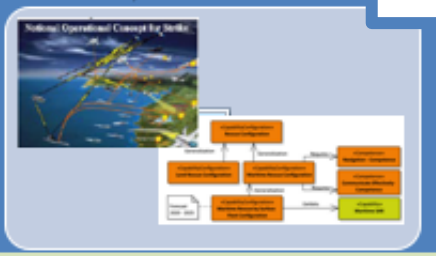
Enterprise Architecture (UAF)

- "Blueprint" for Organization
- Provides System Context
- MOEs, Enterprise Rs-Sr

OAD

- Operational Capabilities
- Operational Scenarios
- Key Performance Parameters
- Physical & Functional Constraints
- Requirements

St-Tx, Op-Sr, Ar-Ct

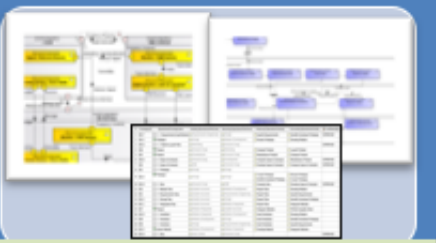


Traceability

Logical System Architecture (UAF or SysML)

- AOA Results, MOPs
- Customer Requirements
- System Rs-Sr

Rs-Sr, Op-Ra, bdd, ibd



Traceability Domain Overlays (DO)

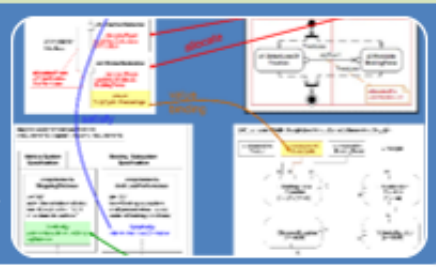
System Architecture (SysML)

- Derived Requirements
- Compliance Evidence (as defined in the DOs)

Proposed Solution

- Solution Architecture
- Compliance Evidence
- Traceability to OAD
- Requirements Allocation

