Addressing the Need of Managing Intellectual Property (IP) in Model-Based Collaboration within the Supply Chain

Kevin Bonanne, RTX
Jason Wilson, Dassault Systemes

Presenter Bios

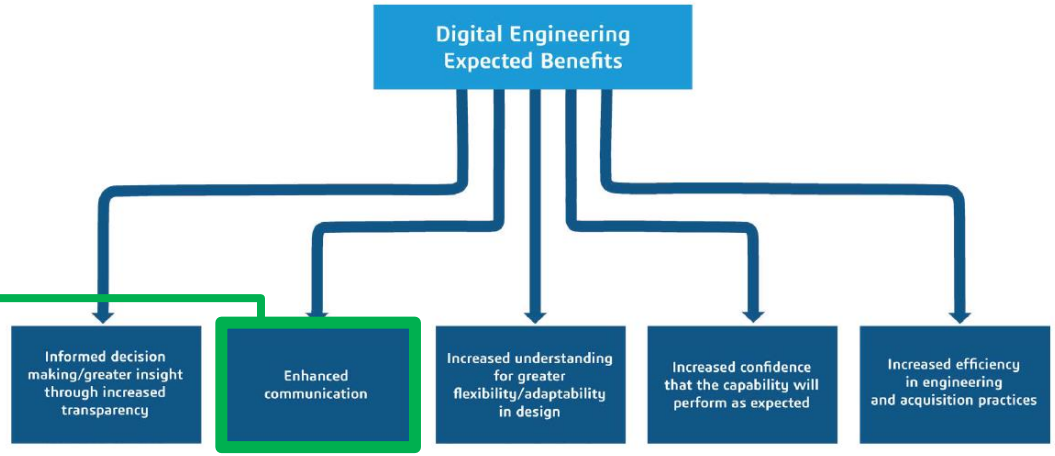
Kevin Bonanne is a systems engineer and product owner in the Model Based Digital Thread PCC at RTX Technologies Research Center. He has over a decade of experience maturing and implementing model-based systems engineering practices in the aerospace industry — including on the NASA Artemis program and the Europa Clipper mission while at NASA JPL. At RTX, Kevin has explored further connecting MBSE into the larger digital thread spanning the full product lifecycle. Kevin holds bachelor's and master's degrees in aerospace engineering from Purdue University. He currently lives in Connecticut with his wife and two children.

Kevin Bonanne

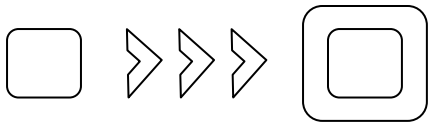
Jason Wilson is the Senior Director for the Americas for the Dassault Systemes CATIA Cyber-Physical Systems, responsible for new customer development, partnerships, Systems Engineering, and client solutions. Jason has been with Dassault Systemes for fourteen years. He has had various roles, from Product, Sales, and Solutions Management to business development and even a Project Manager.
Jason is part of and contributes to the OMG (Object Management Group), IIBA (International Institute of Business Analysis, Dallas), ASEE (American Society for Engineering Education), and INCOSE (International Council on Systems Engineering) and is proud to be a Toastmaster. Jason resides in McKinney, Texas, with his wife and two children. When not working, Jason enjoys the outdoors, sports, and time with family.

Jason Wilson

Collaboration in Digital Engineering

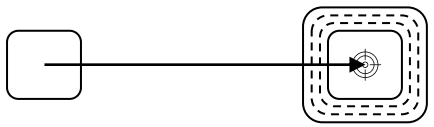


Expected benefits → enhanced communication



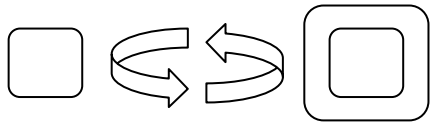
Increased Speed

- Enable direct consumption of transferred information – remove the step of data entry
- Automate transformations of models to exchange forms



Increased Accuracy

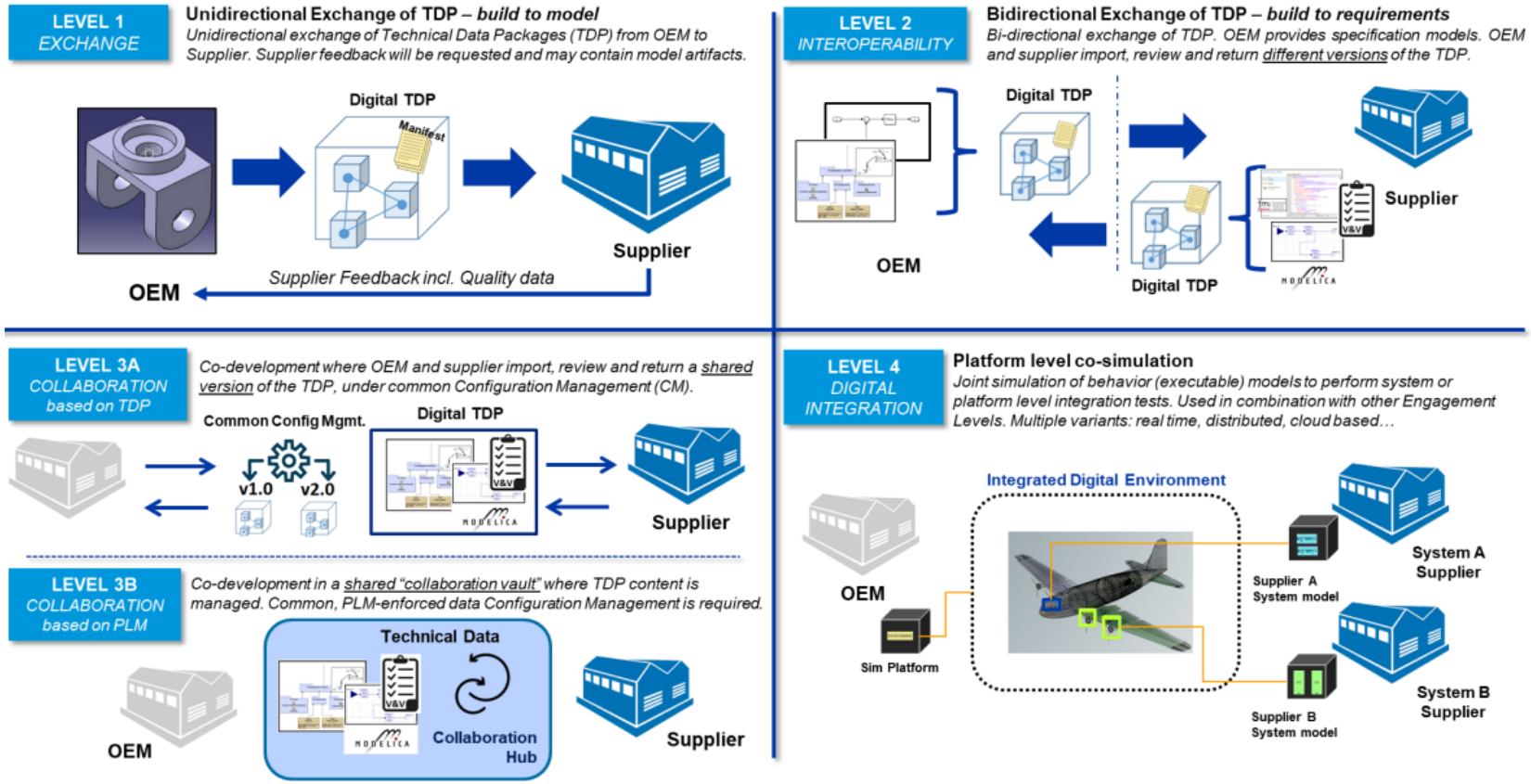
- Better convey information by removing a translation step to documents
- Allow direct integration of models into models



