Air Force Life Cycle Management Center
Engineering and Technical Management/Services Directorate

Providing the Warfighter's Technical Edge

The Emerging Air Vehicle Government Reference Architecture

Moving Towards Model-Based Acquisition

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Overview

- BLUF: Superior knowledge management
- Acquisition System MetaModel – Quick Review
- ASMM Maps to MBAcq Concept Model
- Domain Overlay Example - Airworthiness
- Model Organization on LaunchPad
- Basic GRA Structure and Features
- Maintaining WBS-to-System Separation
- Example of GRA Linkage
- Architecture of Reference Architectures
- Utilizing Branching in GRA Management
- Establishing on Standards

BLUF: Superior Knowledge Management

BLUF: Ultimately the AF wants superior knowledge management, which is what the whole Digital Transformation is all about.

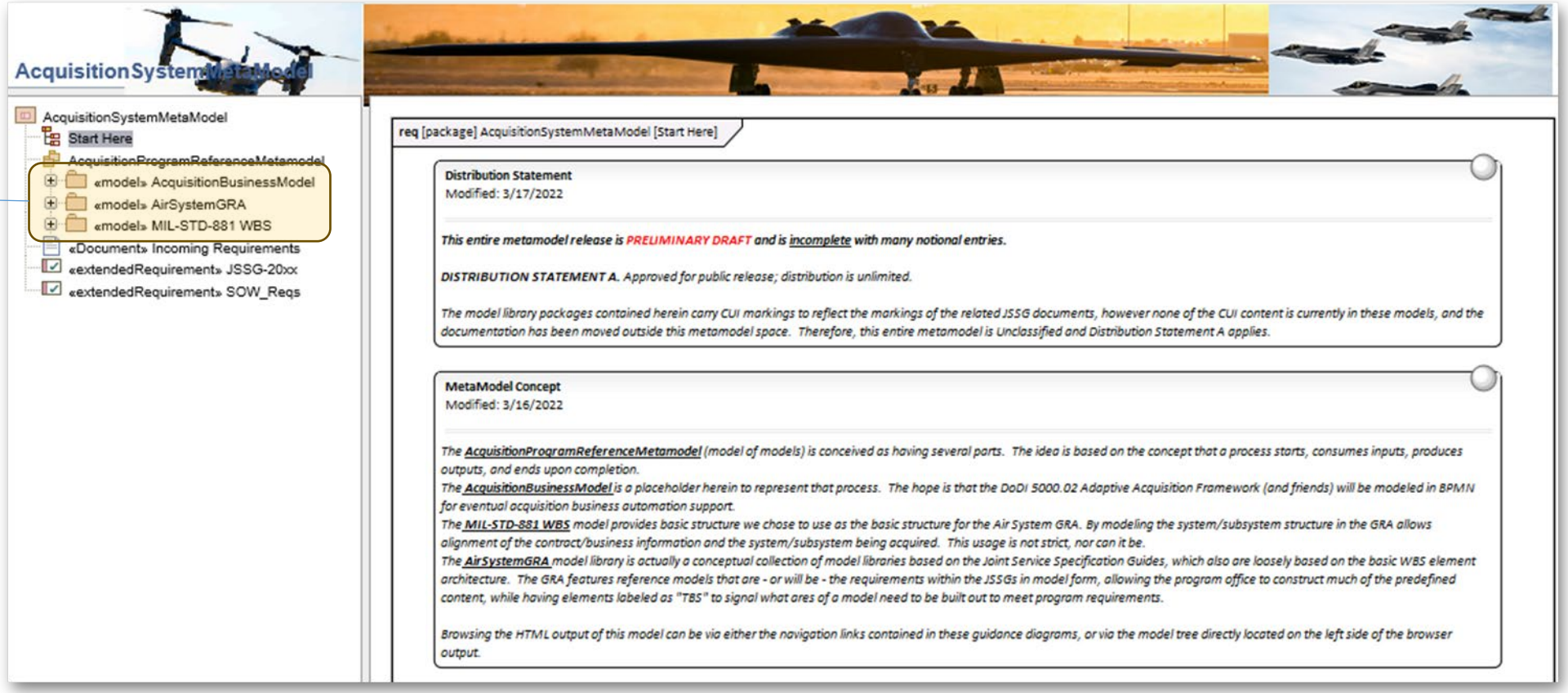
Achieved via:

- **model-centric environments**
- **solid data management processes**
- **modeling best practices and methods**
- **reference architectures**

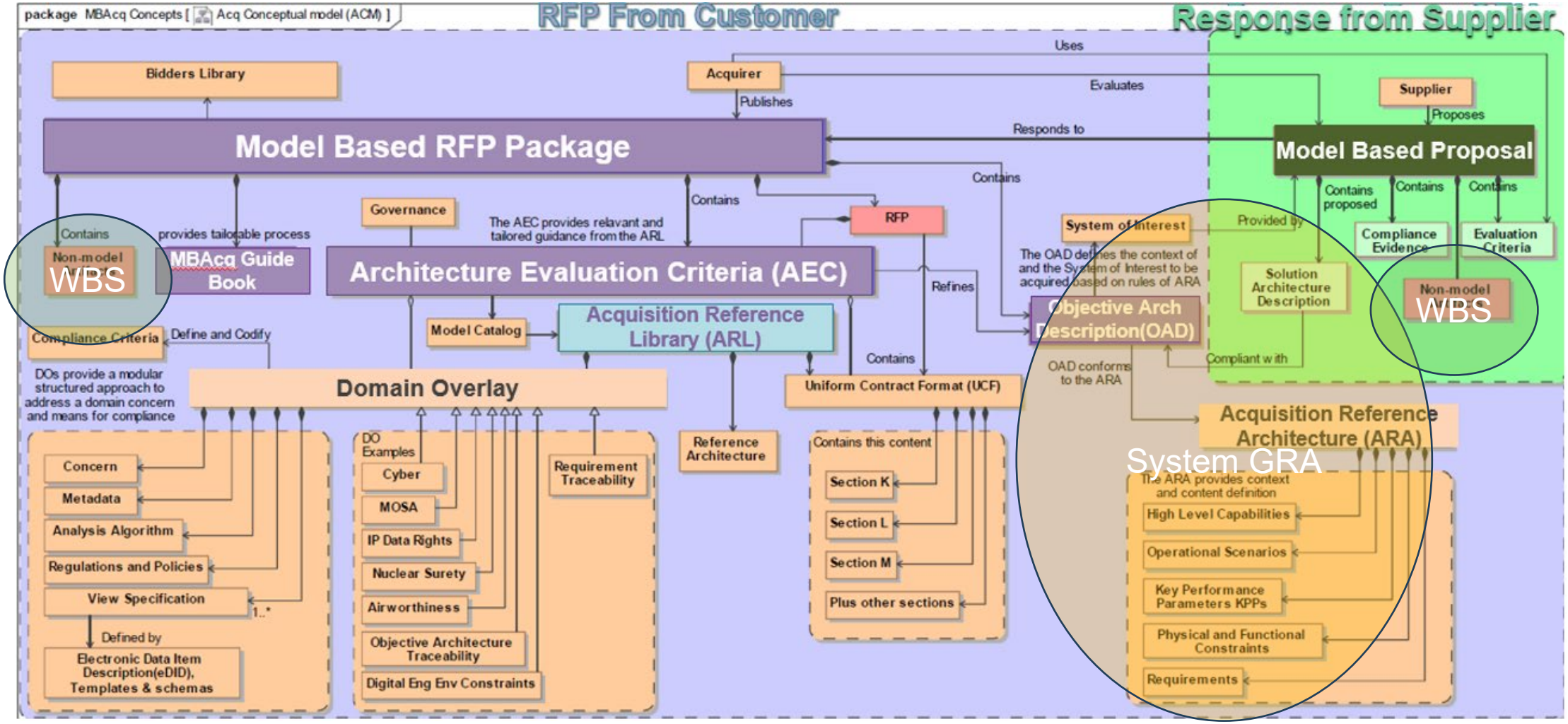
The right knowledge in the right hands at the right time that is authoritative and trustworthy.

