GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

Customer-Supplier Digital Collaboration

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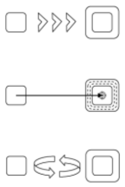
Presenters Bio

Melinda G. Refford

- Model-Based Systems Engineering (MBSE) Principal research engineer at Collins Applied Research & Technology (ART)
- 20+ years in aerospace, work spanning from Space Shuttle Communication Systems, Antenna Ground Stations, Aircraft communication systems, Avionics Aircraft Integration Labs, and Model-Based System Engineering.
- Principal Investigator leading MBSE Methods Development as part of the ART organization. Areas of focus are collaborative MBSE environments, methodologies for model-based analysis, and model-based ICD management.
- Interests include transforming SE processes from document-based to model-based, mentoring, and dissemination of MBSE practices within Collins.

From GPDIS 2023 …

Expected benefits of Collaborative DE



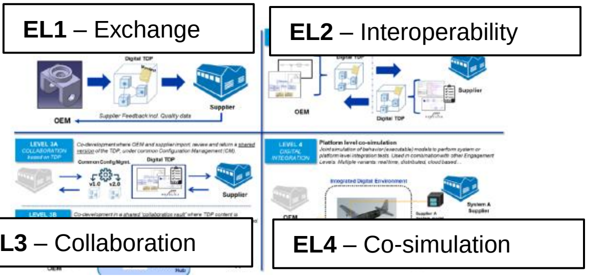
Increased Speed
- Enable direct consumption of transferred information – remove the step of data entry
- Automate transformations of models to exchange forms

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

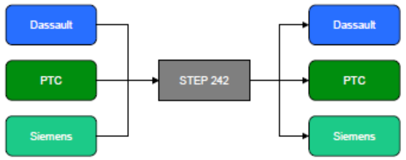
Bonanne, Kevin and Wilson, Jason. "*Addressing the Need of Managing Intellectual Property (IP) in Model-Based Collaboration within the Supply Chain*", presented at GPDIS, 2023

Engagement Levels



Mendo, Juan Carlos and Williams, Mark. "*Boeing's Supplier Engagement Framework (SEF) and Technical Data Package (TDP)*",presented at GPDIS, *2022. Copyright © 2024 Boeing. All rights reserved.*

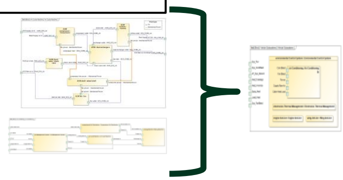
Std for Mechanical Model Exchange



Bonanne, Kevin and Wilson, Jason. "*Addressing the Need of Managing Intellectual Property (IP) in Model-Based Collaboration within the Supply Chain*", presented at GPDIS, 2023

In 2024 we focused on different use cases, challenges and needs for standardization in EL3 efforts

EL3 – Collaboration

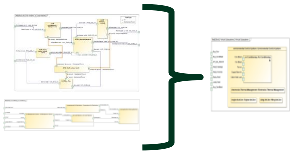


DE = Digital Engineering

Challenges of Collaborative Digital Engineering – Examples from Collins Experiences

EL3 Use Cases	Challenges	Needs

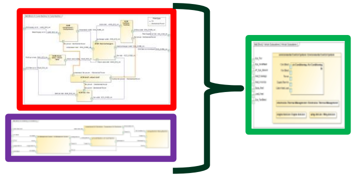
Reqs&Arch co-development in shared modeling env



- Inconsistent expectations for modeling in terms of modeling boundary and purpose resulting in inconsistent information exposed by the model to support analysis and/or reasoning
- Inconsistent delimitation of authoring boundaries and model ownership when it is stored in a shared/collaborative authoring space (e.g., change control)
- Digital artifact change control and management
- Escape of proprietary libraries, profiles, validation plugins embedded in the models
- Inconsistent and/or incomplete information captured in the model (especially at its boundary)
- Escape of IP restricted information (e.g., design decisions) in models and/or parts of models due to limitation of ACL in collaboration environment