bdd, ibd, par, req



UAFML

SysML

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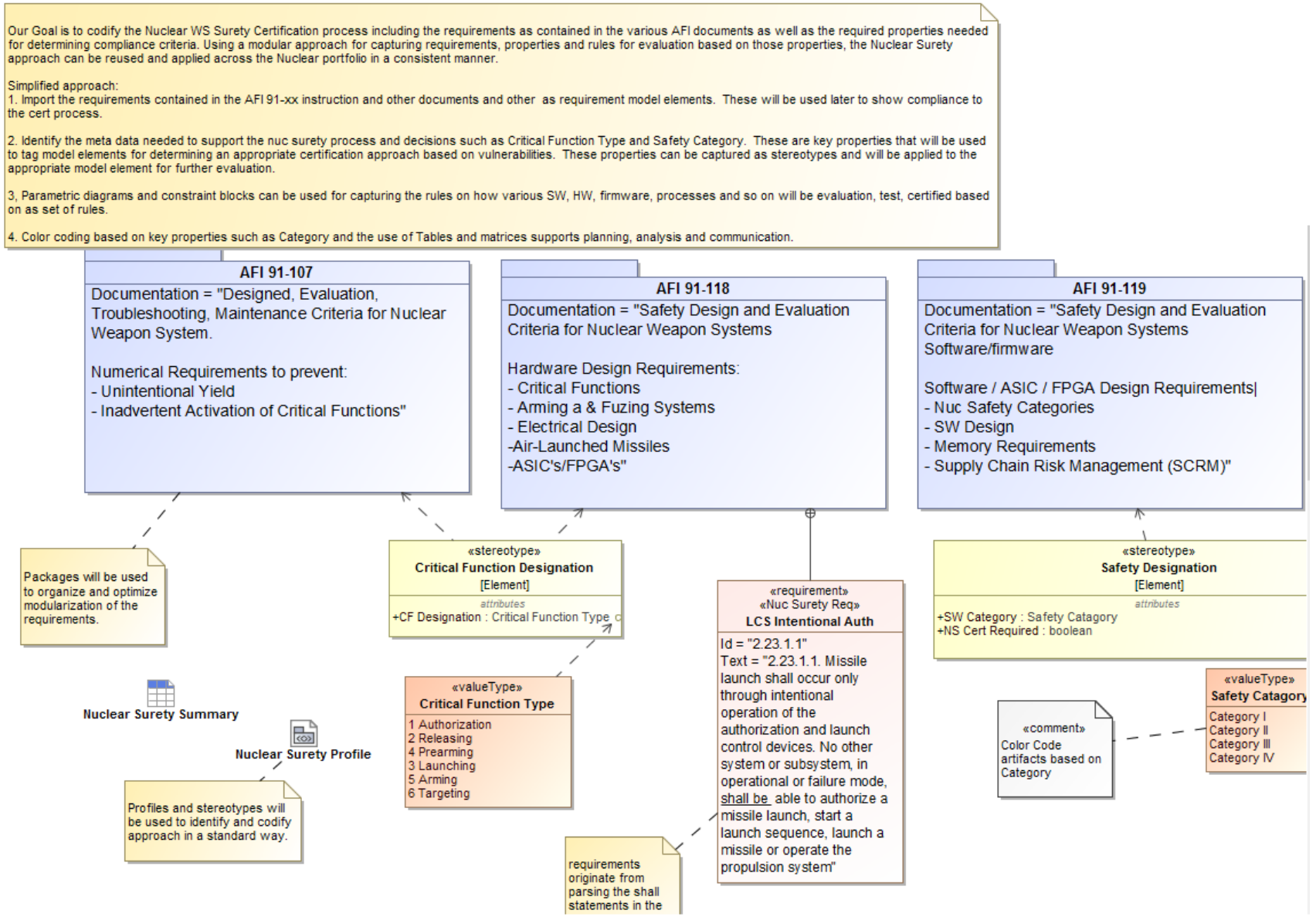