Acquisition System MetaModel

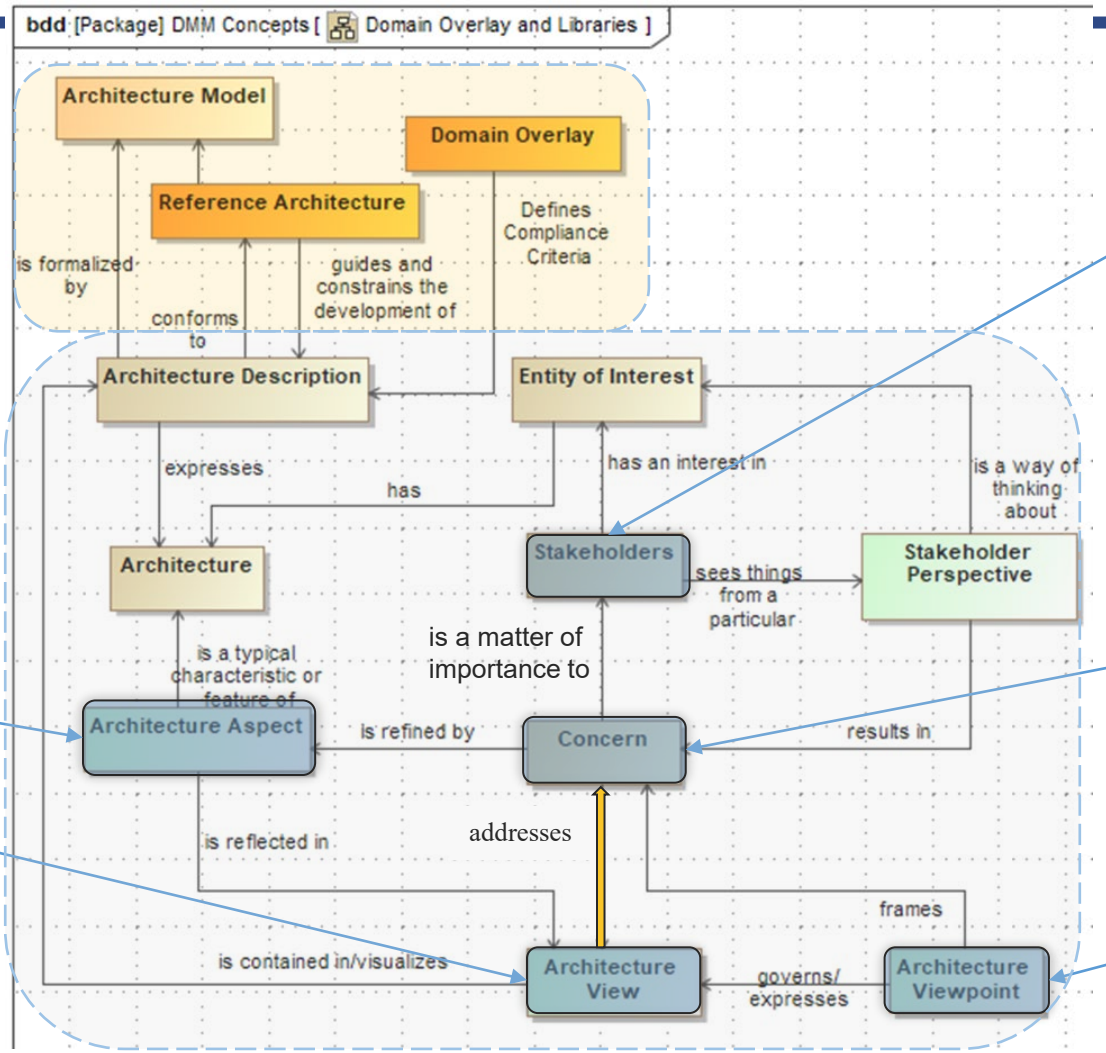
3 distinct model areas
- Business Process
- System GRA
- Program Data



ASMM Maps to MBAcq Concept Model



Domain Overlay Example - Airworthiness



«block»
MIL-E-7016::Data::Power Source Analysis Data

references

load Analysis data : Load Analysis Data
subject : Electric Power Source [1]

values

operatingConditions : Operating Condition [1..*]
analysisTimeInterval : Time Interval [3]
compositeRatingFactorPerOperatingConditionPerTimeInterval : Composite Rating Factor [1]
intervalRatingACPerOperatingConditionPerTimeInterval : Interval Rating AC [0..1]
intervalRatingDCPerOperatingConditionPerTimeInterval : Interval Rating DC [0..1]
adjustedACCapacityPerOperatingConditionPerTimeInterval : Adjusted AC Source Capacity [0..1]
adjustedDCCapacityPerOperatingConditionPerTimeInterval : Adjusted DC Source Capacity [0..1]
loadRequirementsDCPerOperatingConditionPerTimeInterval : electric current[ampere] [0..1]{unit = ampere}
loadRequirementsACPerOperatingConditionPerTimeInterval : apparent power[volt ampere] [0..1]
growthCapacityPerOperatingConditionPerTimeInterval : Growth Capacity [1]
phaseLoadUnbalancePerOperatingConditionPerTimeInterval : Phase Load Unbalance [0..1]
powerFactorPerOperatingConditionPerTimeInterval : power factor[watt per volt per ampere] [0..1]

«AW_View»
«AbstractRequirement»
12.1.1 Airworthiness Assessment of Power Quanity
{ID = "12.1.1"}

«stereotype»
AW_Stakeholder
[Class]

attributes

+AWconcernList : AW_Concern [*]{redefines concern}

«AW_Concern»
Sufficient Source Power Quantity

Id = "21"
Text = "Sufficient source power quantity"

«AW_Viewpoint»
12.1.1 Power Quantity

«AW_Viewpoint»

