2019 MBSE Workshop

Greg Pollari, Collins Aerospace
and
Mark Williams, The Boeing Company

Workshop Agenda

- **Intro, History, summary, goals of workshop**
- **Survey1 5 min**
- **Don Tolle, CIMdata 35 min**
- **Survey2 5 min**
- **Talisen 15 min**
- **Break 20 min**
- **Workshop exercise 1.5 hr**
- **Survey3 5 min**

MBSE Workshop Agenda

- **What is the MBSE Workshop?**
- **CIMdata - MBSE meets PLM**

  Don Tolle
- **Industry Survey**
- **Talisen Technologies - MBX Data Exchange**

  John Stevens, Dan McAfee, and Neil Lichty
- **Rest Break**
- **Concurrent MBSE and creating Exchange Packages**

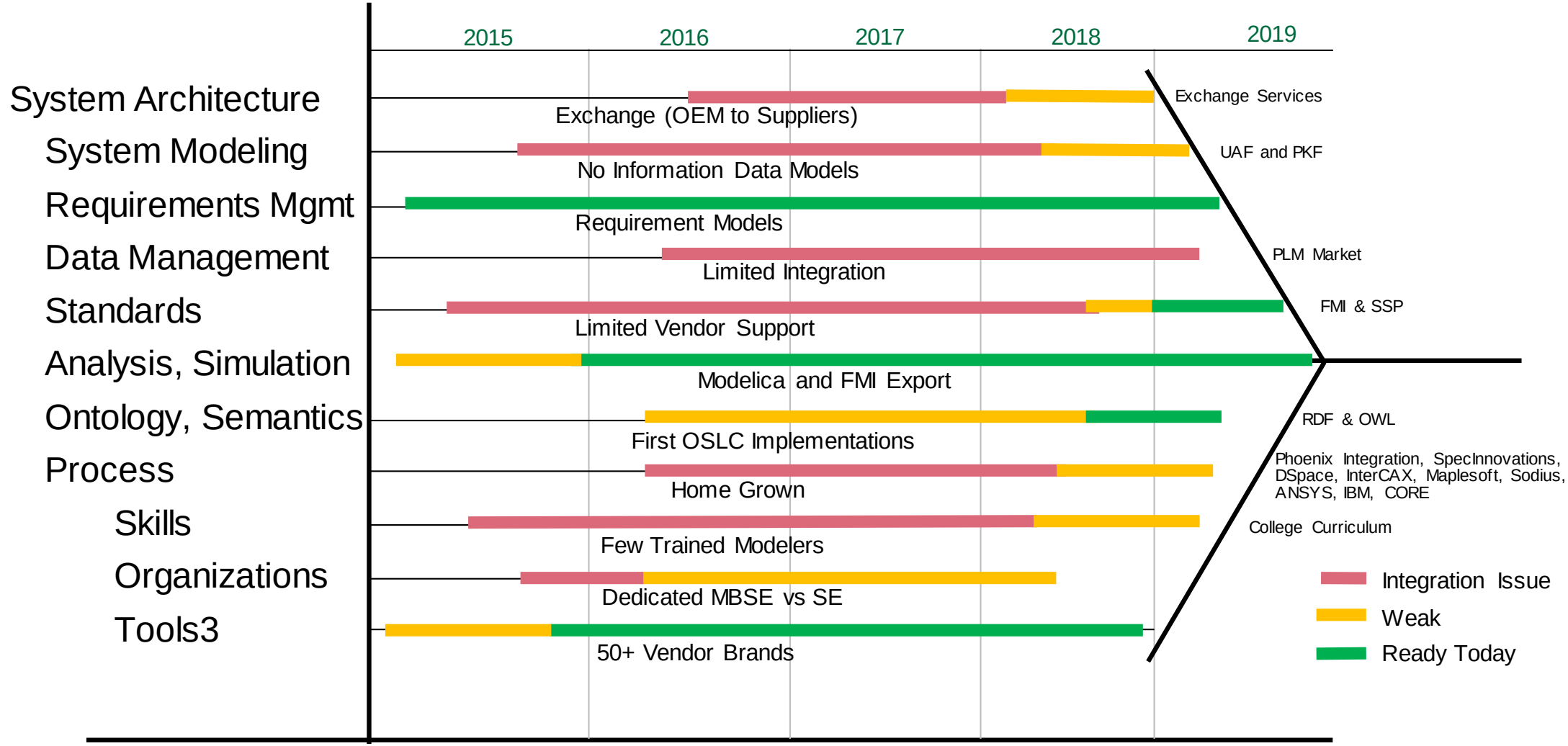
  Workshop Exercise

Workshop History at GPDIS

- **The first Systems Engineering Track in 2014**
  The impact on PLM, Contributions/Suggestions from Multiple Industries
- **2015 - The first MBSE Workshop - OEM to Supplier Interoperability**
  Prioritized Industry Data Standards: SysML, OSLC, FMI, ReqIF
- **2016 MBSE Workshop - the Roadmap outline**
  Implementation issues - where/how to start, the role of the PLM Vendors
- **2017 MBSE Workshop - Gaps in the Roadmap**
  Interoperability Issues, the need for Leadership
- **2018 Improving/Integrating our Models with meta-data**
  The State of the Industry, opportunities and our Roadmap

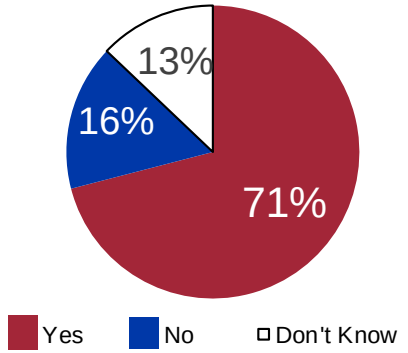
Discuss MBSE Interoperability/Implementer's Forum on Monday at 5:20 PM

2015 to 2018 Workshop: Industry Roadmap

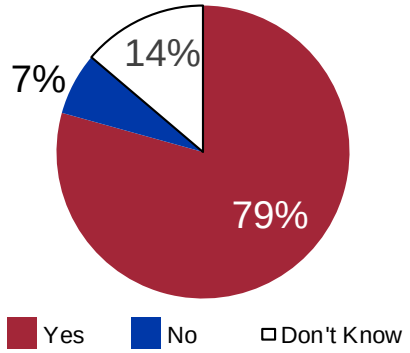


2018 MBSE Presentations and Workshop

Do you have **access to MBSE tools**?