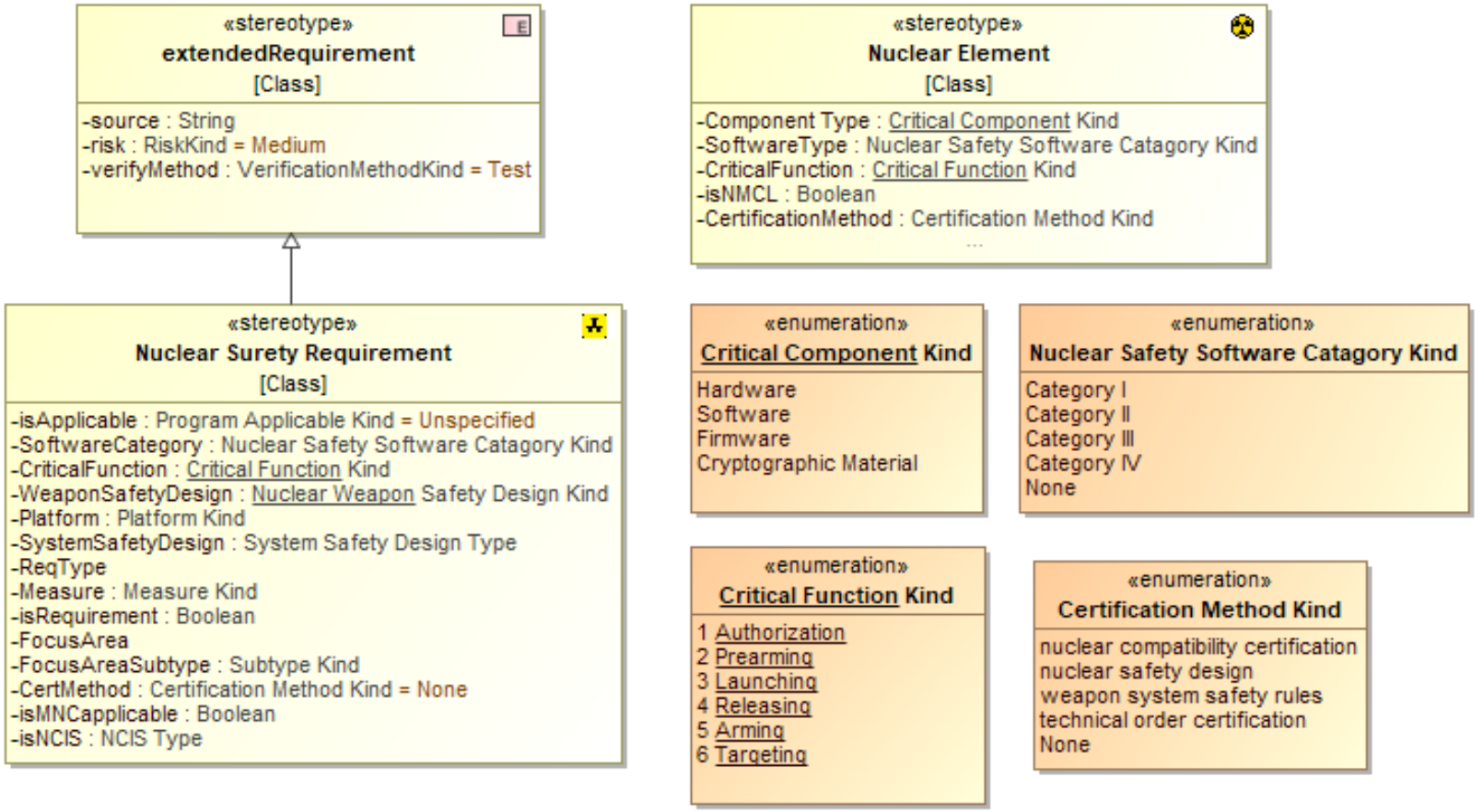
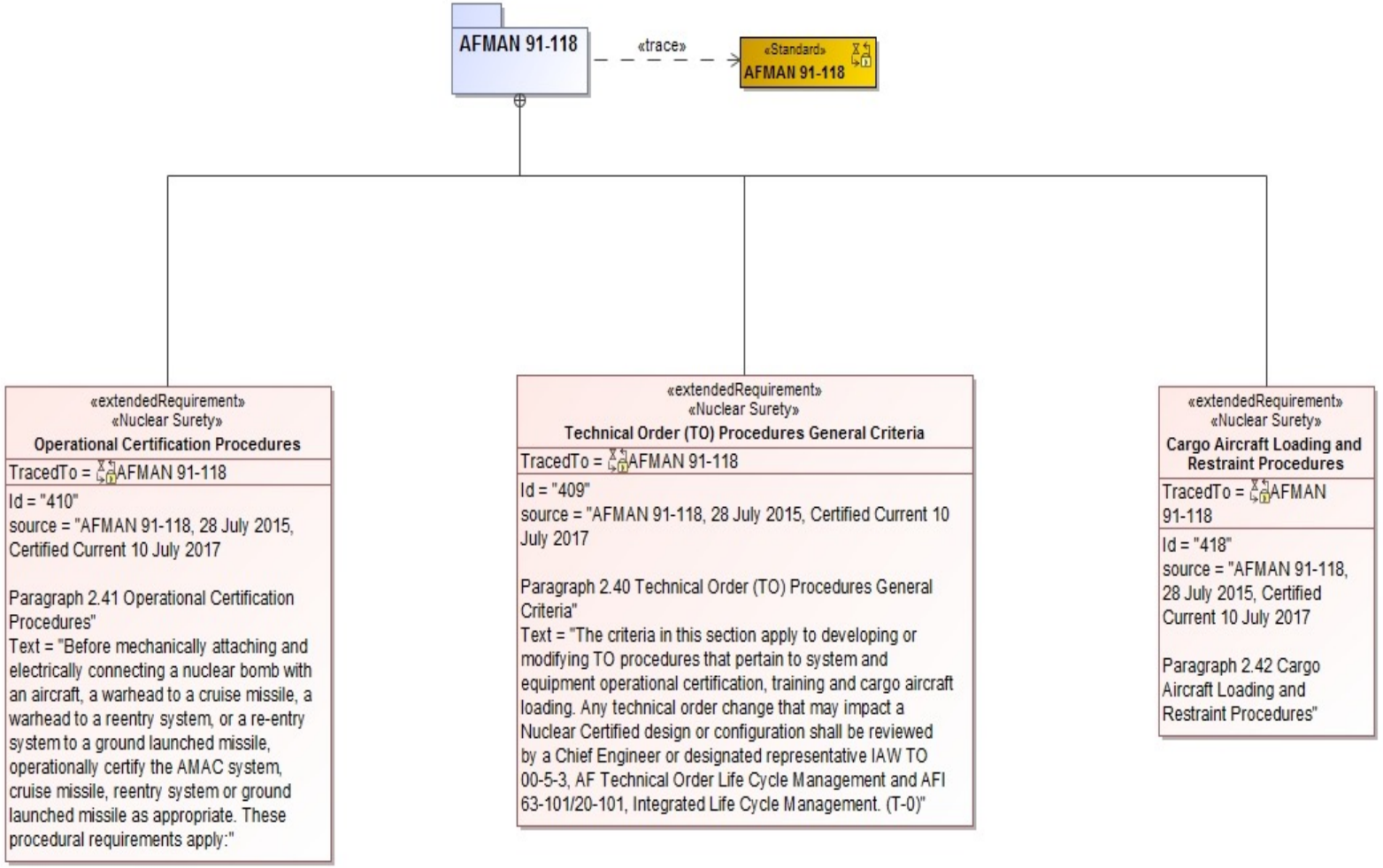
Example DO for Nuclear Surety Certification