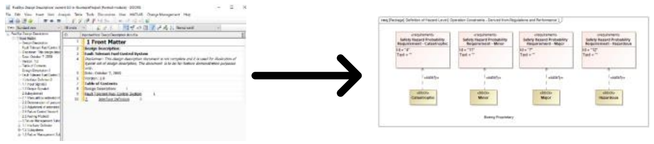
- Agreed upon Modeling & Simulation Plan
- Agreed upon Architectural Modeling Framework and Standardized modeling patterns
- Standard language and data-model for SE artifacts
- Modeling guidelines supporting the identification of IP restricted parts
- Tool support for enhanced ACL
- Agreed upon usage of IP in contracts
- Standard method to exchange DE artifacts while capturing change/version control information

Integration of Reqs&Arch models from different parties



- Inconsis
- Incomp
- Incomp
- Digital
- Escape
- Limitat informa

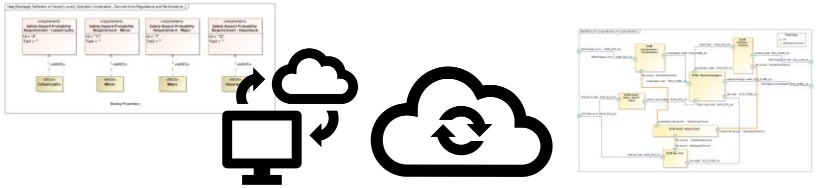
Import of Reqs&Arch info from legacy tools into modeling env



- Incomp
- Digital
- Differe
- Inadeq concep

Challenges call for both technology and business-oriented solutions. One goal with standards is to play a key role for both cases.