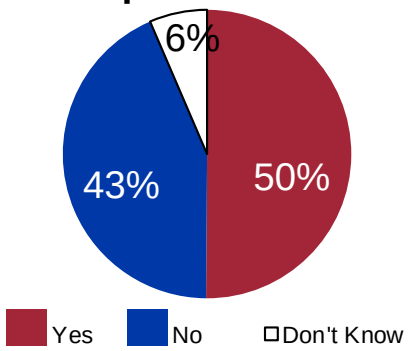


Company recognition of **MBSE as contributor**?

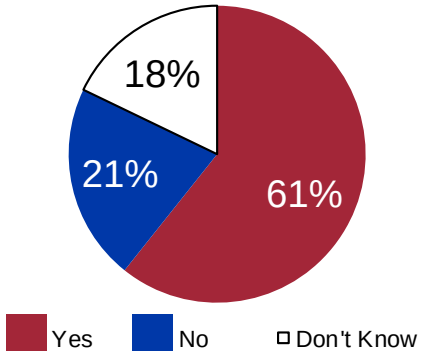


Data from 2017 Workshop

Do you have **multiple ADL Tools**?



Company has **MBSE department**



- Industry CIMdata
- Explore MoSSEC - Build a Bicycle
- GPDIS Work Statement and Survey

Presentation	Participants
Airbus/Prostep iViP	63
Airbus	31
ANSYS	43
Aras	33
Boeing	43
Boeing	59
Boeing	42
Northrop Grumman	42
Northrop Grumman	73
Phoenix Integration	31
MBSE Workshop	70

MBSE Enablers

A&D PLM Action Group

INCOSE – PDES MoU

Standardization Days

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2020

MBSE for PDES

SmartSE

LOTAR for MBSE

SE Handbook

INCOSE TIMLM and DEIX WGs

Advocating for MBSE

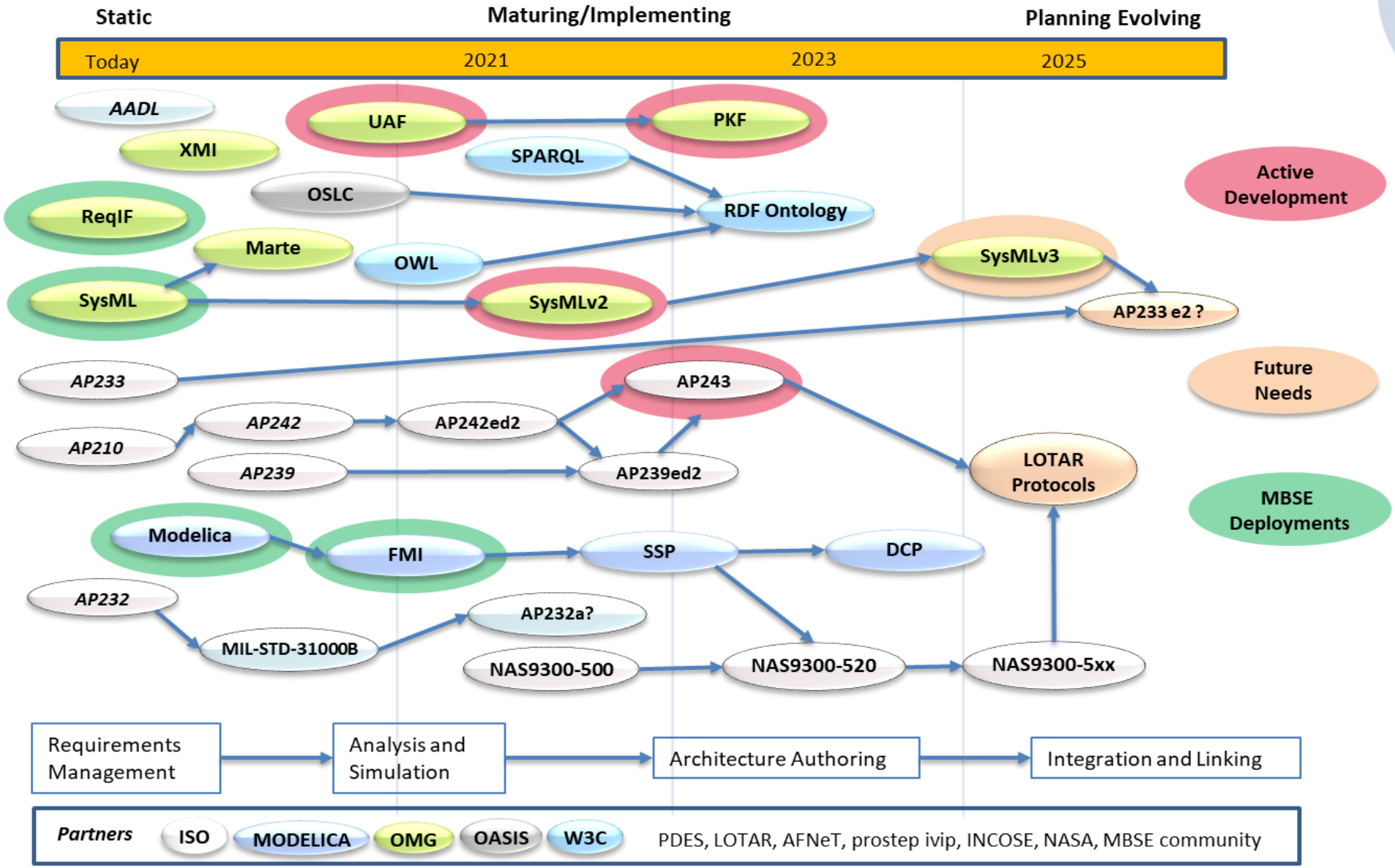
PDES, Inc.®

Connecting the Digital Enterprise

Who Are We?

PDES, Inc. is an international industry, government, and university consortium committed to accelerating the development and implementation of standards for product data exchange in the Digital Enterprise.