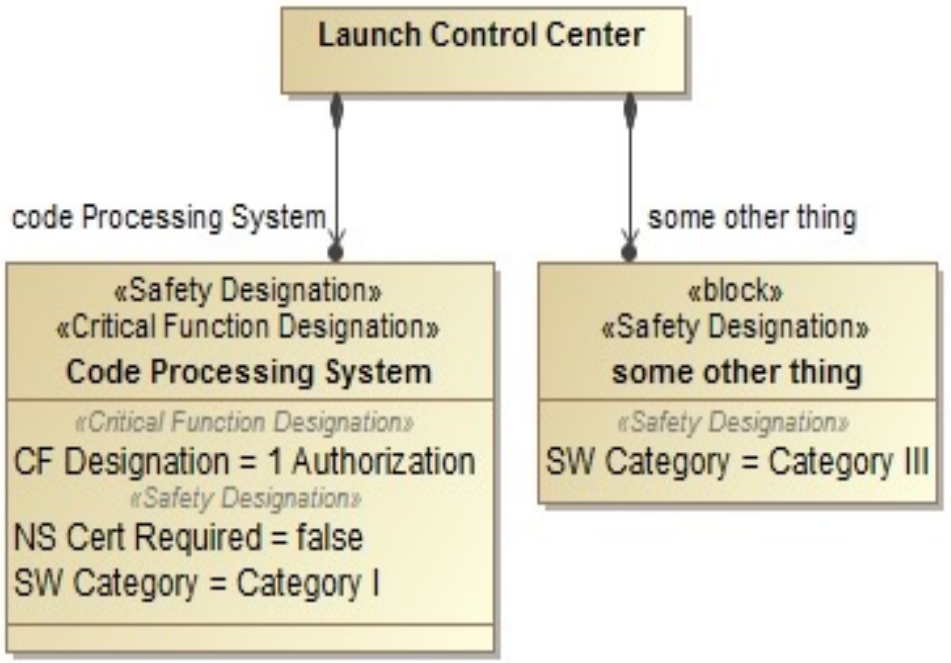
Tailoring Language for Surety



Requirements Model



Applying to the System Model



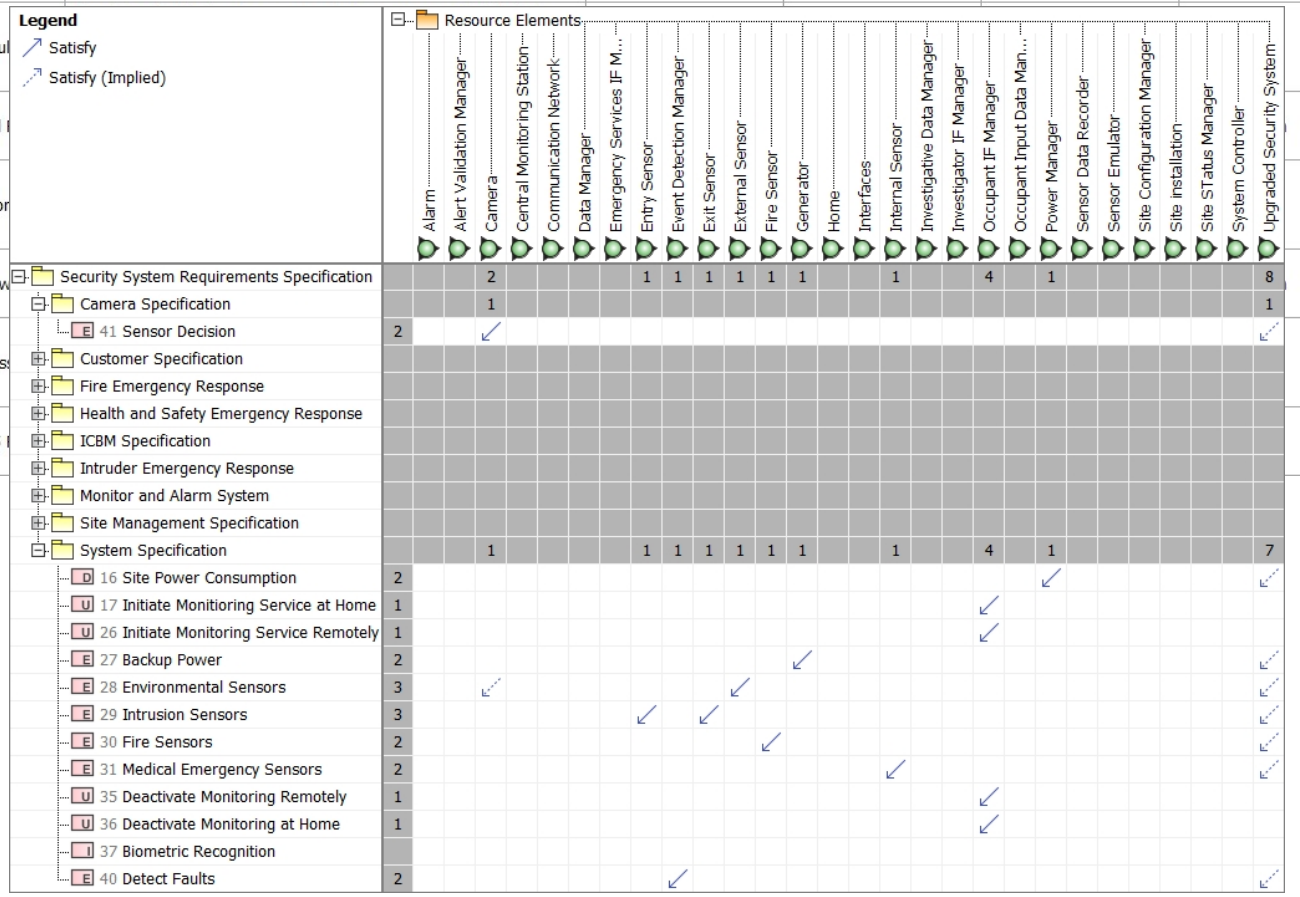
Criteria

Element Type: Block ... Scope (optional): Appling Nuc Surety Example ... Filter:

#	Name	CF Designation	SW Category	NS Cert Required
1	Code Processing System	1 Authorization	Category I	false
2	Launch Control Center			<undefined>
3	some other thing		Category III	<undefined>

Analyze System Design

#	Name	Text	Critical Function	Software Category	Satisfied By	Verify Method	Verified By
1	1087 Troubleshooting	Troubleshooting and maintenance operations must prohibit using any nuclear weapon as a troubleshooting tool.	3 Launching		ALCM Support Equipment		
2	1088 Transitory Fault Rates	The system specification shall specify acceptable transitory fault rates.					
3	1089 Transitory Faul						
4	1090 Detect Critical I						
5	1091 Critical functior						
6	1092 Revert to Know						
7	1093 Stop Transmiss						
8	AFMAN91-119-0.75 I						Fault Detection Self-te



Applying to Requirements

Criteria

Element Type: Extended Requirement ... Scope (optional): AFMAN 91-118 ... Filter:

#	Name	Text	Applied Stereotype	Is Applicable	Critical Function	Software Category
1	Weapon Arm	Once commanded to the prearm state and presented with proper arming stimuli, the weapon shall arm.	«» Nuclear Surety [Clas	Apply	1 Authorization	
2	Separate Arm and Authorize Funct	The weapon system design shall keep the prearming function separate and independent from the authorization function.	«» Nuclear Surety [Clas	Apply	1 Authorization	
3	Preclude prearming	Weapon design features shall preclude prearming in the absence of the prearm command signal and prevent bypass of any prearming device that would permit arming without prearming.	«» Nuclear Surety [Clas	Not Apply	4 Prearming	Category III