Increased Cadence of Data Exchange

- Integrated environments allow for direct collaboration
- Lower overhead to integrate information allows for more exchanges

Levels of Digital Collaboration



Brendan, Mark. "Assessing Model Based Exchange Capabilities", presented at GPDIS, 2022.

Digital Engineering collaboration can occur at various levels of integration

- **Different techniques/tools used at different levels**
- **Different requirements for infrastructure**
- **Different types of IP protection desired**

This presentation will mostly focus on, but is not entirely limited to, Stages 1 & 2

- **Exchanges of modeled information**
- **Touch on integrated environments**

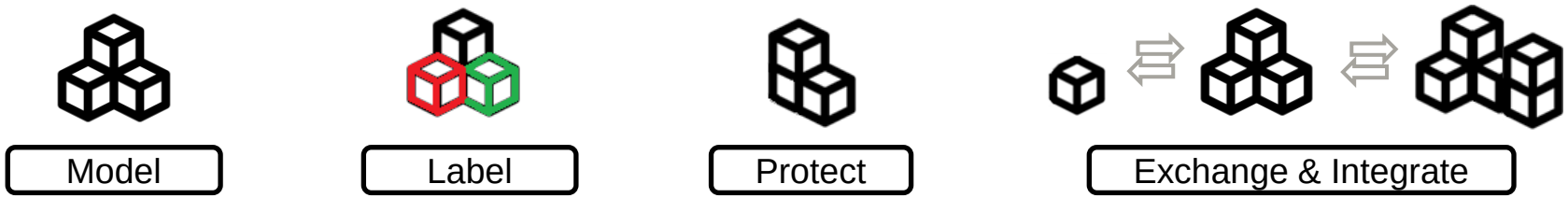
Information Protection as an Emerging Need in Digital Engineering

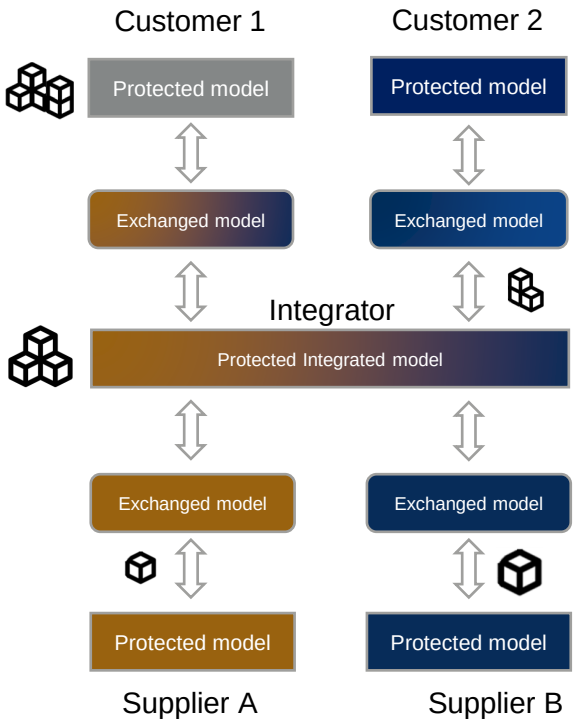
- **Why is this an issue? Don't we already exchange information and protect our IP?**
  - **Highly coupled data in complex models → increased likelihood of oversharing**
  - **Technology- and standards-based methods vs manual approaches → digitization enables automation**
  - **Understand new capabilities for technical mitigation of IP exposure risk → rely less on legal mitigants**

- **Moving to model-based collaboration allows new techniques for information protection**
  - **Increased automation for handling information in models – e.g. model transformations, query capabilities, AI-ML**
  - **Collaborative workspaces with identity management – more ways to control what people can see and do**

- **Pitfalls to avoid**
  - **Different techniques to label modeled information → labels become incompatible across supply chain**
  - **Labeling coupled to information handling techniques → protection mechanism relies on labeling approach**
  - **Misuse of new capabilities or too much trust in the tools → ensure processes are thorough, better than existing approaches**