Dev of impl. models from customer spec models in shared env

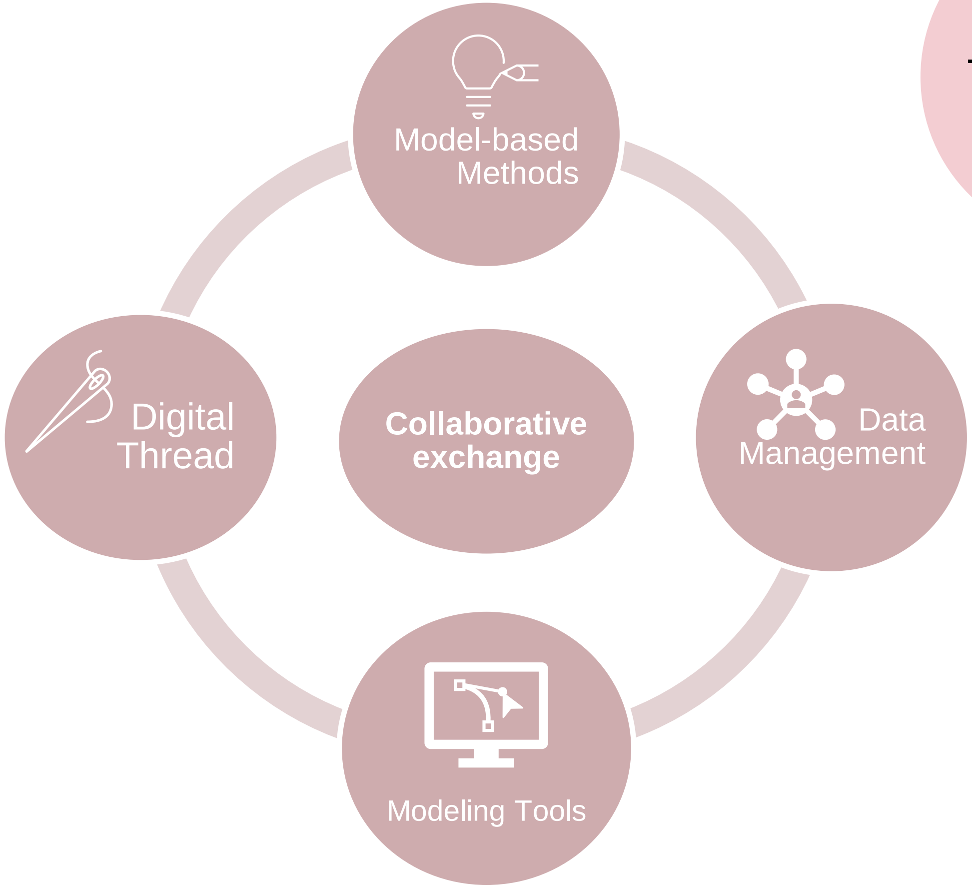


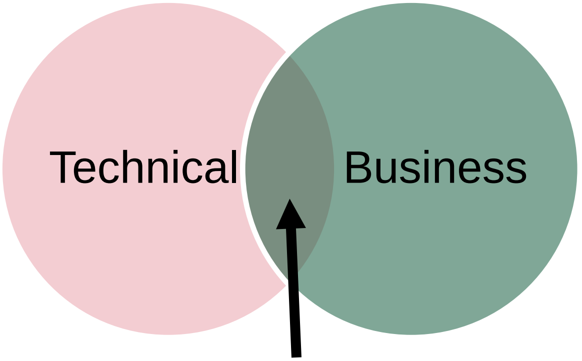
- Limit information in a model
- Inconsistent delimitation of authoring boundaries and model ownership when it is stored in a shared/collaborative authoring space (who can change what)
- Digital artifact change control and management
- Use of 3rd party proprietary libraries, profiles, validation plugins to develop the models

- Tool support to enforce separation of IP restricted from IP unrestricted parts
- Modeling guidelines supporting the identification of IP restricted parts
- Tool support for enhanced ACL
- Agreed upon usage of IP in contracts

Technical vs Business Needs for Collaborative Digital Engineering

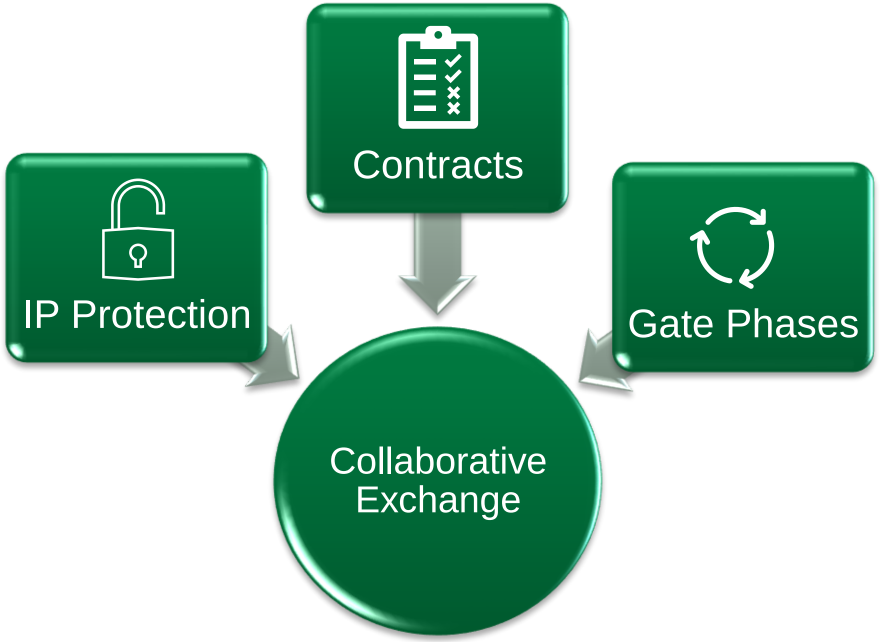
Required Digital Engineering Technical Aspects





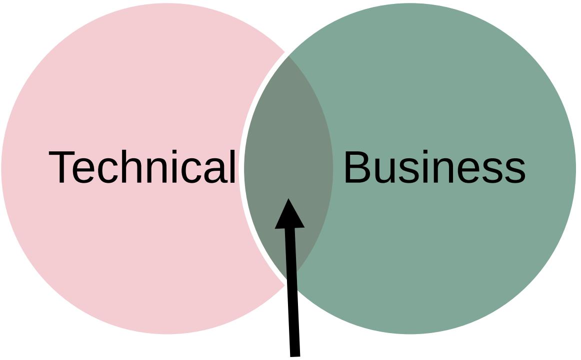
Both include aspects include process alignment technology alignment