4	Information Control Concept Prear	For weapons whose design is based on the information control concept, use uniquely coded prearm command signals. The information needed to generate the unique signal shall be physically unavailable to the unique signal generator until its use is required.	«» Nuclear Surety [Clas	Apply	4 Prearming	
5	Energy Control Concept Prearming		«» Nuclear Surety [Clas	Not Apply		
6	No Separation Without Release Co	Without the unlock command, separation of the weapon from the combat delivery aircraft shall not occur even if the release command is sent.	«» Nuclear Surety [Clas	Apply	2 Releasing	Category I

Collaboration and Transparency in an Open Env

wiki.codev.mitre.org/display/UAF/T3%3A+High-Level+Domain+Model

Welcome to LMPeo... | External Outreach... | Service Central Ho... | CoDev Portal | SAP Budet Reports | Calendar Vacation... | Weekly Team M

Spaces | Forums | People | Questions | Polls | Ideation | Glossaries | Calen

- Websites
- Digital Acquisition WG
  - Membership and Attendance
  - Agenda/Meeting Minutes
  - Activities and Deliverables
    - T1/2: Landscape Assessment
    - **T3: High-Level Domain Mo**
      - Sustainment
    - T4: Use Case Development
    - T5: Digital Eng Env (DEE) ass
    - T6: Language Architecture
    - T7: Updates to the Example I
    - T8: (ARM) Acq Ref Model: Te
    - T9: Policy Review Group
    - T10: Identify Reference Reso
    - T11: Acquisition Guide Outli
    - T12: Modeling Environment
    - T13: MOSA Metrics
    - T14: Define (ARA & OAD): pr
    - T15: Define Model Based RFI
    - T16: Joint interface compone
- MBAcq Shared Files