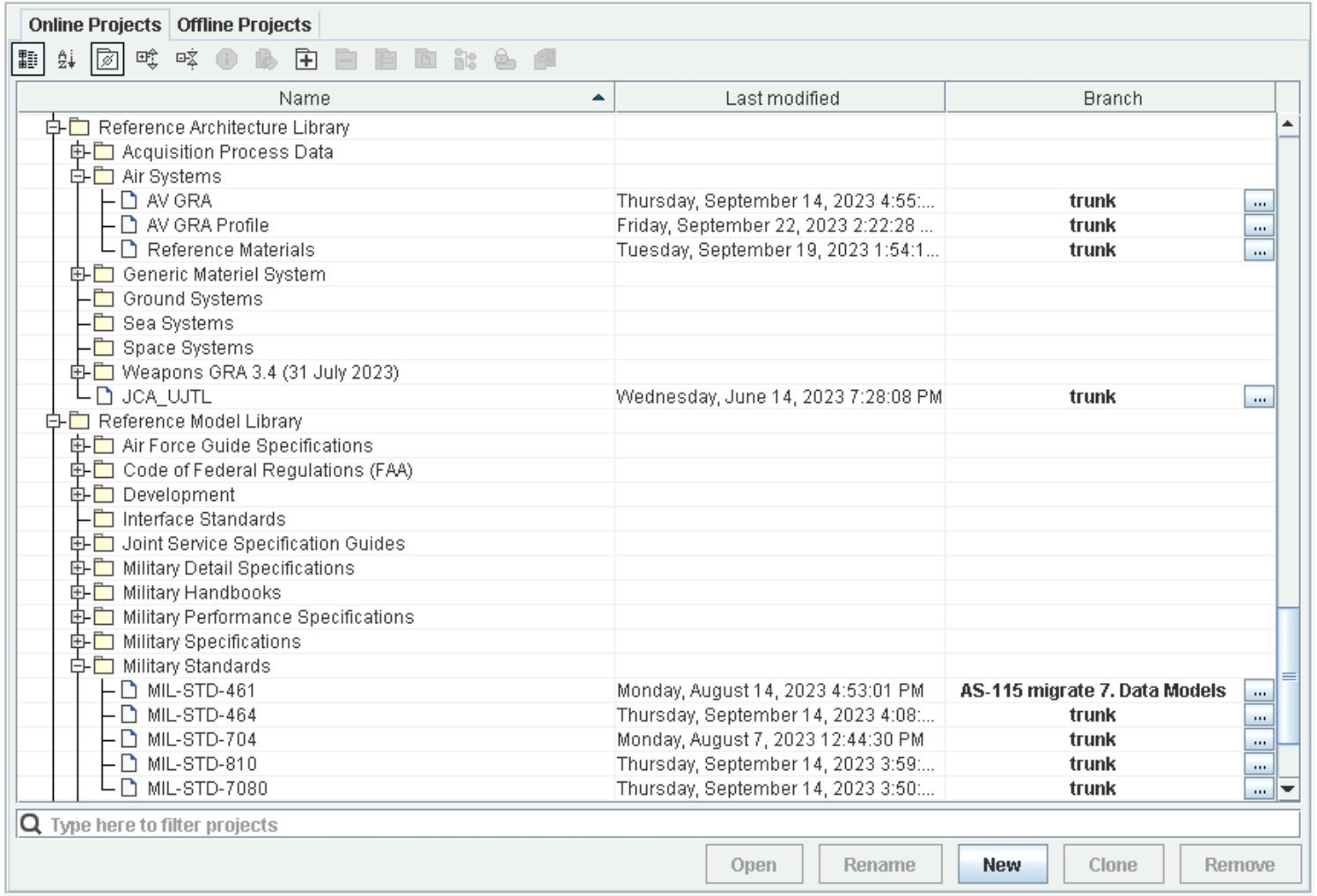
concernList =
Sufficient Source Power Quantity
Battery Discharge Rates

«viewpoint»

concernList = Sufficient Power available for all modes of operat...
purpose = "Verify that sufficient power is available to meet the power requirements during all modes of operation, mission profiles, failure conditions and malfunction recovery procedures."
stakeholder =
EPS SME
Safety Engineer
Lead Engineer

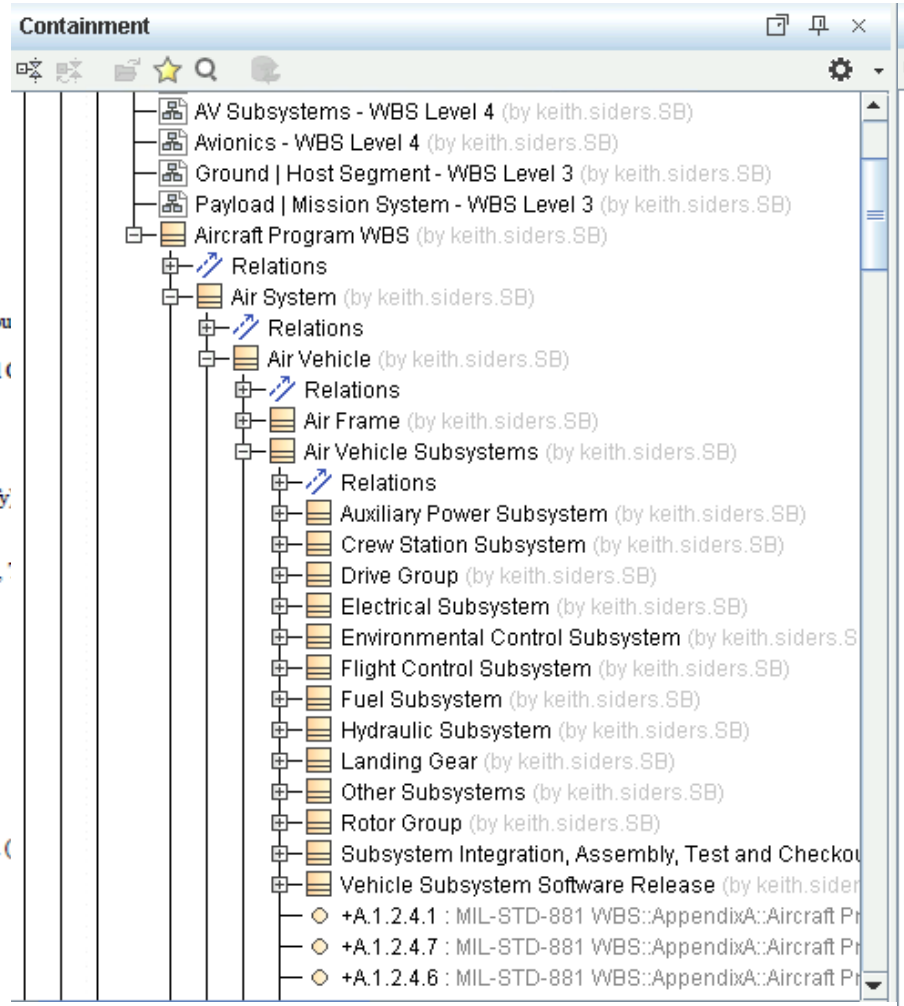
Model Organization in LaunchPad

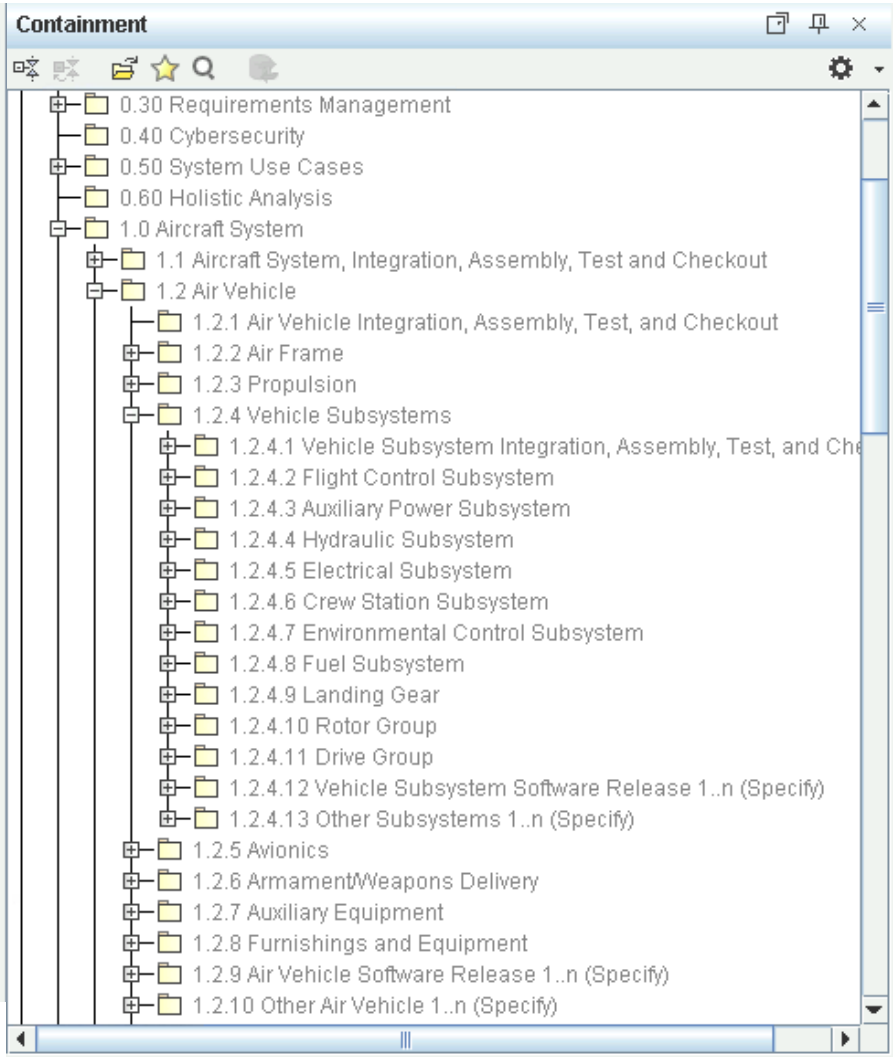
- Separate Reference Architecture and Reference Model Libraries
- Reference Architecture populated/linked with Reference Model elements