Information Protection in Models and Across the Supply Chain



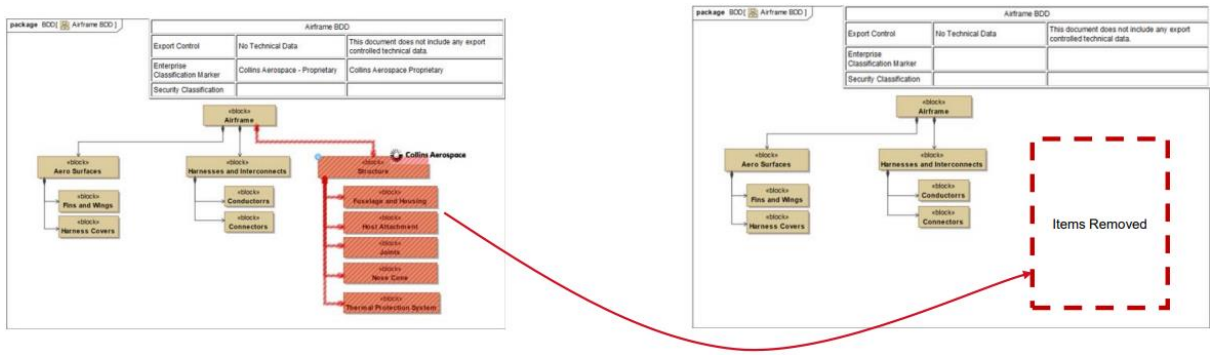


- **Technical information protection mechanisms**
  - **Defeaturing / Partitioning – transform model to remove protected information**
  - **DRM / Encryption / Obfuscation – protected info stays in model but is inaccessible**
  - **ABAC – Identity- or location-based controls in integrated environments**
- **Collaborate across the supply chain driven by authoritative source of truth**
  - **Avoid duplication of information in multiple models in order to engage with multiple suppliers or customers**
  - **Utilize model transformations or controls to manage information transfers**
- **These methods are still in early stages of maturity**

DRM – Digital Rights Management
ABAC – Attibute-Based Access Controls

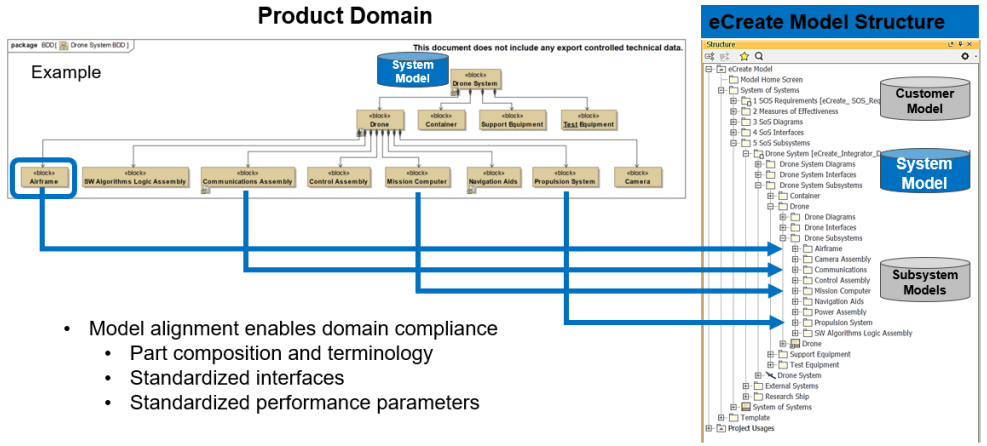
Model Exchange & Information Protection in MBSE

Model Labeling and IP Protection



- Leverage model variants for automated defeaturing based on labels
- Provide company-standard set of labels along with customizations and utility scripts
- Built-in validation and common views