Pages / ... / Activities and Deliverables

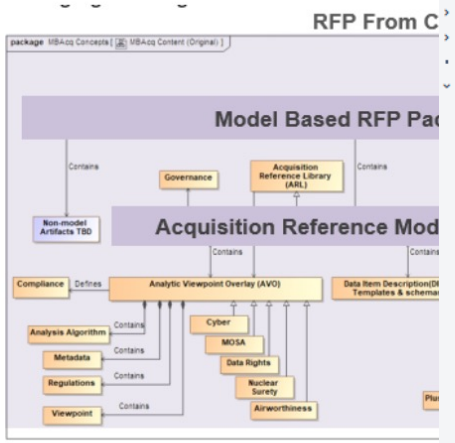
T3: High-Level Domain Mod

Created by Laura Hart, last modified about 22 hours ago

Special Task Description: Capture the core high-level conc

Task Leader: @Laura Hart @Matthew Hause , Monty

Members: Yvette Rodriguez, Jeff Banks



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OMG UAF Task Force

- Pages
- Calendars

SPACE SHORTCUTS

- Meeting Notes & Action Items
- UAF 1.2 Sample Model Document
- Glossaries

PAGE TREE

- Meeting Notes & Action Items
- UAF 1.2 Sample Model Document
- UAF 1.2 Layers
- Files list
- How-to Articles
- Websites
- Digital Acquisition WG
  - Membership and Attendance
  - Agenda/Meeting Minutes
    - 05/06/2022 Agenda/Minutes
    - 05/20/2022 Agenda/Minutes
    - 06/07/2022 Agenda/Minutes
    - 07/01/2022 Agenda/Minutes
    - 07/29/2022 Agenda/Minutes
    - 08/12/2022 Agenda/Minutes
    - **09/02/2022 Agenda/Minutes**
    - 09/09/2022 Agenda/Minutes
    - 10/14/2022 Agenda/Minutes
    - 10/28/2022 Agenda/Minutes
    - 11/18/2022 Agenda/Minutes
    - 12/6/2022 OMG Agenda/Minutes
    - Orientation Meeting Sept 1, 2023
  - Activities and Deliverables
  - MBAcq Shared Files
  - Files: Reference Documentation
  - MBAcq User Group Charter
  - New CoDev Request
  - Model & Data Catalog
  - Sub Committee Meeting Schedule
  - FAQs -- Frequently Asked Questions
- Glossaries

Pages / ... / Agenda/Meeting Minutes | 22 views

09/02/2022 Agenda/Minutes

Created by Laura Hart, last modified on Sep 02, 2022

All Attendees put your name/org/email in the chat window. That allows us to capture attendance

and if you need access to the MITRE CoDev Collaboration Site (Confluence)

https://wiki.codev.mitre.org

General Request:

- If this was your first meeting, please send me your Chat Introduction
- To request an MBAcq collaboration site account, send email request to Rae Ande
  - Gaining access to the OMG UAF Task Force Confluence site is a THREE STE

1) follow the link and register either using a password or enrolling your Dc
2) You must log in to the MITRE CoDev network to create an account on tl
3) Once you do, please email me (rahaselden@mitre.org), and I will invite

Agenda:

- Topics:
  - Report from the subgroups: What can we get done in the next 30, 60, 90 c
    - [x] Rae Anderson: T1/2: Landscape Assessment and Lessons Learned
      - [ ] Monte will provide rolled up Lessons Learned
    - [x] Hart/Hause: T3: High-Level Domain Model
    - [x] Rae/Tom: T4: Use Case Development
      - [ ] Review UC document and instructions
    - [ ] Hart: T7 Example Model Definition
    - [x] Tom M and Barry P: T9: Policy Review Group - The SERC has comple
    - [x] Yvette Rodriguez: T10: Identify Reference Resource Authoritative So
    - [x] Bob Scheurer/John Quintana: T11: Acquisition Guide Outline
      - [ ] This will be a distributed effort; all please review and provide
    - [x] T5: Digital Eng Env (DEE) associated with primary System
    - [x] Rae Anderson/Dave McDaniel: T14: Define (GRA & GRM): proposed
    - [ ] Daniel Brookshier: T12: Modeling Environment Tool Support
    - [ ] Gene Sherve: T6: Language Architecture
  - General conversation around the room:
    - Nadine: new OSD Architecture group is being formed lead by Lt Co
    - Ed Moshinski (OUSD R&E and NDIA Arch co-chair) stated that a MC these deliverables will be pivotal to the MOSA standardization appr
    - Frank Salvatore Asked, Are you planning to start with what was dor
    - Keith provided new contract for ASDP ->"Frood" SCHNEIDER, MICH
    - Monte Porter - PEO MS : I'm interested in the govt reference model
    - Frank Salvatore : I will sign up to be a reviewer of the concept map.
    - Mike Guba to support GRA/GRM development
    - Frank Salvatore : There is a digital engineering measurement frame
    - Keith Siders, AFLCMC/EZSI, working to get AF legal/contract suppor
- Actions:
  - [ ] Frank, can you get us a copy of the Skyzer model?
  - [ ] Ed Moshinsky, provide MOSA Implementation Guide
  - [ ] Ed Moshinsky, provide NDIA Arch MOSA Metrics from Steve Henry
  - [ ] Get SATCOM RM
- Acquire existing Arch models to build upon (NAVAIR, AF MBSE, AFC, SATCOM....) who can get these for us?