Required Digital Engineering Business Aspects



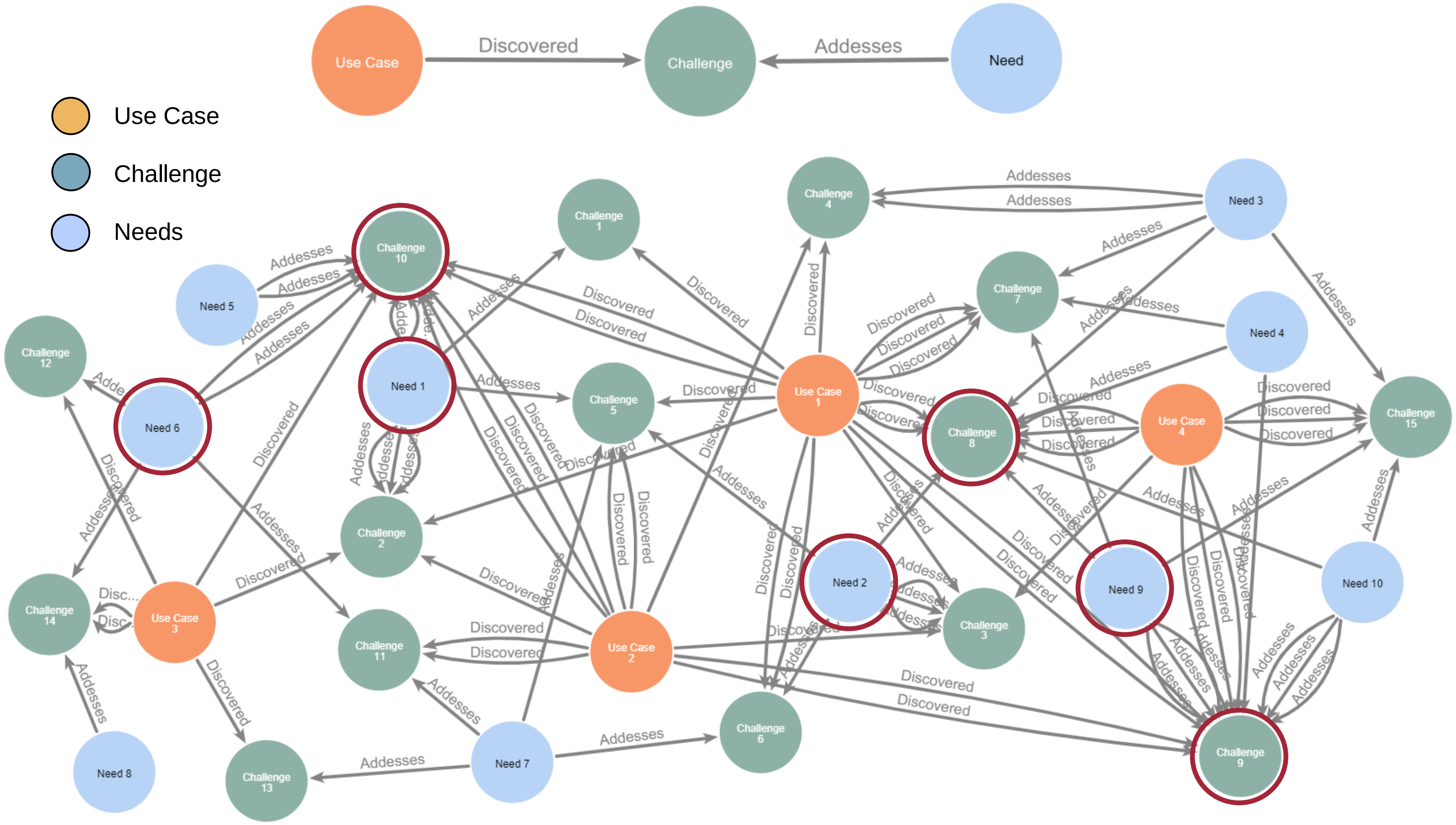
What are the different aspects – Challenge Taxonomy for both Technical vs Business Needs

Aspect	Definition in the context of DE
Modeling Tools	Provides a clear, visual and unambiguous representation of the system (of system) under design
Model-based Methods	Practices engineers use to structure models to define, design, and analyze the system of interest for multiple organizations
Data Management	Access control for partners to share databases and other digital artifacts while protecting their company IP and servers
Digital Thread	Use of digital tools and techniques for design, evaluation, life cycle phases and management
IP Protection	Providing mechanisms to share necessary digital assets with the relevant partners
Phase Stages	Development stages to verify collaborative effort is progressing as planned
Contracts	Agreement between partners that outlines the terms and conditions, scope of work, deliverables, and responsibilities.