Basic GRA Structure and Features

WBS#	Level 1	Level 2	Level 3	Level 4	Level 5
1.0	Aircraft System				
1.1		Aircraft System, Integration, Assembly, Test and Checkout			
1.2		Air Vehicle			
1.2.1			Air Vehicle Integration, Assembly, Test and Checkou		
1.2.2			Air Frame		
1.2.2.1				Airframe Integration, Assembly, Test, and (	
1.2.2.2				Fuselage	
1.2.2.3				Wing	
1.2.2.4				Empennage	
1.2.2.5				Nacelle	
1.2.2.6				Other Airframe Components 1…n (Specify)	
1.2.3			Propulsion		
1.2.4			Vehicle Subsystems		
1.2.4.1				Vehicle Subsystem Integration, Assembly, '	
1.2.4.2				Flight Control Subsystem	
1.2.4.3				Auxiliary Power Subsystem	
1.2.4.4				Hydraulic Subsystem	
1.2.4.5				Electrical Subsystem	
1.2.4.6				Crew Station Subsystem	
1.2.4.7				Environmental Control Subsystem	
1.2.4.8				Fuel Subsystem	
1.2.4.9				Landing Gear	
1.2.4.10				Rotor Group	
1.2.4.11				Drive Group	
1.2.4.12				Vehicle Subsystem Software Release 1...n (	
1.2.4.13				Other Subsystems 1...n (Specify)	
1.2.5			Avionics		