MBSE Data Standards Roadmap



from PDES-LOTAR MBSE Conference, May 8th, 2019. Revised July 8th, 2019

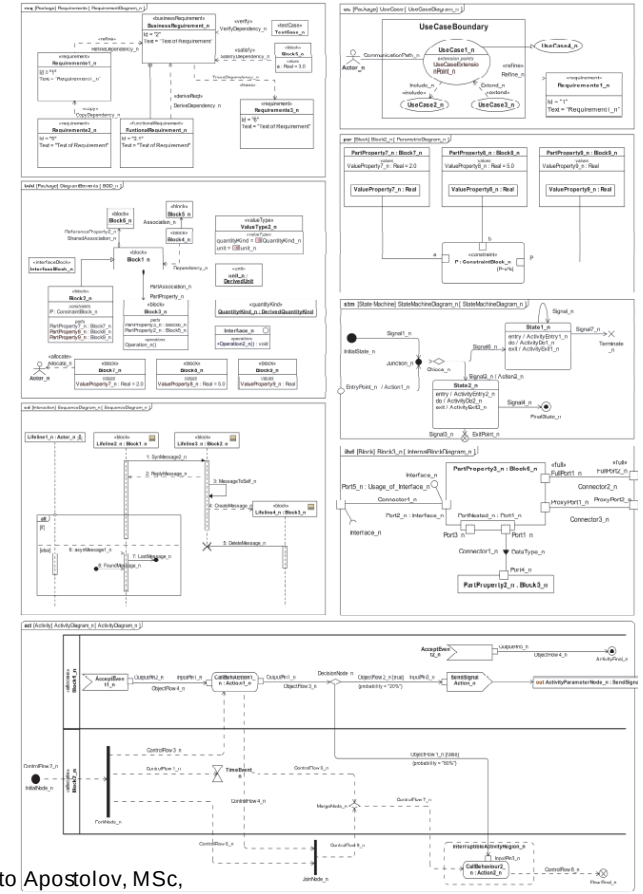
Reference ASD Radar Chart for detailed descriptions

An Academic Analysis

Current Status of SysML Model Interchange between Common Modeling Tools via XMI – A Practical Study

Hristo Apostolov, Damun Mollahassani Madjdabadi
University of Kaiserslautern, Institute of Virtual Product Engineering (VPE),
EMEASEC 2018 / TdSE 2018

Standard SysML Test Models



Used with permission : Hristo Apostolov, MSc, Institute for Virtual Product Engineering, Technische Universität Kaiserslautern

Source tool >	IBM RR					NM CSM				
Target tool >	IBM RR	NM CSM	PTC IM	SS EA	cluster total	IBM RR	NM CSM	PTC IM	SS EA	cluster total
Structural Elements	72%	83%	0%	50%	51%	31%	100%	6%	88%	56%
Activities	100%	100%	82%	65%	87%	81%	100%	81%	81%	86%
Interactions	86%	100%	0%	100%	71%	86%	100%	0%	100%	71%
State Machines	100%	100%	25%	100%	81%	60%	80%	20%	60%	55%
Use Case	100%	100%	40%	100%	85%	100%	100%	40%	100%	85%
Requirements	100%	17%	0%	83%	50%	0%	100%	0%	17%	29%
	89%	86%	30%	72%		58%	98%	31%	78%	

Source tool >	SS EA					PTC IM				
Target tool >	IBM RR	NM CSM	PTC IM	SS EA	cluster total	IBM RR	NM CSM	PTC IM	SS EA	cluster total
Structural Elements	56%	31%	6%	100%	48%	19%	31%	44%	69%	41%
Activities	81%	100%	63%	100%	86%	82%	88%	88%	76%	84%
Interactions	86%	100%	0%	100%	71%	14%	14%	14%	14%	14%
State Machines	100%	100%	50%	100%	88%	100%	100%	75%	100%	94%
Use Case	100%	100%	40%	100%	85%	100%	80%	40%	100%	80%
Requirements	33%	0%	0%	100%	33%	0%	0%	17%	50%	17%
	72%	69%	28%	100%		49%	53%	53%	67%	

Advocating for MBSE

CIMdata The Leader in PLM Education, Research, and Strategic Management Consulting

PLM RESOURCES EDUCATION PLM CONSULTING RESEARCH MEMBERSHIPS EVENTS CALENDAR

- Home: Aerospace & Defense PLM Action Group
- Members
- Mission
- Publications
  - Direction Statements
  - Research Reports
  - Position Papers

HOME > HOME: AEROSPACE & DEFENSE PLM ACTION GROUP

Founded in 2014, the Aerospace & Defense PLM Action Group is an association of aerospace & defense companies within CIMdata's globally recognized PLM Community Program, which functions as a PLM advocacy group.

Our stated mission is to:

- Set the direction for the aerospace & defense industry on PLM-related topics that matter to members
- Promote common industry PLM processes and practices

MBSE meets PLM: Trends, Challenges and Opportunities

Donald Tolle, Practice Director
Simulation-Driven Systems Development
CIMdata, Inc.
d.tolle@cimdata.com