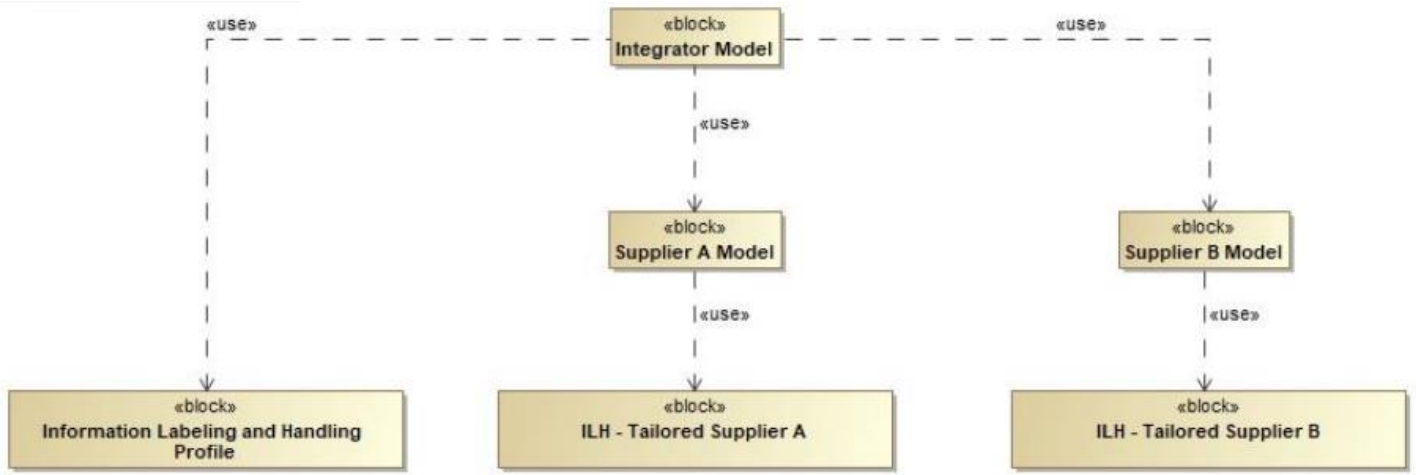
Model Structure

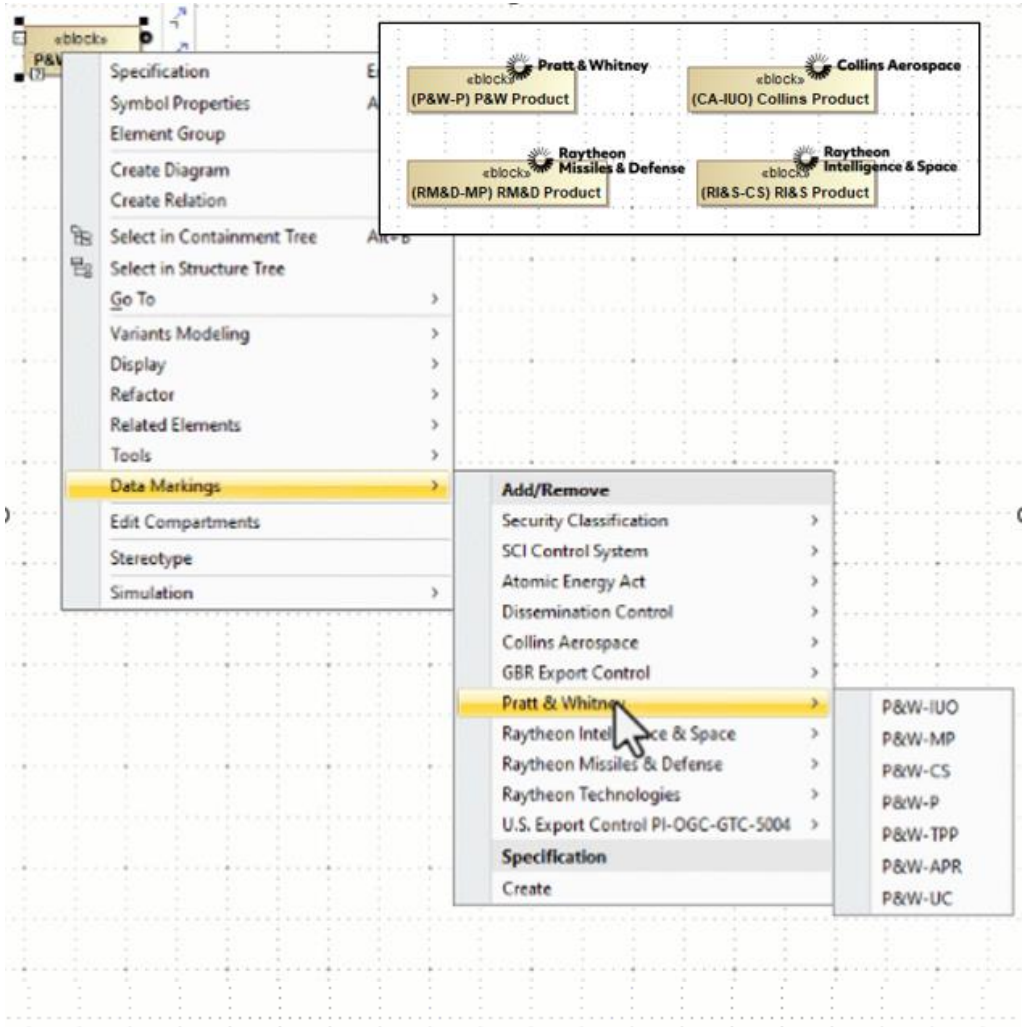


- Modular approach to structuring models for collaboration with multiple partners
- Best practices for exporting and importing sub-models, common interfaces/elements, and requirement models

SysML Labeling: A modular and scalable approach

- Using out-of-the-box tools, set up a profile to easily enable:
  - Company-specific labels
  - Additional visual attribution
  - Built in transformations
  - Model validation, metrics, and views/tables
- Labeling profiles are modular and complementary
- Method for creating supplier profiles in order to align labeling approach and ensure compatibility across supply chain
  - Goal: move towards an industry standard approach





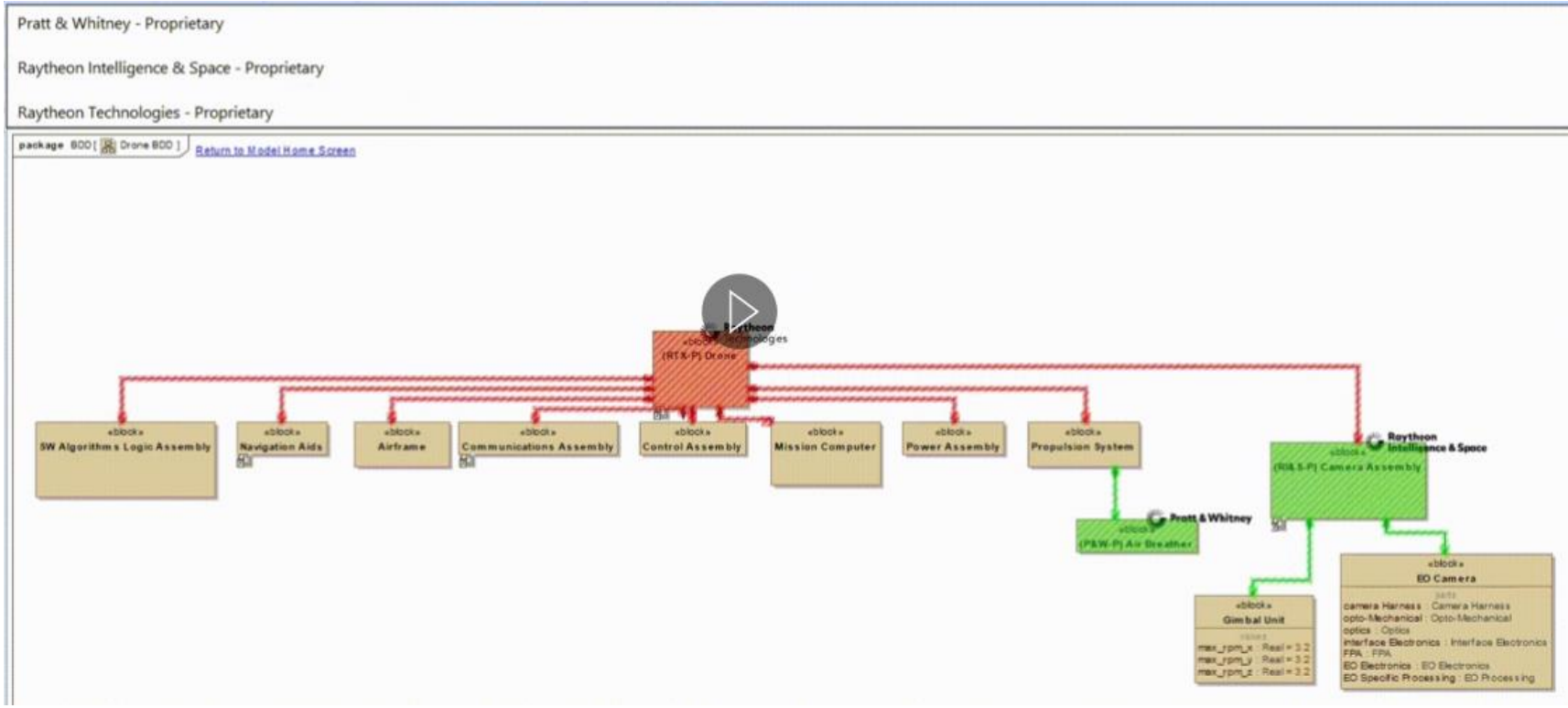
SysML IP Protection: Putting Labels to Work