Basic GRA Structure and Features

- **Basic structure mimicked in JSSGs**

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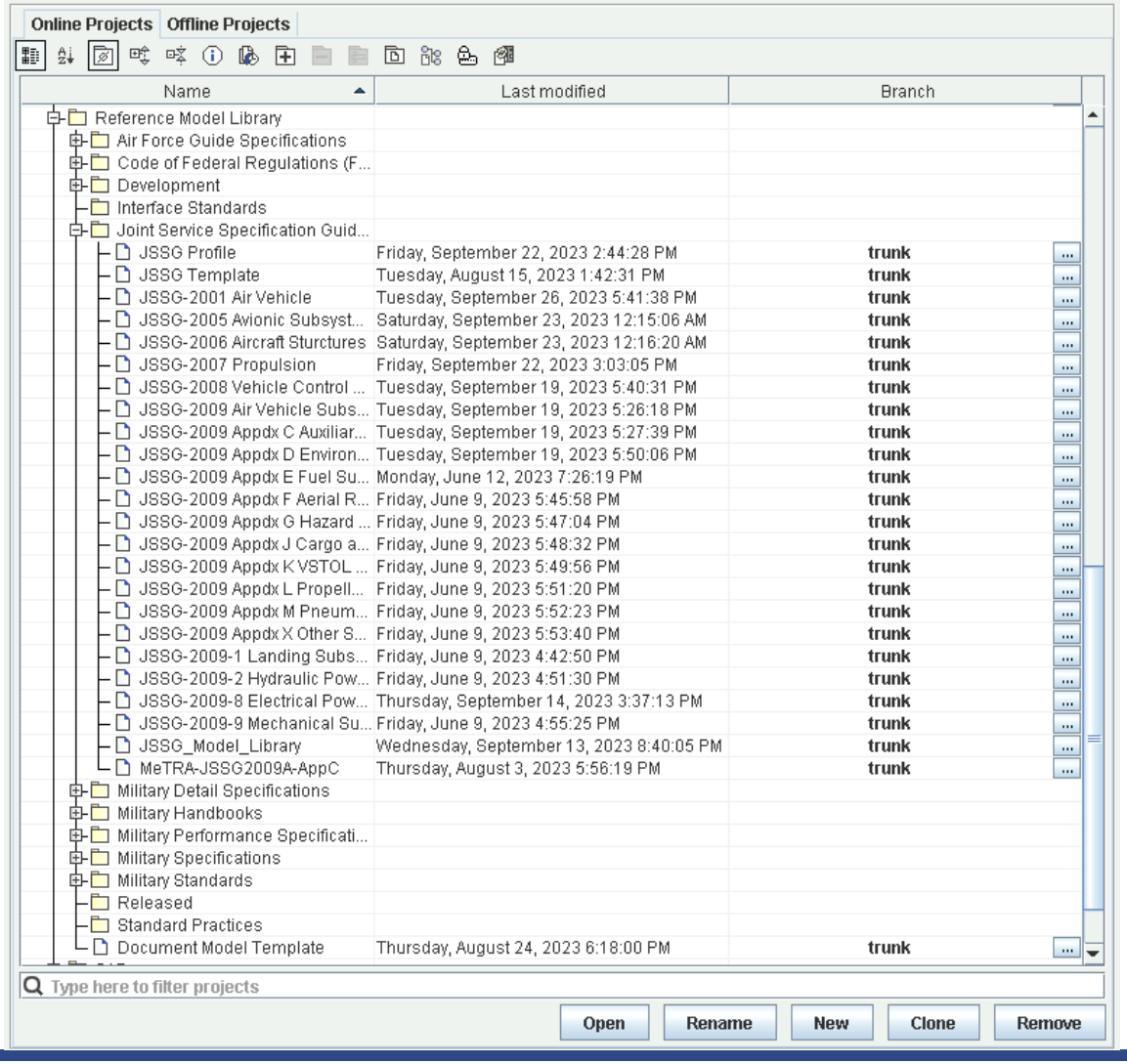
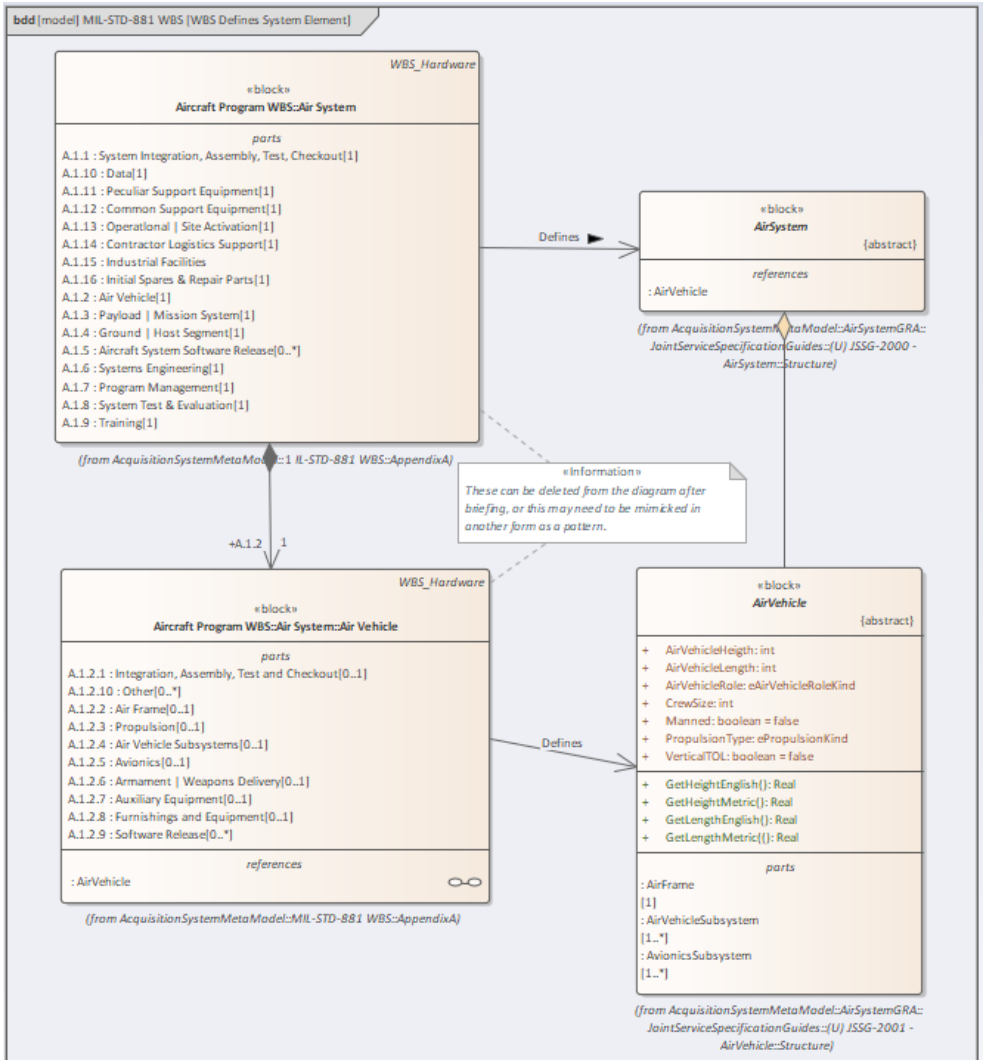
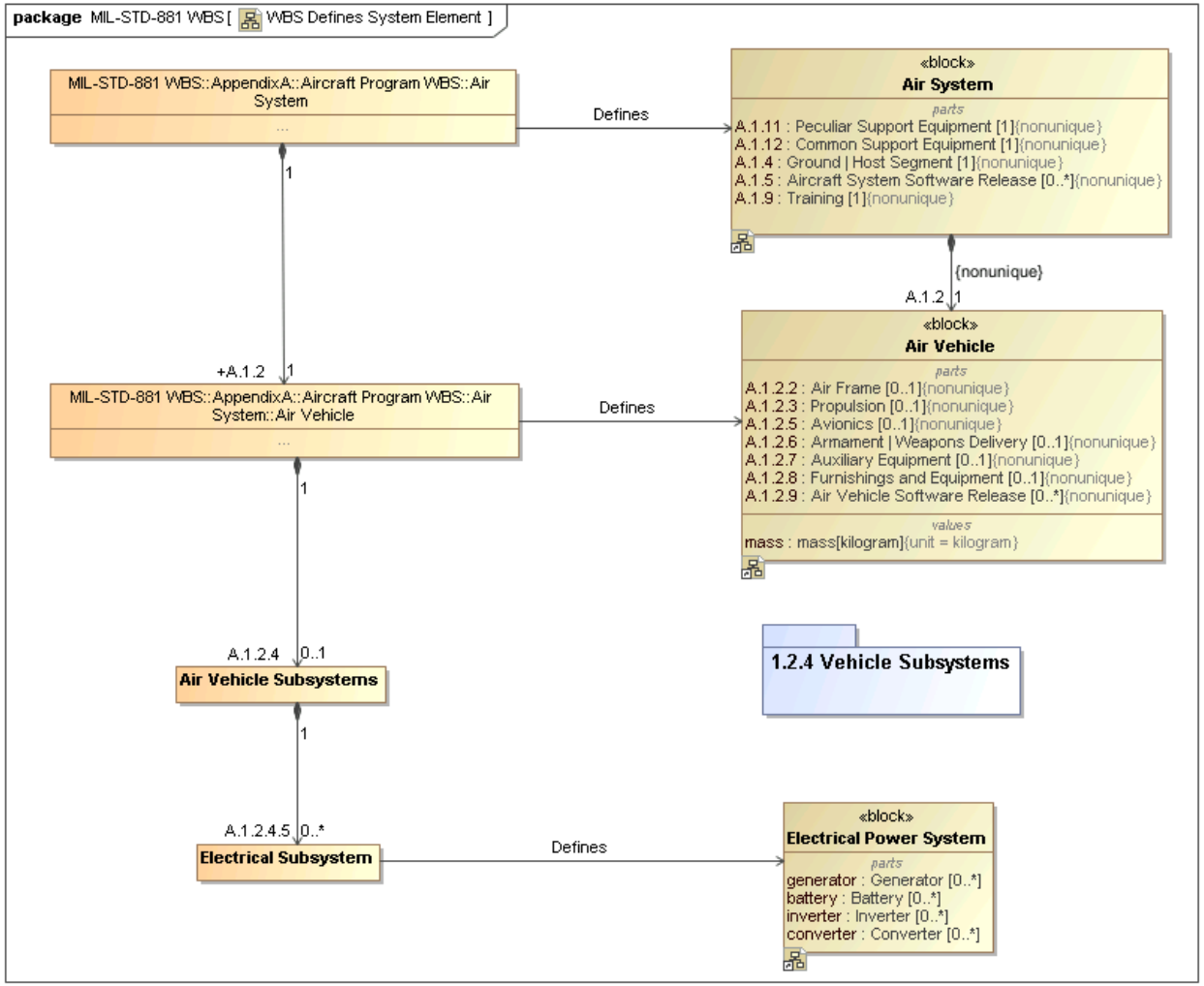