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MBSE Workshop Agenda

- What is the MBSE Workshop?
- CIMdata - MBSE meets PLM

  Don Tolle
- **Industry Survey**
- **Talisen Technologies - MBX Data Exchange**

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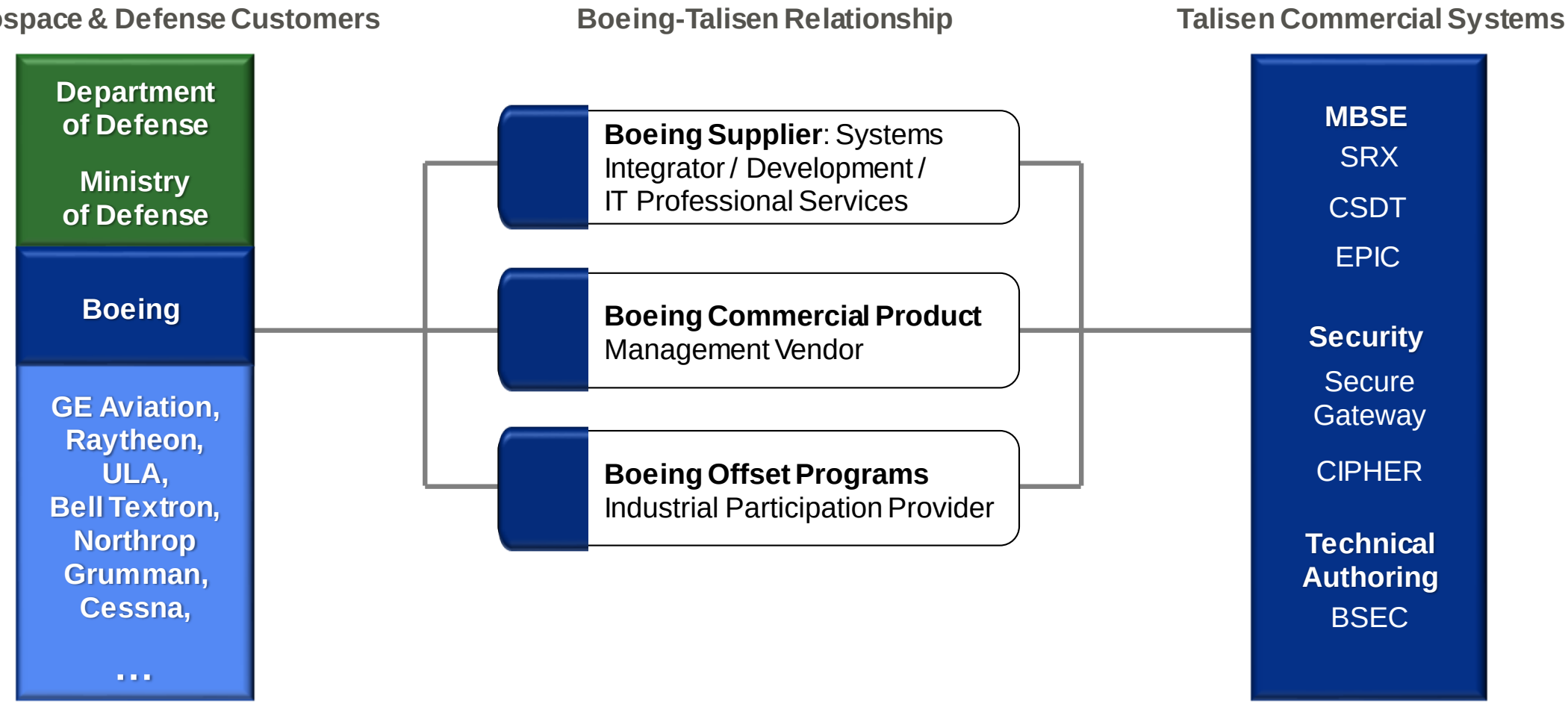
  Workshop Exercise

Talisen and Boeing

Global Product Data Interoperability Summit | **2019**



SRX Supporting Digital Transformation of Model-Based Engineering

SRX revolutionizes the method for packaging requirements and exchanging engineering models, while maintaining configuration control and digital thread integrity.

1 Design Requirement Collaboration

Provides integration between Design Engineering, Supplier Management and Boeing Design Suppliers, enabling innovative, affordable and value driven Aerospace product designs.

2 Enhances the Buy-Package Integration

Enables model based buy-packaging for product development and requirements exchange with suppliers during the front end of the development lifecycle.

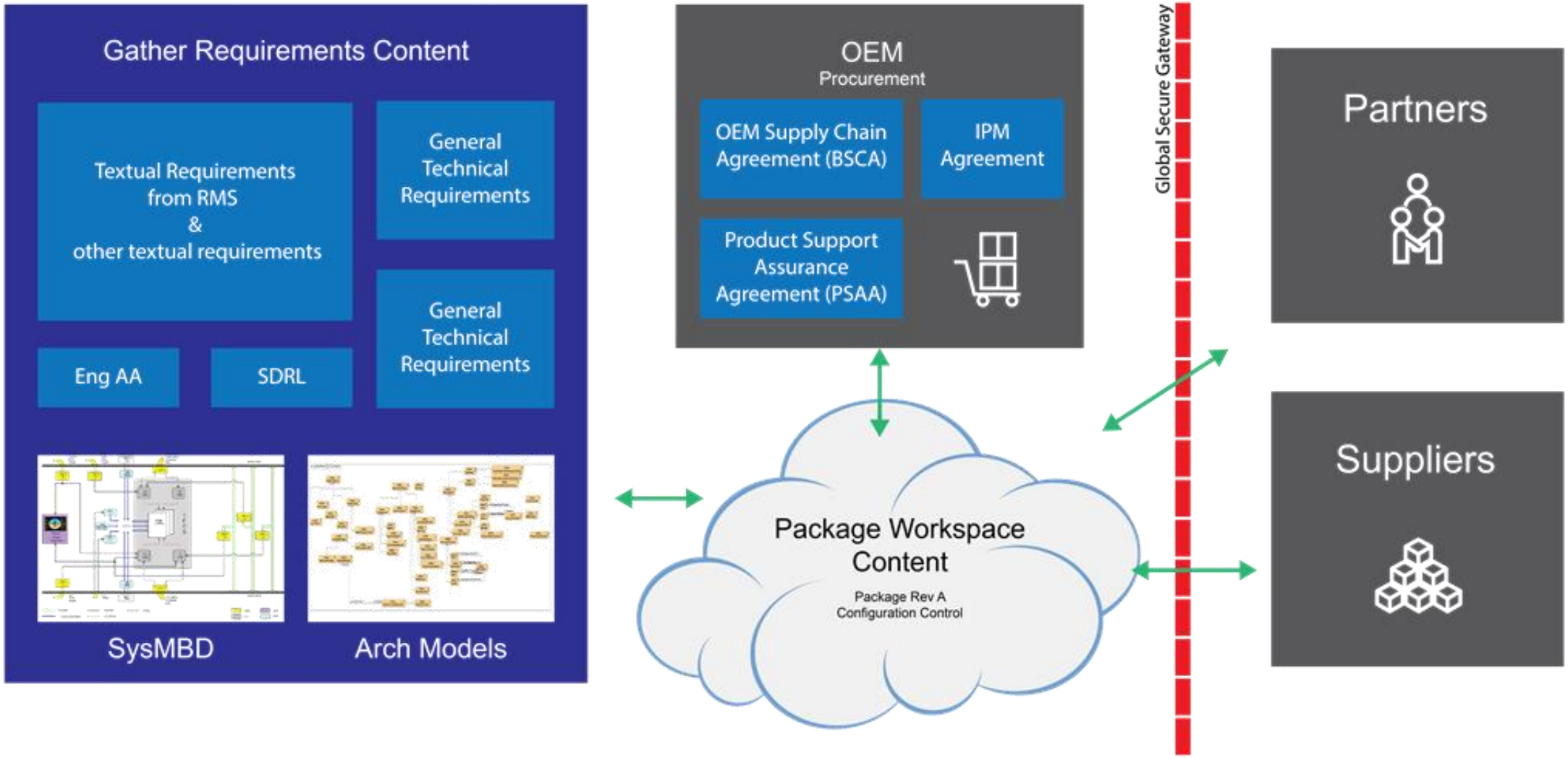
3 Role-Based Customization

Customizes interaction based on roles for Engineering, Stakeholders and Procurement Agents during the model-based requirements development and exchange to first pass quality of design requirements.