Leverage labeling in models to perform model transformations (labels establish variation points)

- e.g. remove ITAR, remove company proprietary information
- Combine and customize these transformations to quickly defeature based on supplier/customer
- Encode common transformations into the labeling profile

Considerations

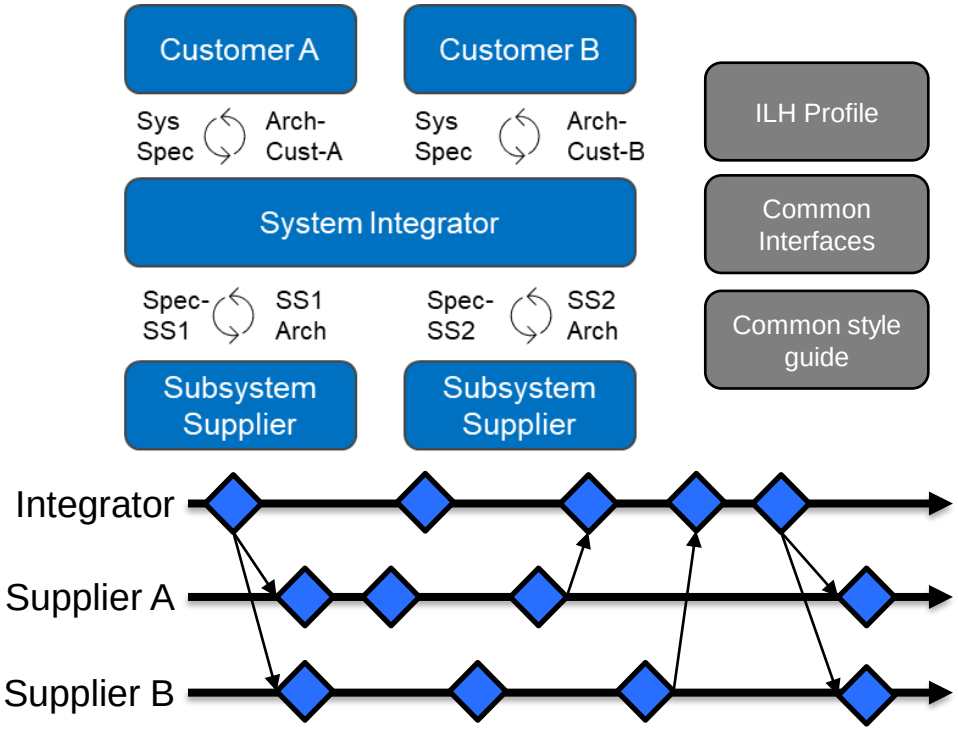
- Label application – are the right elements labeled?
  - Labeling best practices
  - Validation rules
- Transformation validation – is the final model what is wanted?
  - Label tables
  - Validation rules
  - Model reviews

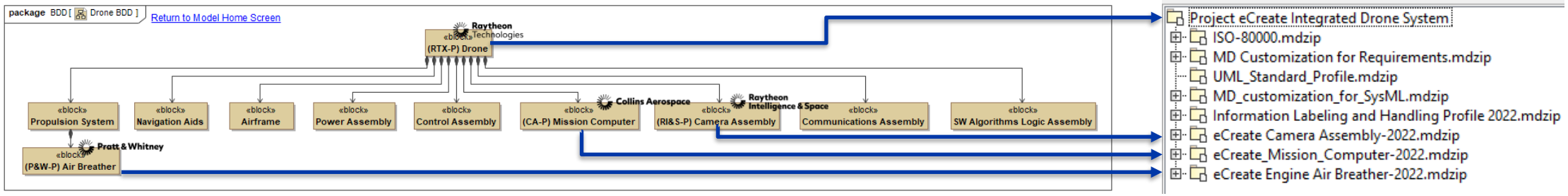


Structuring Models for Defeaturing and Integration

- Best practices needed to:
  - Handle configuration management process across suppliers
  - Structure models for federation and integration with ease
  - Identify and modularize common elements for reuse

- Handling IP protection within federated set of models
  - Align labeling approach – integrator-provided template for supplier labeling & common labels
  - Modularity helps to ensure that defeaturing doesn't impact other parts of the integrated model





Future Approach for Integrated Development Environments

Emerging capabilities for collaboration within / between development environments