- **MIL-HDBK-516 follows similar structure**
- **Basic common architecture**

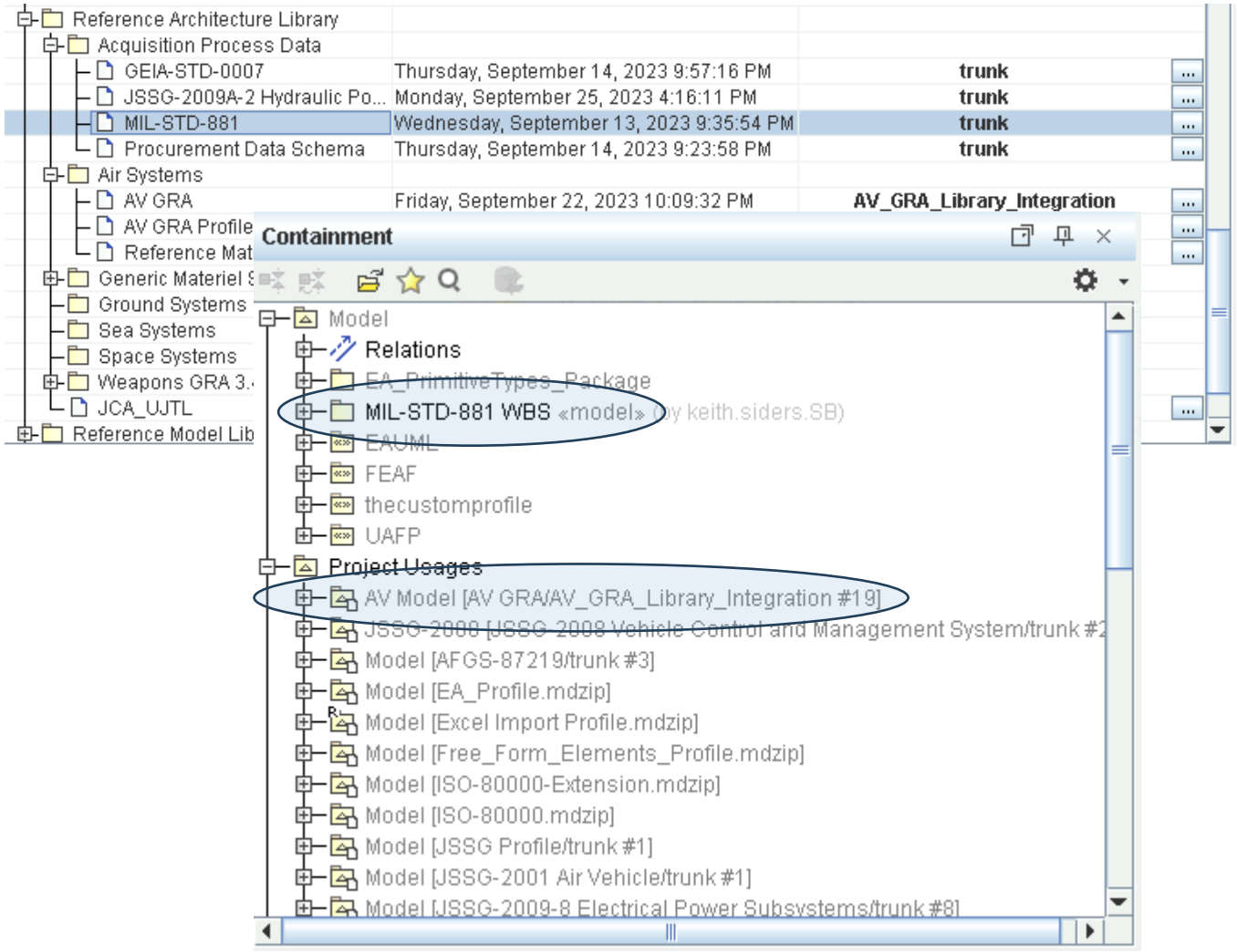
Maintaining WBS-to-System Separation





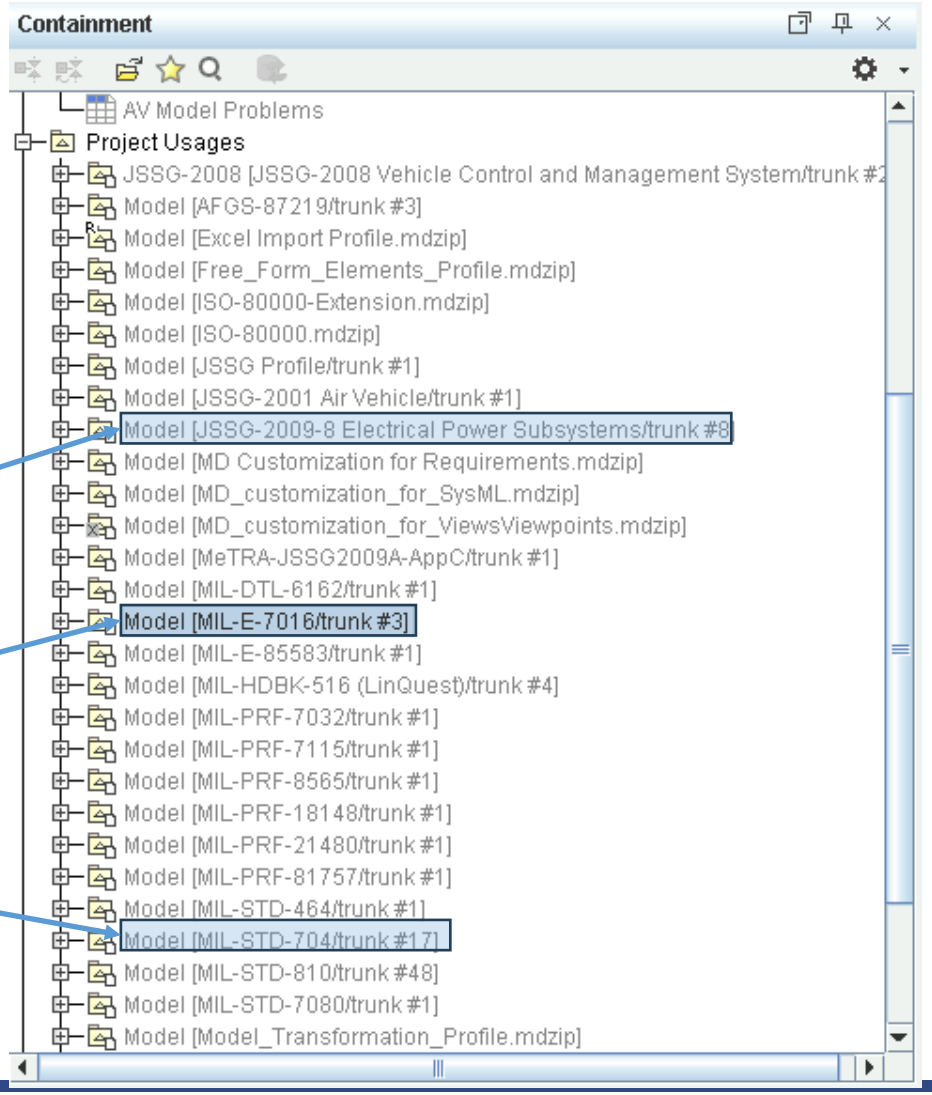
Maintaining the WBS to System Separation

- Keeping WBS information linked but separate
- MIL-STD-881 model "uses" AV_GRA
- Linkages ("defines") maintained in WBS model, not Air Vehicle