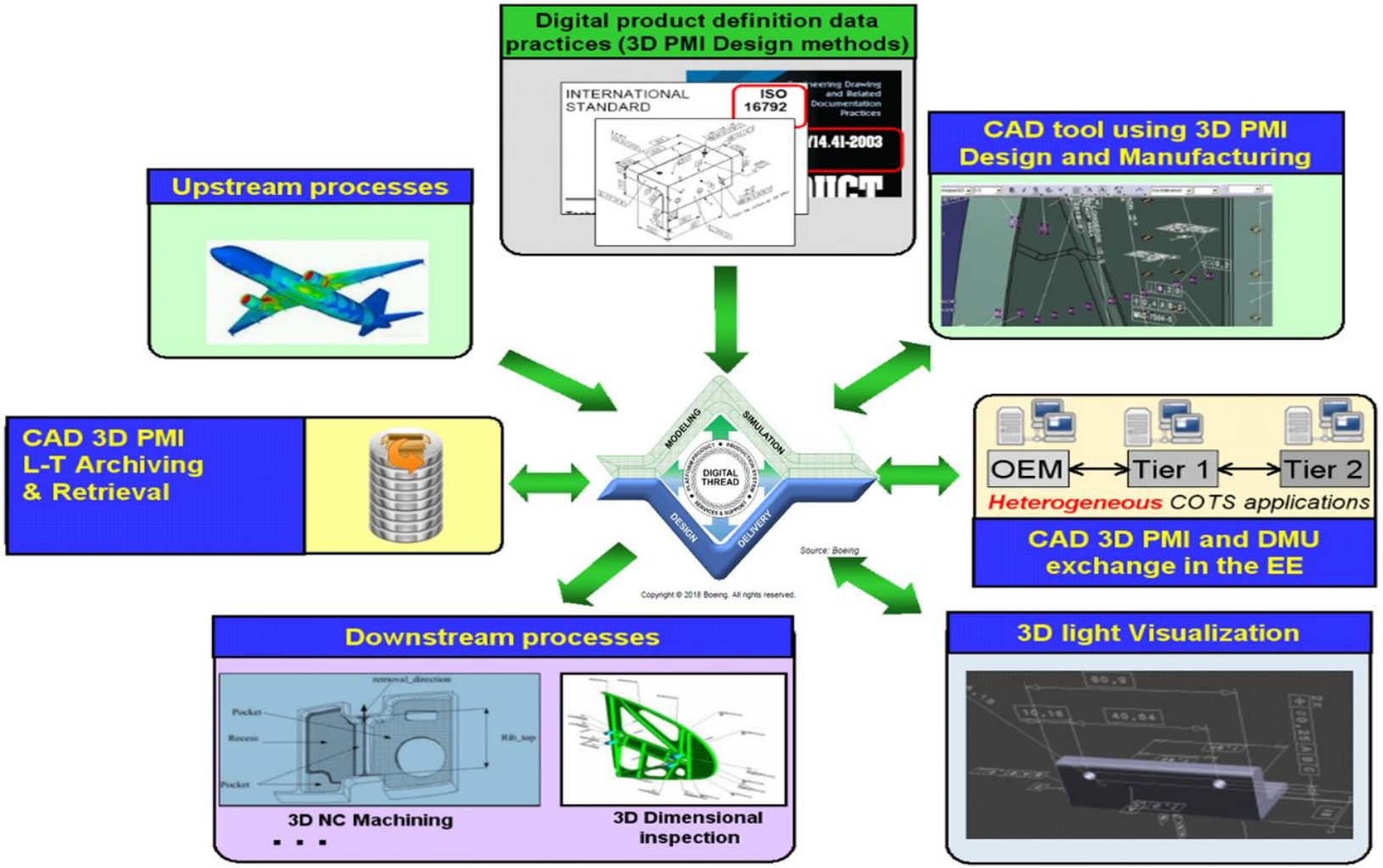
4 Leverages Digital Data and Configuration Control

Accelerate change throughout the business. Supports Model-Based Systems Engineering (MBSE) and establishes metrics for managing requirement first pass quality.