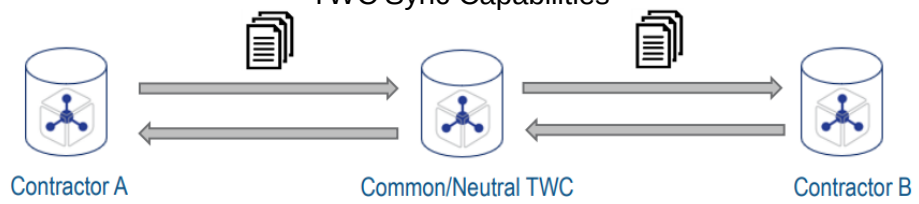
- Bi-directional Teamwork Cloud (TWC) syncs
- Access control capabilities within TWC and other systems for managing identities and permissions

Labeling still needed, defeaturing used in conjunction with identity management + access controls

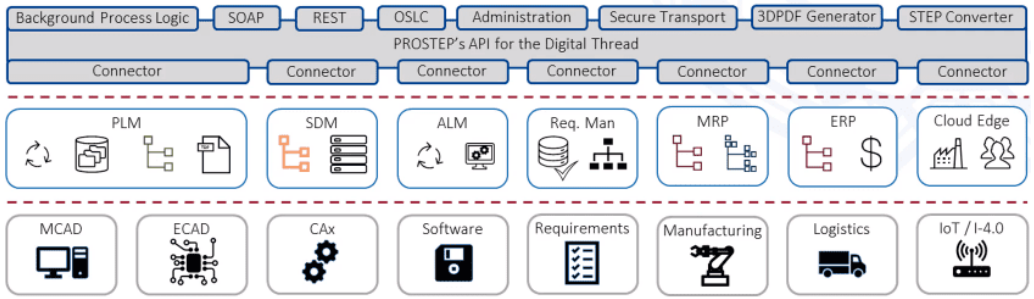
Current standards like OSLC allow for API-based access to modeled information

- *Similarly, digital thread tools (e.g. Syndeia, SBE Vision, OpenPDM) offer methods for integration and interface to modeled information*
- *SysML v2 formalizes APIs and services*

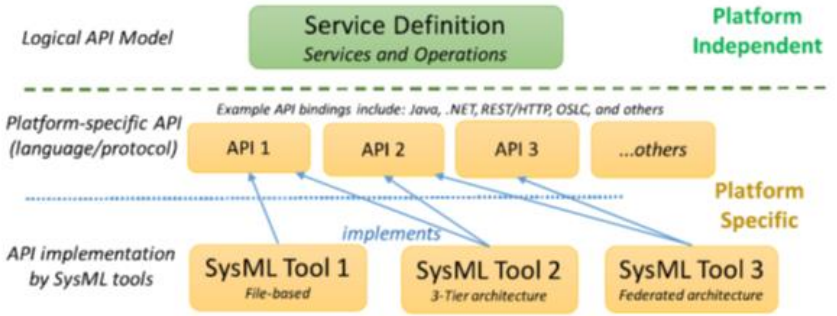
TWC Sync Capabilities



PROSTEP Digital Thread API



SysML v2 API and Services Architecture

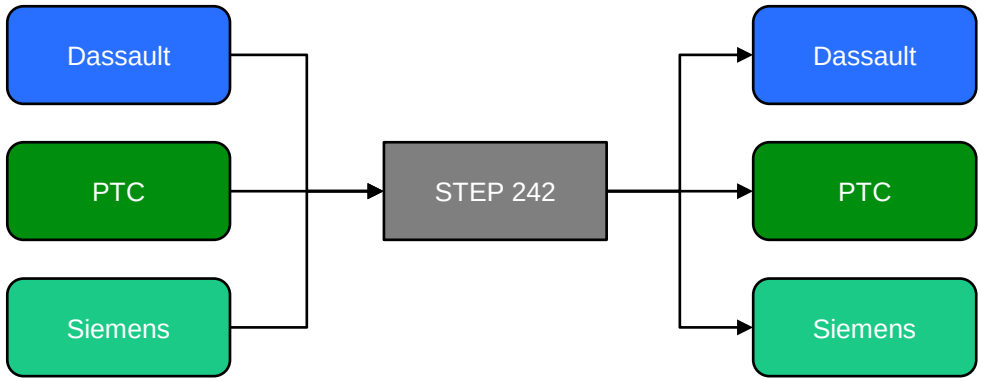


Source: SysML v2 RFP

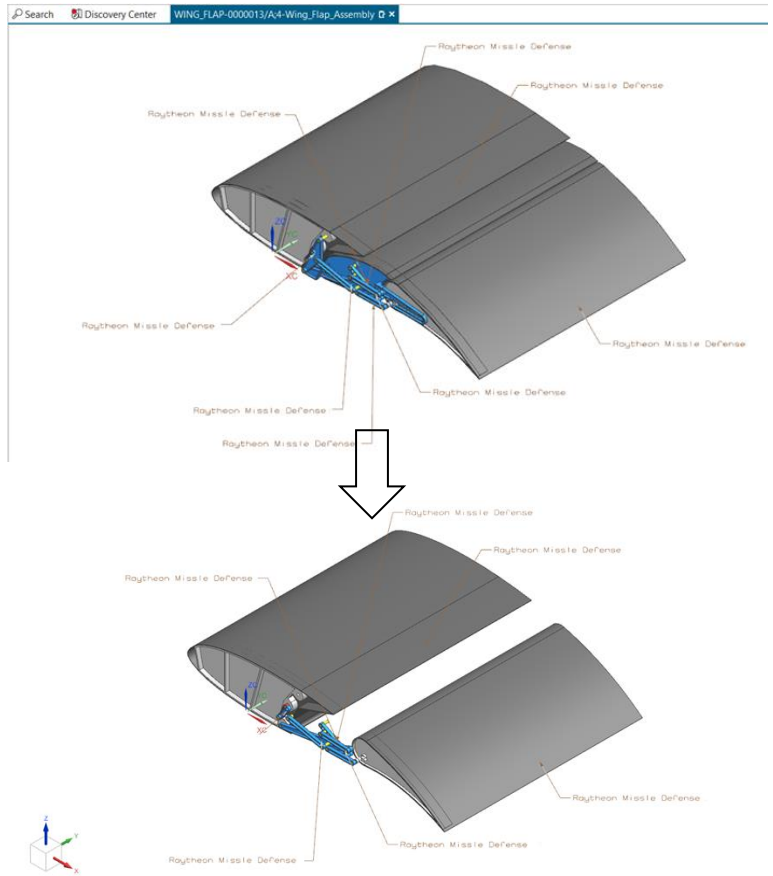
Model Exchange & Information Protection in Mechanical Design