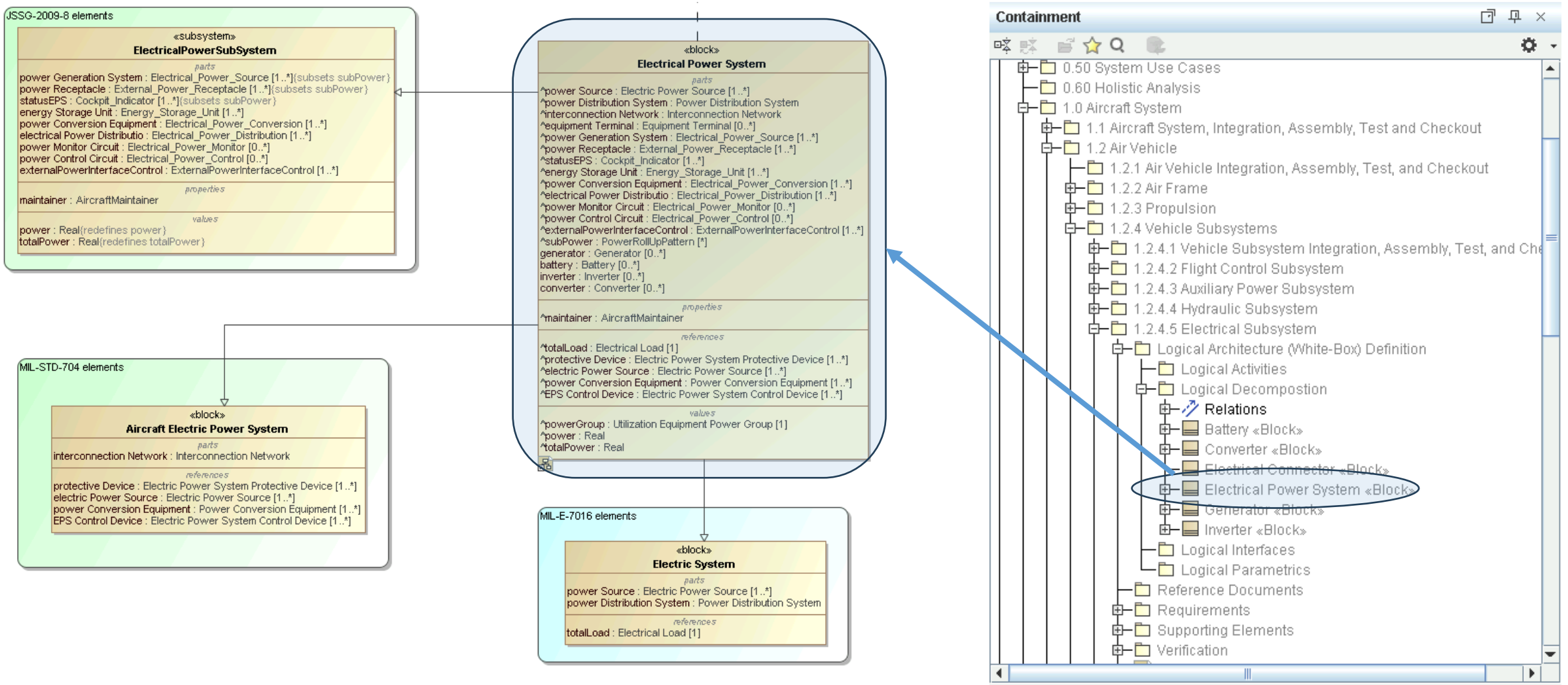


Example of GRA Linkage

- Library Reference Models
  - Listed as Project Usages
  - Maintains model federation
- Combined using inheritance
- For this example, using
  - JSSG-2009-8 Electrical Power Subsystem
  - MIL-E-7016 Electrical Loads Analysis
  - MIL-STD-704 Aircraft Power

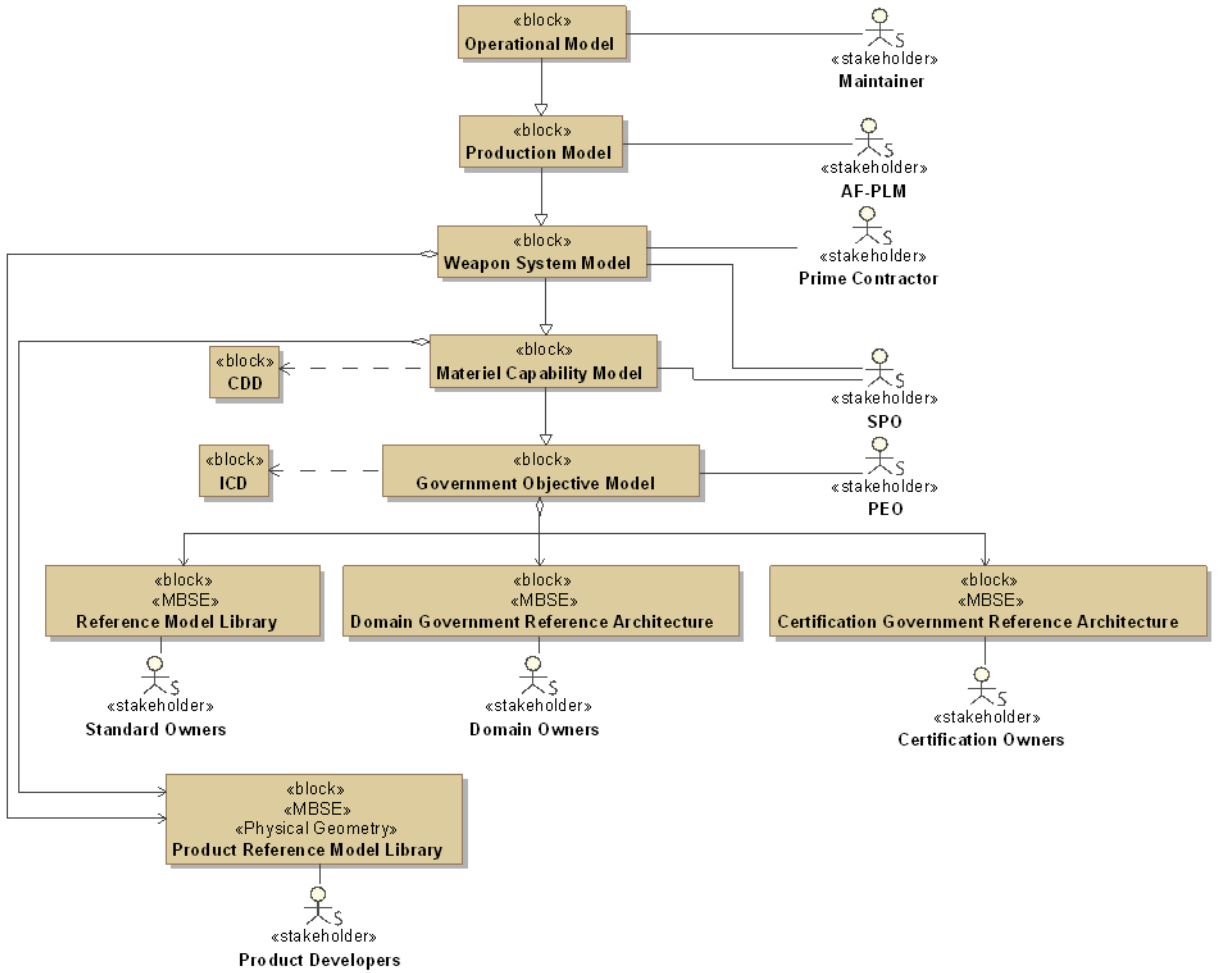


Example of GRA Linkage



Architecture of Reference Architectures

- Hierarchical Architecture of Reference Architectures
- How to use?
- How to maintain?



Utilizing Branching in GRA Management

- **Two Basic Methods (from Software Development)**
  - Release Branching: develop on trunk, keep a branch for each release
  - Feature Branching: develop each feature in a separate branch, only merge once stable
- **Model Branching Uses Modified Hybrid Method**
  - Release Branch Establishes Baseline
  - Option 1: Customizations/Features Developed on Branch
  - Option 2: Maintain Branch separately using Inheritance
  - Either Option: Merge Recommendation to owners of more generic model
  - Either Option is Recursive
  - Option 2 Provides Greater Flexibility