Next Week:

Spaces | Forums | People | Questions | Polls | Ideation | Glossaries | Calendars | Blogs | Create

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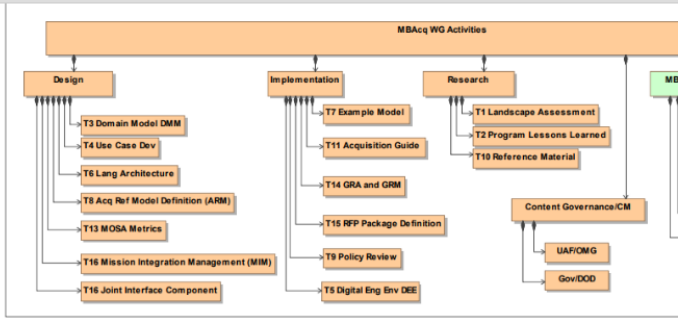
  - Files: Reference Documentation
  - MBAcq User Group Charter



Topic ID#	WG Name	Leader(s)	Description
T1/2 Landscape Assessment & Lessons Learned	Research	@Rae Anderson	Identify Existing activities and organizations associated with [
T3 Domain Model	Design	Laura Hart Matthew Hause	Capture the core high-level concepts, definitions, relationship Metamodel
T4 UC Development	Design	@Rae Anderson	Identify and define major MBAcq Use Case set
T5 Digital Eng Env	Implement		Examine the special considerations for addressing the **Digita** support the larger strategic goals expected from Digital Engi address DEE requirements/specificity in a MBAcq context. De the enabling system and a lighter version of requirements. D
T6 Lang Arch	Design	Gene Sherve	Define the implementation of the ACQ DMM for inclusion int

The Problem

So, we need to share, search for, find (hopefully), reuse, publish, update, notify, etc.:

- Models
- Model Libraries
- Reference Architectures
- Components
- Interfaces
- Types
- Patterns
- Keywords
- Solution Elements
- Etc.

What is the solution to this?

Model Curation

"If we build it, they will come." *Field of Dreams*

- However, ***"they"*** need to know that ***"it"*** exists.

For a library to be of any use, people need to know where it is, be able to enter it, search through a catalog system, check out the elements that they need, and suggest new items to be added. Regarding model reuse, most organizations have a hidden library that few people know about, with no doors, card catalogue or search capability, where you can't check out or add any objects. We need a solution for model curation.

Model Curation – The Status Quo

Wu et al (2021) describes a maturity assessment of Systems Engineering reusable assets to facilitate MBSE adoption, basically a Capability Maturity Model (CMM) for model and asset reuse.

Hause (2014), defines how the OMG Reusable Asset Specification (RAS) was used to build an asset library to harvest, curate, and share SysML model assets to promote and enable model asset reuse.