- Leverage vendor capabilities for labeling and defeaturing transformations
  - Requires configurations of PLM system

- New issue: heterogenous exchange
  - Need to rely on standards for exchange between different platforms (e.g. Dassault, PTC, Siemens) – focus on STEP 242
  - Must validate STEP file to source to ensure no information loss in translation



Fully assembled modeled with labels



Defeatured model

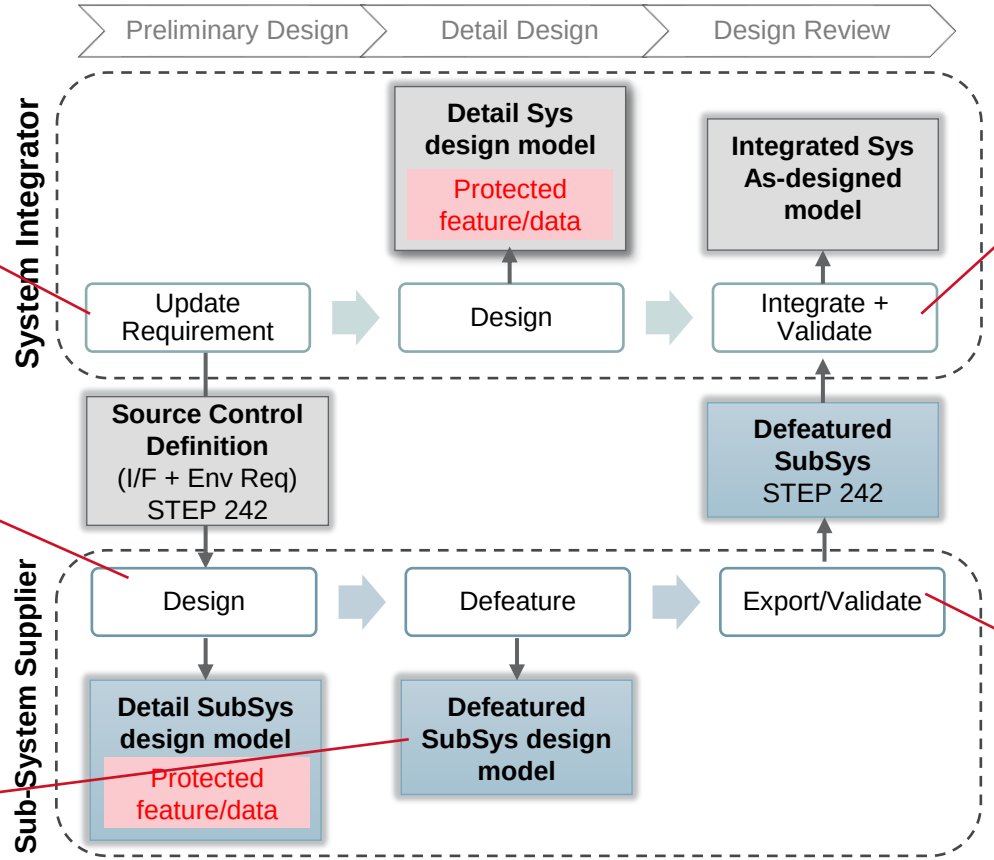
Note: Labels are for demonstration only, all models contain no technical data

Mechanical Design Model Exchange

Model-Based Definition (MBD) as Authoritative Source of Truth (**ASOT)** for Source Control Definition

Apply **info protection labels** to CAD objects in PLM and propagate to product design CAD model.

Automatically defeature protected design features to generate exchange model



Integrate supplier exchange model into system design model to **validate** design

Export exchange model in **interchangeable file format** (i.e. STEP AP242), including ILH labels

Validate STEP file to source CAD model for use as ASOT on the data consuming end

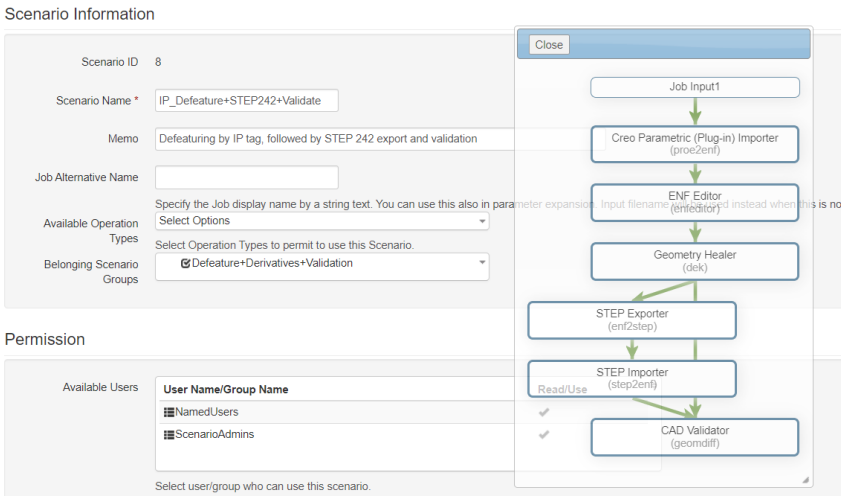
Exchange model and the representation file **traceability** to source CAD model