To Do: Compare Option 1 and Option 2 for pros and cons of each option

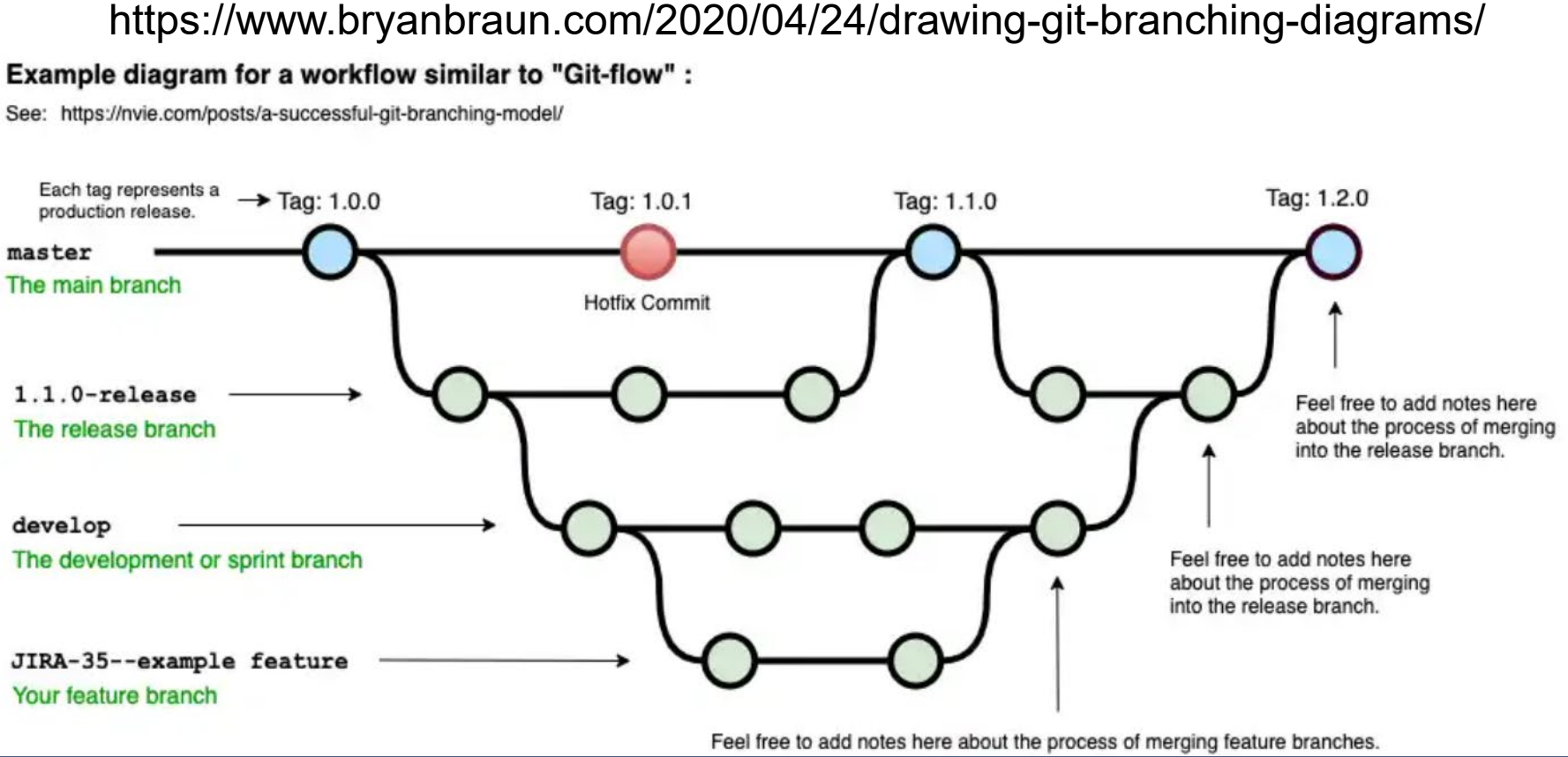
Utilizing Branching in GRA Management

- **AFLCMC/EN-EZ Releases AV GRA**
  - **Uses Release Branching Method**
- **PEO Branches AV GRA Release Version**
  - **Creates Generic Platform GRA**
    - **Direct Modification of AV GRA Branch, or**
    - **Inheritance from AV GRA Branch**
  - **PEO manages changes from AV GRA for its branch baseline**
    - **CM process to decide what changes to incorporate, if any**
    - **Maintains AV GRA branch based on accepted changes**
    - **Inheritance method allows incorporated/approved baseline changes**
    - **Direct Modification method requires direct merging of changes**
- **Program Office Branches Generic Platform Release**
  - **Same process as PEO, except managing the Platform-specific baseline**

Utilizing Branching in GRA Management

Example Git Branching Diagrams

https://www.bryanbraun.com/2020/04/24/drawing-git-branching-diagrams/

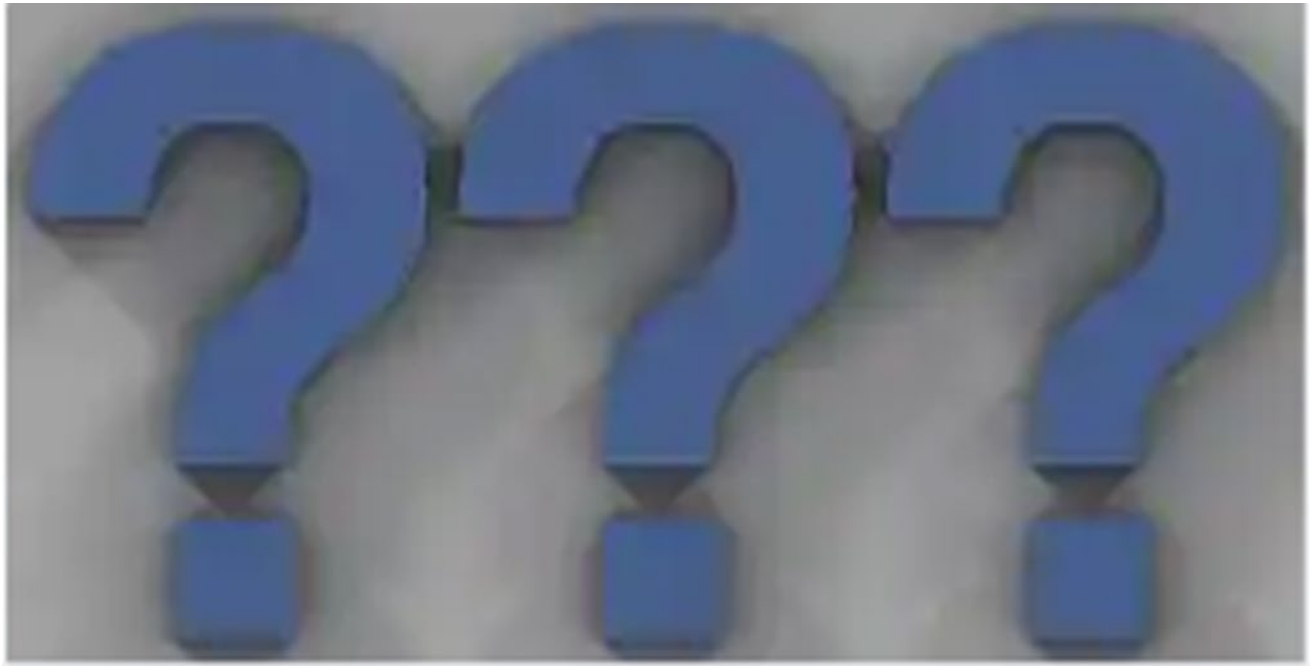


Software Example is Simpler than Model Release Management; Only One Configuration in the Master

Establishing on Standards

- ISO 42010:2022 Architecture Description
  - iso-iec-ieee 42010:2022 definitions (free view)
- ISO 42020:2019 Architecture Processes
- ISO 42030:2019 Architecture Evaluation Framework
- ISO 15288:2015 System Life Cycle Processes
- Others as appropriate (examples)
  - ISO 24744:2014 Metamodel for Developmental Methodologies
  - ISO 24765:2017 Vocabulary

Questions / Comments / Feedback



Backup Slides

https://itsecurity.blog.fordham.edu/2017/10/24/backup-all-of-your-devices-and-do-it-often/#prettyPhoto