SRX Virtual Shared Workspace

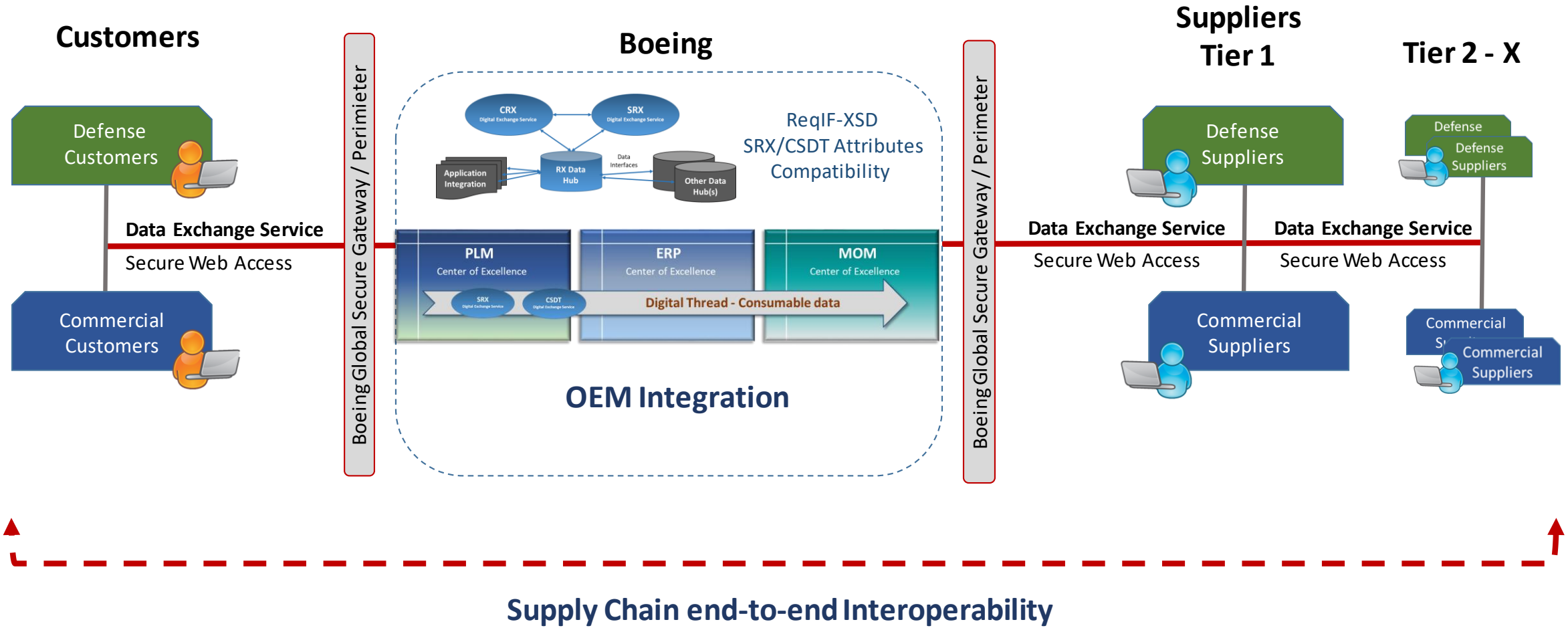


MBE Business Strategy



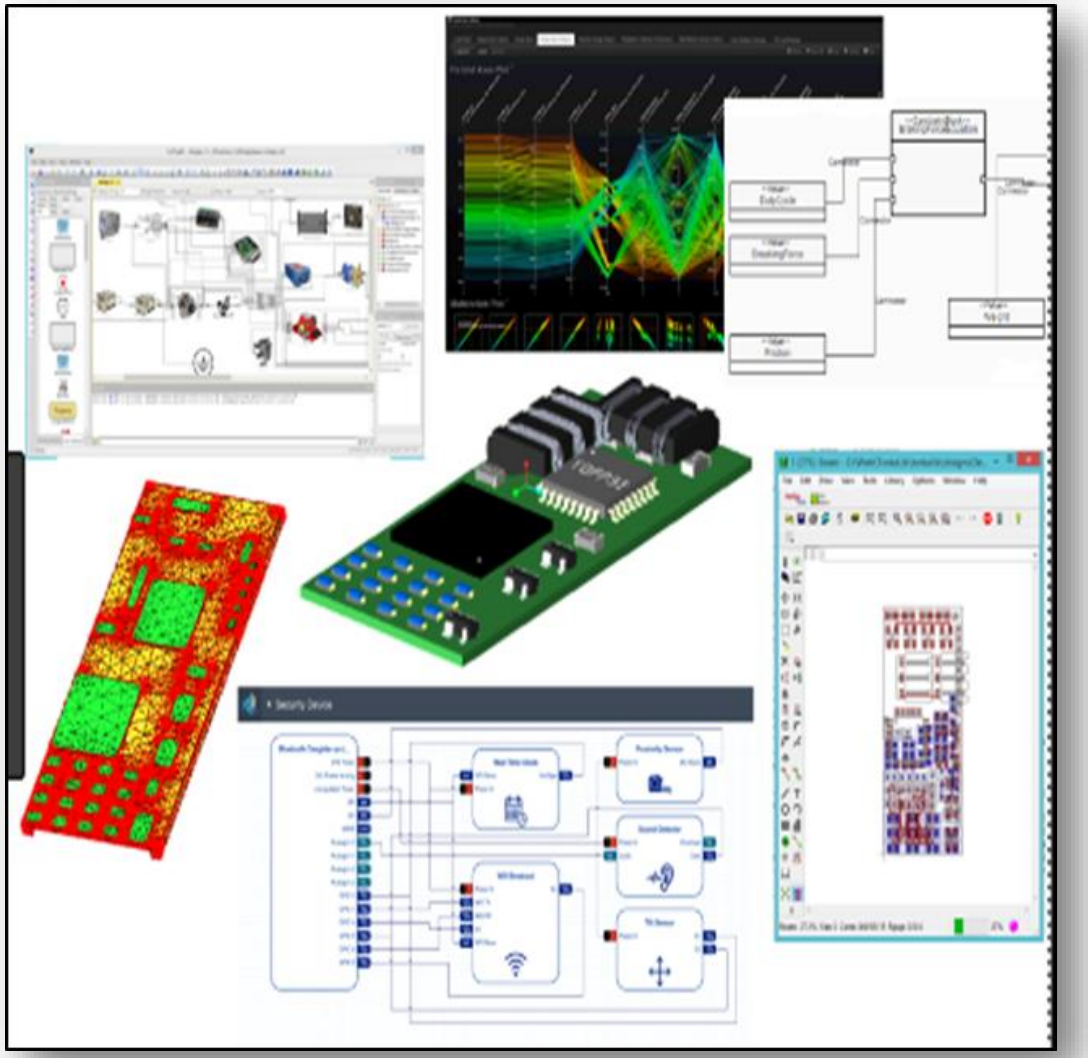
MBX Data Exchanges Services Interoperability

Global Product Data Interoperability Summit | **2019**



Applying Model-Based Engineering Methods

- Requirement Quality, Analysis and Reuse
  - ✓ Improves Data Quality
  - ✓ Reduces effort for creation and review
  - ✓ Takes advantage of previous work
  - ✓ Provides consistency for compliance
- Advanced Analytics Available
  - ✓ Ability to use metrics to assist the user in creating quality Data relationships to requirements
  - ✓ Availability of customized group and program metrics and reporting
- Product Reliability & Maintainability
- Expanded capability for integration of requirements and data



Talisen Technologies – More information

For more information:

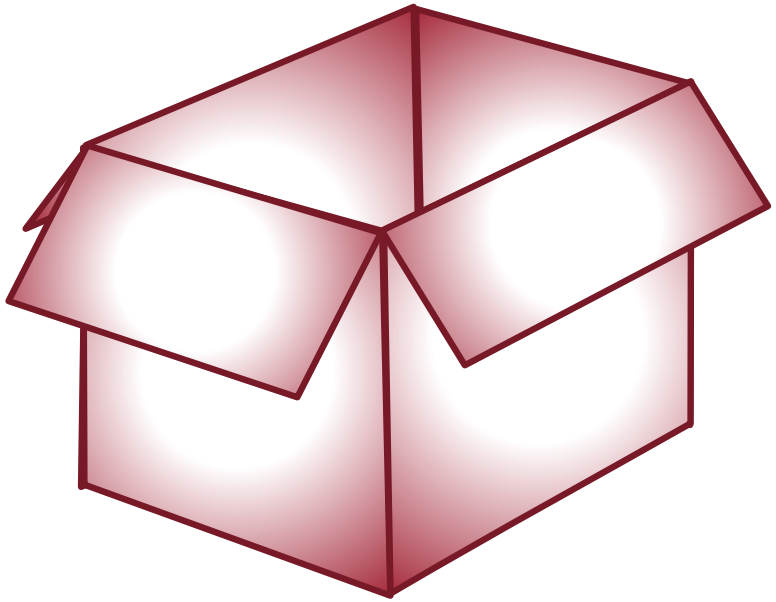
Stop by the GPDIS Vendor exhibit:
Talisen Technologies booth