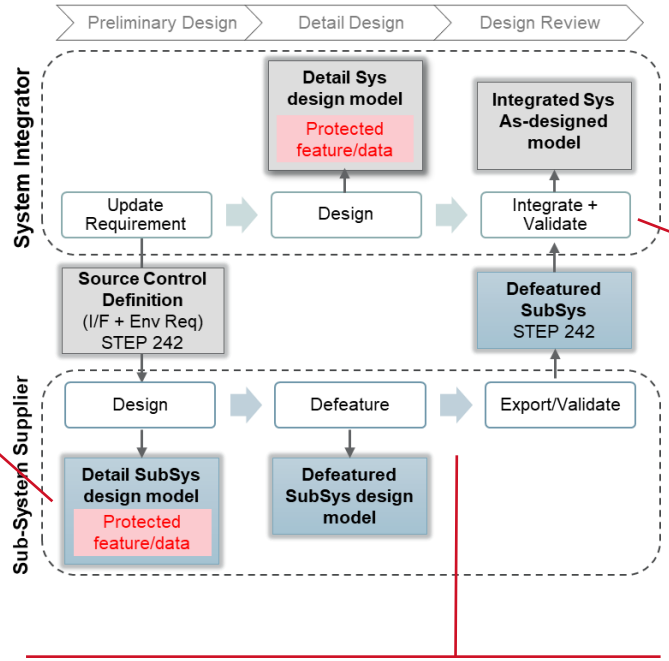
Use Case Exploration

windchill® TEAMCENTER 3DS ENOVIA

Testing mCAD design labeling, defeaturing, and exchange in 3 largest PLM platforms.

Method development to understand labeling best practices and PLM configurations.

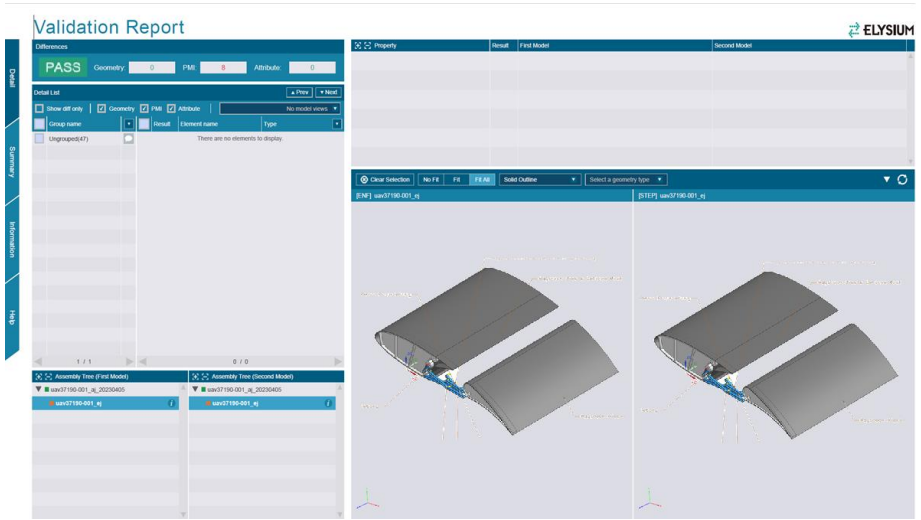




Elysium for STEP validation. Identified any discrepancies or issues in STEP export and communicated back to vendors.

Elysium for automated workflows for defeaturing and STEP export. Tested both native and Elysium export.

Elysium 3DxSUITE™



Conclusion

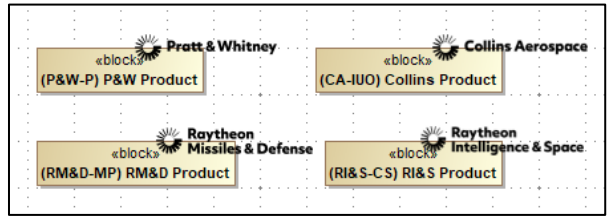
Identified methods for labeling and protecting information in systems and mechanical design domains

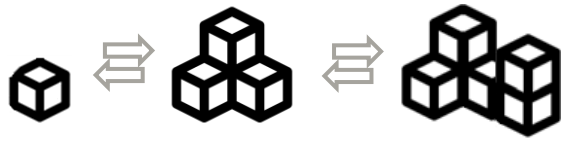
Started to identify best practices internally, looking to integrate into standards of model-based collaboration

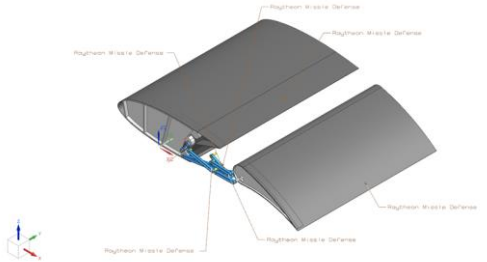
Demonstrated and validated standards-based techniques for heterogeneous exchanges in the mCAD space

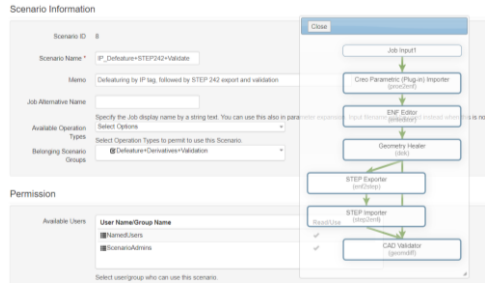
What have we found difficult?

- Level of effort for labeling elements within a model
  - Ensure we're leveraging the correct tools for the level of protection needed
  - Educate on and utilize best practices and processes
- PLM versions and STEP adoption
  - Many PLM systems across RTX at various different versions; sometimes specific versions of tools are required by customers
  - Native STEP conversion in CAD/PLM systems is varied – may not be automated, requires validation









Note: Labels are for demonstration only, all models contain no technical data

Next Steps

- Expand approach through the product lifecycle / digital thread

- Increased maturity in integrated environments –
  - Various solutions on the market, further investigation ongoing at RTX
  - Mature standards and adoption of integrated approaches

- More interoperability support
  - Continue advancing standards, further/better integration of standards like OSLC
  - Better compliance to STEP across industry
  - Future implementation of SysML v2 to correct SysML interoperability issues

- Greater partnerships across supply chain for establishing model exchange framework collaboratively