Both include aspects
include process alignment
technology alignment

Challenges of Collaborative Digital Engineering – sorting through the data



Graph produced with Neo4j

Most Common Challenges

- Digital artifact change control and management in shared space
- Modeling guidelines alignment
- IP Management and segregation
- Model format and tooling alignment

Most Common Needs

- Agreed upon Modeling & Simulation Process
- Agreed upon Architectural Modeling Framework and Language
- Modeling guidelines for the identification + tool support of IP restricted parts
- Standard data/model Interoperability for DE

Standards that can address needs discovered in Collaborative Digital Engineering

Most Common Needs to support **collaboration on requirements and architecture**

- Agreed upon Modeling & Simulation Process
    - Definition of collaboration boundaries
    - Access/Change control ownership
    - Exchange change control management
- Agreed upon Architectural Modeling Framework and Language
    - Architectural reference models
    - Requirements structure
    - Decomposition abstraction levels
    - Shared elements
- Modeling guidelines for the identification + tool support of IP restricted parts
    - Limitation of ACL
    - Identification of proprietary libraries
    - Tool support to restrict IP elements
- Standard data/model Interoperability for DE
    - Importing ICD data + level of abstraction
    - Transformation between model types
    - Maintaining model metadata and relationships (requirements, design elements, etc.)

DDP/TDP

STEP (AP242)

Standards

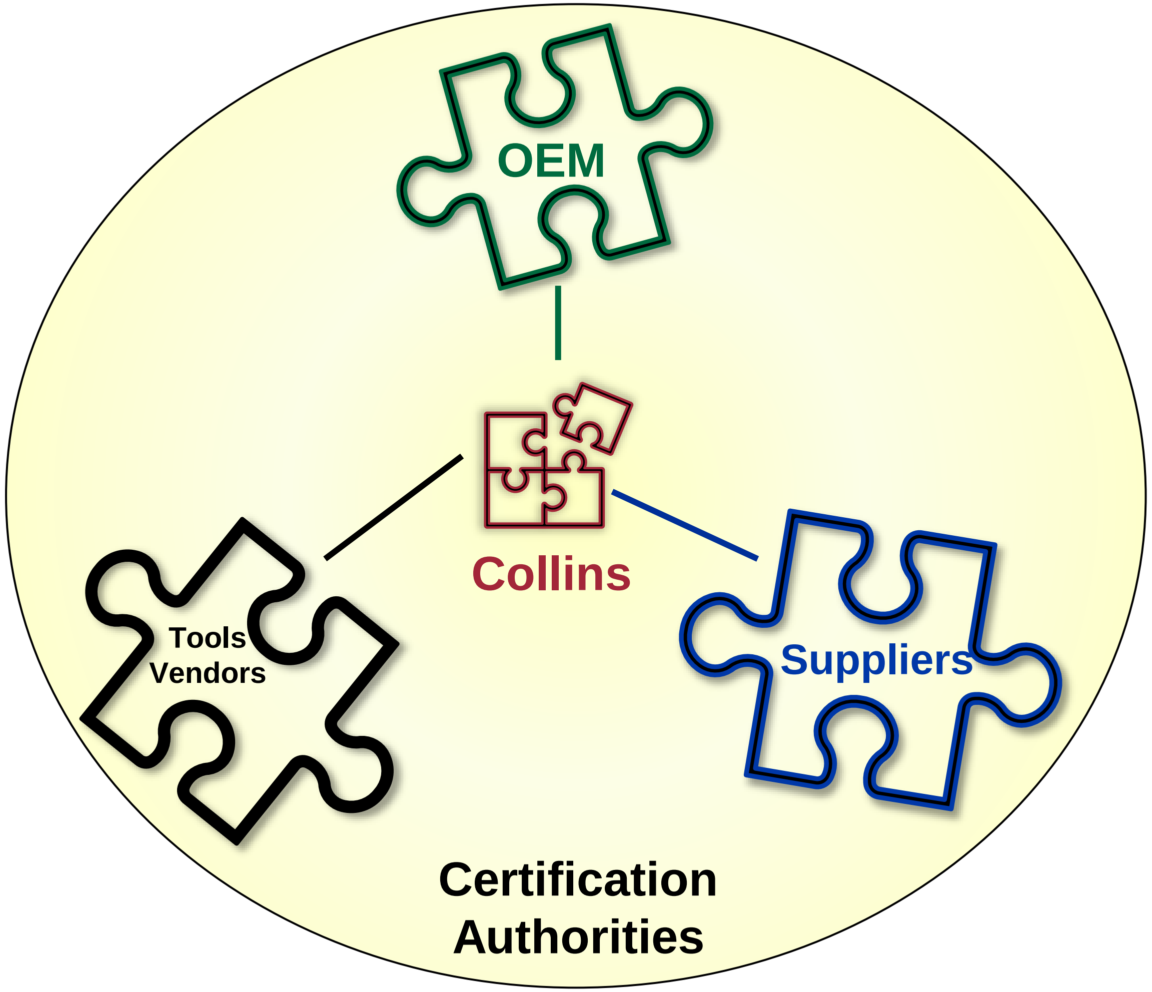
- Agreed upon Modeling & Simulation Process
    - ARP4754C/4761A, DO 178C/331
    - DDP/TDP, SysMLv2
- Agreed upon Architectural Modeling Framework and Language
    - Lang: SysMLv2, AADL, RAAML, MOSA/FACE
    - Frameworks: RFLP, Arcadia, MagicGrid, UAF
- Modeling guidelines for the identification + tool support of IP restricted parts
    - ISO/IEC 26580:2021 – PLE approach
    - SAIC DE Validation tool
- Standard data/model Interoperability for DE
    - STEP AP242, ReqIF, DDP/TDP
    - ISO 10303-243 – MoSSEC
    - FMI, ED 247