Visit us on the web:
https://www.talisentech.com/

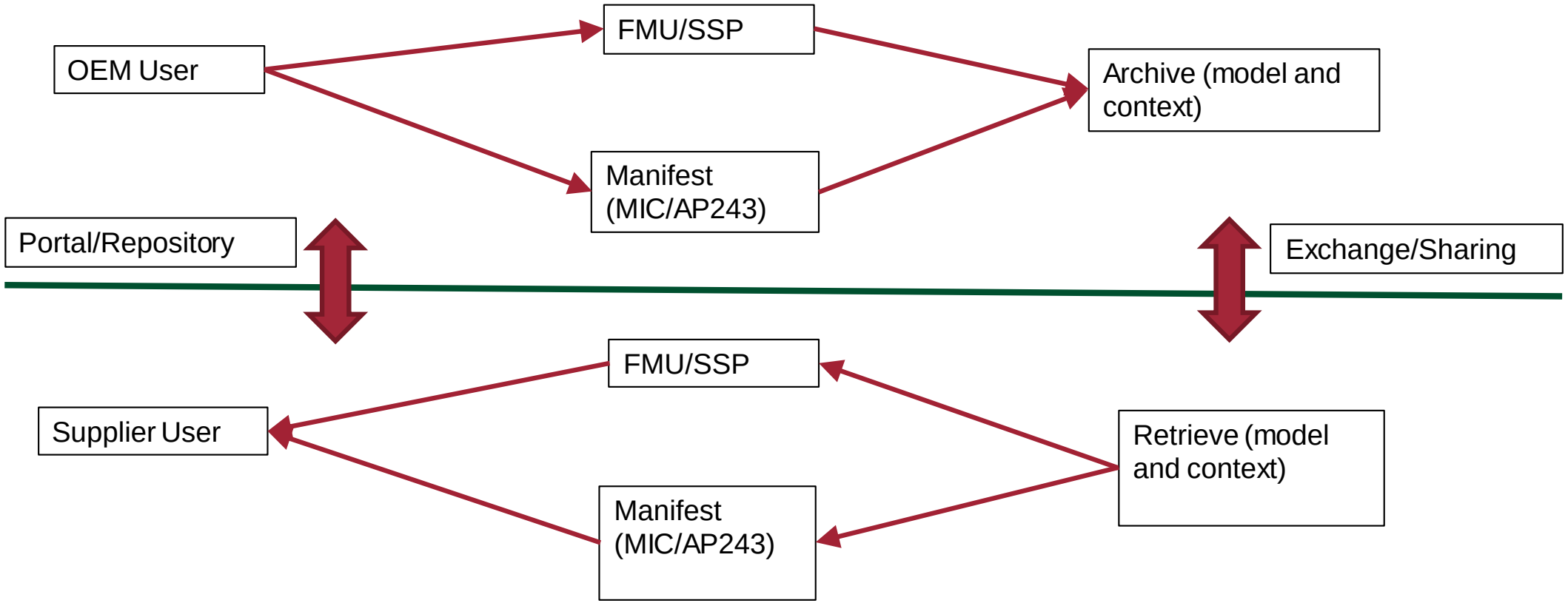
2019 Workshop Overview

- **MBSE implies data (model) relationships/integration**
- **Design Integration implies a process for exchanging data**
- **Concurrent Design implies we all start work at the same time**

We will define, design, manufacture, and qualify a box (made from paper).



Baseline MBSE archive, retrieval, sharing



2019 Workshop Plan

Divide audience into teams and assign Roles:

- **Stakeholders:** what to create
- **Define and Optimize Design:** concepts (size, folds, strength)
- **DEIX Team:** create, share, manage package process
- **Fab Planning and Mfg:** verify consumption, execute
- **Regulatory/Quality:** product, design, build rules
- **Scoring Team:** audit each team's output, completeness

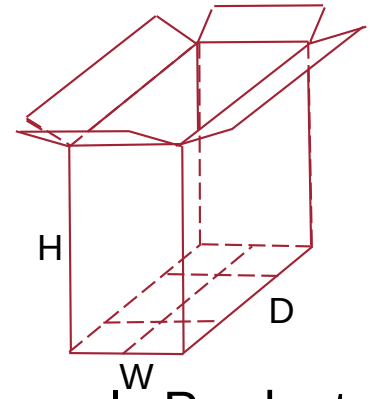
Workshop Execution

Activity Guidelines:

- We provide handouts to each team with directions and rules for their deliverables.
- 30 minutes to create deliverables and exchange, then everyone will switch teams.
- Identify one manager for each team, and one scribe with laptop (ppt, excel, docs, images), and one folder for each team (to collect paper deliverables).
- Each Team is a separate supplier, owns their IP, and success. Integrate with other teams as required, but maintain 30 minute rule.

what to create

- **What will the box be used for (mission)? Will the box be sealed?**
- **How big should it be? How much weight should it hold?**
- **Does it need to be recyclable? Can it be made from single sheet of paper?**
- **What features matter (e.g. color, shape, folds, complexity)?**
- **How much should be defined digitally with requirements traceability?**
- **What MBSE capabilities (model/doc relationships) matter?**
- **Packaging of deliverables: risks and value.**
- **Should you request Prototypes? Examples for use and longevity.**
- **Expectations that validate manufacturing quality, mfg capacity, mfg rate,**
- **Optional: Operations, Cost & Schedule, Performance, Training & Support, Test, Disposal, Manufacturing**

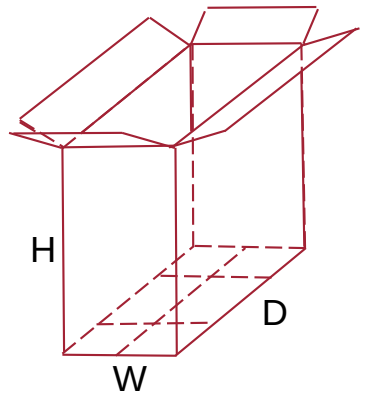


Sample Product

Rules to consider:
Assume every team is a different supplier, and they are all customers
Ask for status, milestones, reviews
Provide samples, and specify 8.5” x 11” paper (sheets)
Keep requirements simple, and prioritize expectations

concepts (size, folds, strength)