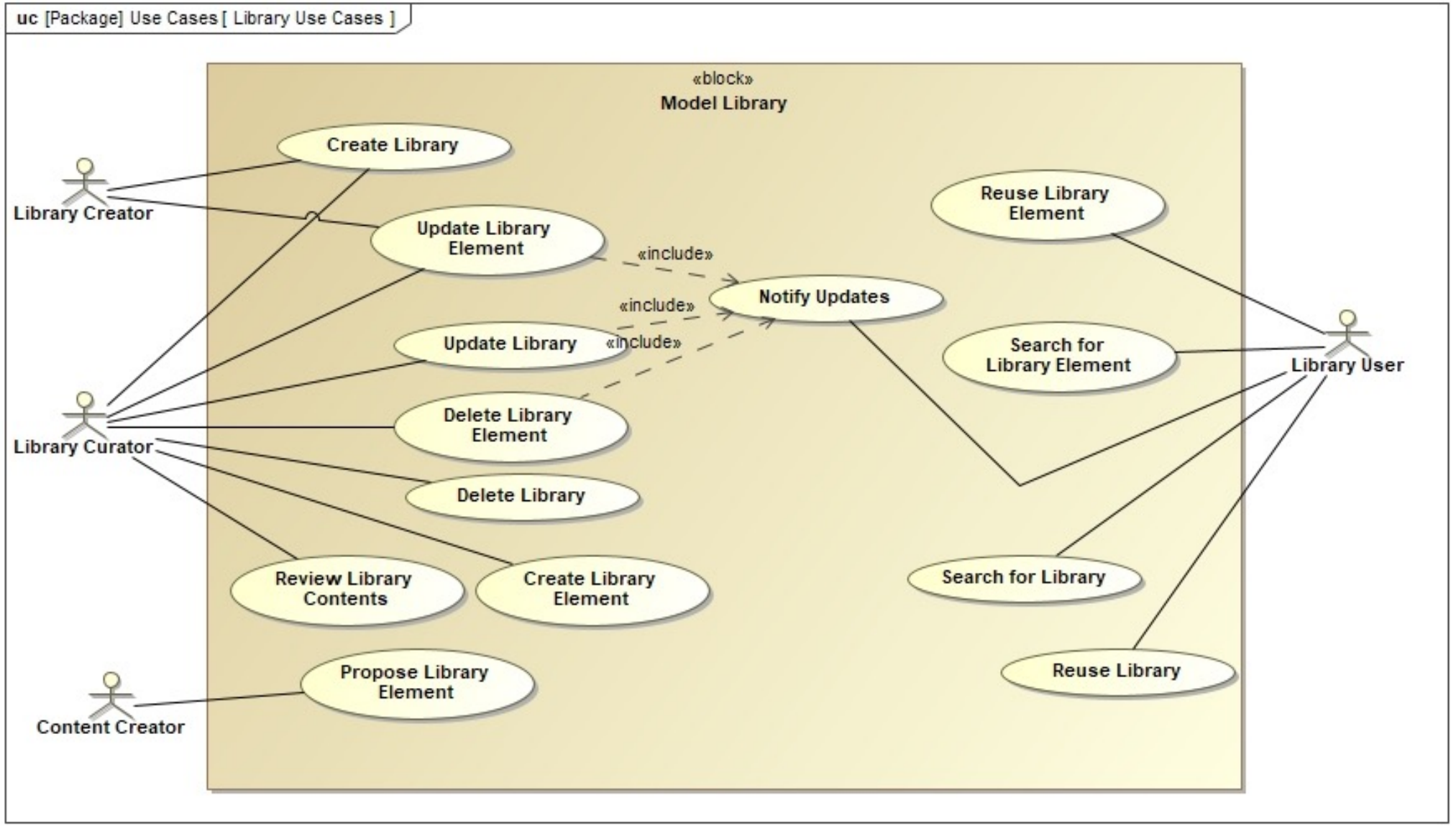
The OMG RAS was published in 2005 and provides a means of categorizing assets for reuse.

- The PTC Asset Library is the only implementation the authors are aware of that is still in use. It does not provide a complete curation solution.
- Other Solutions?

A Few Requirements – NOT A COMPLETE LIST!!

- Standard API – Extended SysML v2 API?
- Multiple libraries with access control
- Permissions at multiple levels - Library, Element, etc.
- Role-based permissions – Curator, user, creator, owner, etc.
- Configuration management of libraries, elements, patterns, ref architectures, etc.
- Search capabilities using keywords, types, purpose, domain, etc.
- Support for Vendor independent/dependent data formats
- Support for UML, SysML, UAF, etc.
- Support for non-UML tools (future?)
- Local, Department, Enterprise, Global, etc. hosted libraries
- Black box & White box sharing
- Interest registration
- Update notifications
- Global element ID's – the same component in multiple models has the same ID
- Etc.

A Few Model Library Use Cases – NOT A COMPLETE LIST!!



Standards Development Organization.

MB Acquisition Summary

- MBSE can be inserted earlier in the acquisition lifecycle to facilitate agile response to change during the acquisition lifecycle and beyond.
- Government enterprises can respond to opportunities and risks grounded in well-formed models based on data driven decisions
- Formalize the development, integration, and use of models to inform enterprise and program decision making.
- Existing processes will need to be examined to determine where and how MBE/MBSE can be inserted, adopted and improved.
- Prototype processes to determine which work best, find issues, and socialize results.
- Stable mature profiles can be incorporated into existing standards/frameworks such as UAF, SysML
- New profiles can be considered as an independent standards

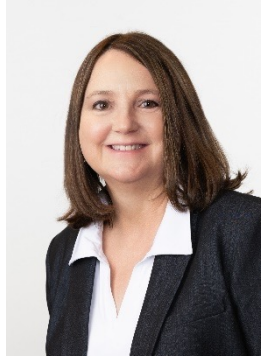
MBAcq is not just a Proposal Packaging Choice. It's about applying Effective SE practices!

Focus on Solutions Instead of Reinventing Modeling and Process!

Moving towards "Born Digital"

Questions?

About the Speakers



Laura E. Hart is a Sr Manager, corporate engineering at Lockheed Martin enabling Digital Transformation. Laura has over 35 years of industry experience covering a wide spectrum of responsibilities applying Model-Based Systems Engineering across the development lifecycle of complex software and hardware systems. Laura's current focus is on the standardization of Model-based acquisition across industry. Laura is the creator and co-chair of the MBAcq user group, co-chair of OMG Unified Architecture Framework (UAF) group, Adjunct professor Drexel University and NDIA Systems Engineering Division vice-chair. Laura.E.Hart@lmco.com

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