What Collins is looking for in standards?

Given the diverse scope of Collins products and customers, we are looking for standards that support DE and are compliant in the certification framework:

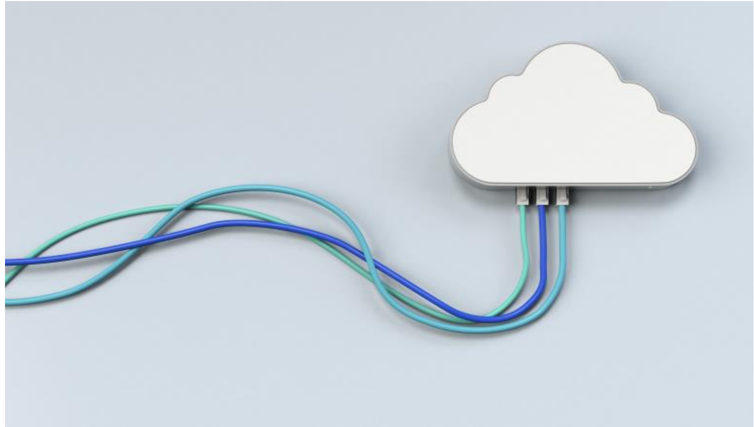
✓Endorsed and implemented by tool vendors
✓Aligns upstream with OEMs (our customers)
✓Aligns downstream with our suppliers
✓**Compatibility with the framework set with the certification authorities**

Best practices coming from outside industries can help shape standards while meeting the certification compliance need for Collins.



Value proposition for Aerospace Digital Collaboration and Next Steps

Breakthroughs in digital engineering is transforming the aerospace industry and calls for standards to enable effective collaboration. Common collaboration points between industry partners are a key opportunity for standards to evolve. Collins is active and fostering joint exploration on:



- Use Cases for DE collaboration during system design (e.g., modeling of novel systems, joint analysis and optimization, interface definition)
- Tool integration and interoperability, including but not limited to modeling, simulation and verification tools
- Moving from document centric approaches to a model for the Source of Truth
- Data management, across teams and locations, including but not limited to access, data consistency, security, version control and IP protection
- Change management and ownership/responsibilities for DE collaboration

Beyond the collaborations expressed here we are building experience on:

- Collaborative Virtual Integration (exchange virtual representation to the solution of the problem)
- Collaborative Digital Certification

Previously companies can go *faster alone* and *further together*, but now

Standardization is a way we can go both *faster* and *further* in DE Collaboration!

Thank you!

Questions?

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