- **Design Requirement:**
  - **Volume = H*W*D = x**
  - **Assume infinite number of design solutions, but optimize**
- **Add Production Requirement:**
  - **Minimize surface area: S = 2*(H+W)(D+W) (production cost requirement)**
  - **Fold methods, and designs for best fabrication rate**
  - **Minimize use of raw material for box system (zero waste,**
  - **Options for producibility (with and without fasteners)**
- **Consider Support and Services Requirements**
  - **Define specifications, limits, characteristics, stability and safety restrictions**
  - **Define product options**

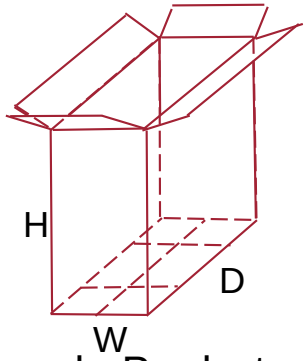


Rules to consider:
Assume every team is a different supplier
Identify your customers and define plan for status, milestones, reviews
Provide samples, and maintain limitation of 8.5” x 11” paper (sheets)
Keep requirements simple, and prioritize expectations.
Create a common design package for all of your customers

create, share, manage package process

HOW to assemble/bundle/couple/ package the MBSE business objects that need to be exchanged (architecture of the process). What is the architecture of the process, and **HOW** should the exchange/sharing/access occur?

1. WHAT information should be part of the package.
2. Assume you know the examples: AP232, MIL-STD-31000, NASA and INCOSE SE Handbooks
3. Create a checklist for process and deliverables
4. Define and demo MBSE capability based on model/doc relationships.
5. Consider Data/Process Conformance and requirements traceability (origination, consumption, V&V)

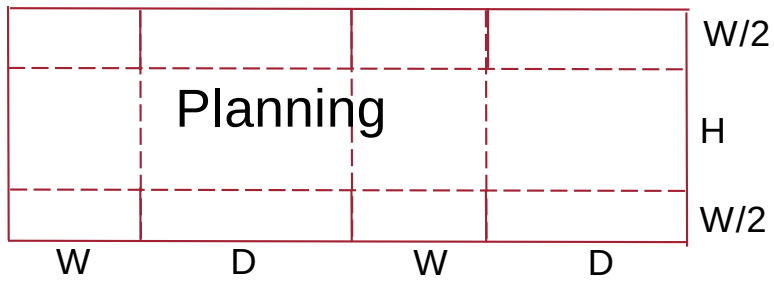


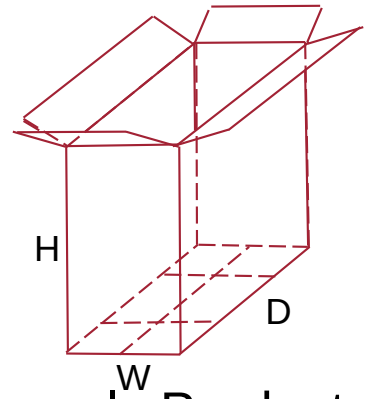
Sample Product

Rules to consider:
Assume every team is a different supplier, and they are all your customers
Include a plan for status, milestones, reviews (based on a 30 min process)
Provide process samples, and maintain limitation of 8.5” x 11” paper (sheets)
Keep requirements simple, and prioritize expectations.
Create a common process package guidelines for all of your customers

verify consumption of packages (planning) and execute fab

1. You are independent of all teams and define the manufacturing allowables
2. You will be rated based on consumption of requirements from other teams (30 minute rule)
3. Define capacity, rate and limitations based on your requirements
4. Consider how to communicate requirements with prototypes
5. Define verification rules for data consumption and requirements compliance
6. Define how to validate process and manufacturing quality.
7. Identify guidelines for operations, team qualifications, product testing



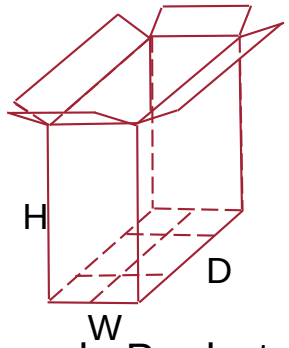


Sample Product

Rules to consider:
Assume every team is a different supplier, and they are all your customers
Include a plan for status, milestones, reviews (based on a 30 min process)
Provide process samples, and maintain limitation of 8.5” x 11” paper (sheets)
Keep requirements simple, and prioritize expectations.
Create a package of capabilities for all of your customers

product, design, build rules

1. You are independent of all teams and define the regulations for conformance
2. You must drive each team's execution to achieve the 30 minute rule
3. Define mission/product scope and limitations based on your rules
4. How much should be defined digitally with requirements traceability?
5. Identify data retention requirements and provisions.
6. Expectations to validate process, design, and manufacturing quality.
7. Identify guidelines for operations, team qualifications, product performance, Test, Disposal, Manufacturing



Sample Product

Rules to consider:
Assume every team is a different supplier, and they are all your customers.
Ask for each team's plan for status, milestones, reviews (based on a 30 min process)
You govern the success of the BOX manufacturing industry that uses 8.5" x 11" paper (sheets)
Keep requirements simple, and prioritize expectations.
Create a common package of guidelines for all of your customers

Scoring Team

audit each team's output, completeness

1. Packaging - unpacking (containers, media, data types, etc.)
2. How did each team define and maintain model/doc relationships?
3. Generate a scoring model and rate each team
4. Evaluate the manifest of package contents and features (plus manifest history)
5. Emphasize scoring of the model's/doc's meta-data (pedigree and intent, AP243)
6. Add value for Config and Quality criteria for V&V and SDRL purpose/compliance
7. Define score for Marking and Security of package and contents (object tagging, package, IP classification, system managing the package)
8. Separate score for the DEIX team: Reference a WHAT and HOW doc/process for creating and exchanging the TDP
9. Notification of TDP exchange action and method

Rules to consider:
Assume every team is a different supplier, and they are all independent
Define your intention to audit each team's progress (based on a 30 min process)
Recognize product limitations of 8.5" x 11" paper (sheets), and minimal digital deliverables
Keep scoring process simple, and prioritize scoring categories
Create a common process package guidelines for all of your customers

Is your company following or leading?

At your company:

- **Is deploying MBSE the responsibility of your Systems Engineering Organization?**
- **Is MBSE a Senior Leadership Priority?**
- **Is there clear communication from your Leadership on the MBSE Strategy?**