PLM Road Map™ & PDT North America 2026
AI in PLM: A Disruptive Opportunity and Challenge
Turning AI disruption into enterprise value:
Strategic insights for the PLM professional
6-7 May 2026
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AEROSPACE & DEFENSE PLM ACTION GROUP

Value Potential of Digital Twins and Digital Threads

Results of Industry Research

Robert Rencher, Sr. Process Engineer, The Boeing Company
Project Leader, AD PAG Digital Twin-Digital Thread Project Team

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Presenter's Profile

Dr. Robert J. Rencher, Sr. Process Engineer, The Boeing Company

- As a Sr. Process Engineer, Robert provides leadership in facilitating a common understanding, strategic roadmap, and functional utilization of digital twins and digital threads standards across Boeing and the aerospace industry. Robert represents Boeing's strategic digital twin/digital tread interests to several aerospace and defense industry standards bodies (AIA, ISO, SAE, OMG, and A&D PLM Action Group)
- Robert has over 40 years of experience in designing successful solutions for complex information technology challenges. He joined Boeing in 1987 as a Systems Analyst. Robert holds a BS degree in Operations Research, an MBA in Information Technology, and a Ph.D. in Information Technology.
- As an avid inventor, Robert has 14 U.S. patents, numerous published technical papers at international technical conferences. Robert's personal pursuits include real estate development, gardening, and community service. robert.j.rencher@boeing.com / https://www.linkedin.com/in/robertjrencher/

James Roche
Aerospace & Defense
Practice Director

Agenda

- Introduction
- Benchmark Plan
- Use Cases
- Use Case Demonstrations
- Conclusions
- Q & A

Aerospace & Defense PLM Action Group

Founded in February 2014

Mission

An association of aerospace & defense companies within CIMdata's globally recognized PLM Community Program, which functions as a ***PLM advocacy group*** to . . .

Members

AIRBUS, BOEING, Bombardier, EATON, GE Aviation, GKN AEROSPACE, Gulfstream A GENERAL DYNAMICS COMPANY, HondaJet, MOOG, Rolls-Royce, RTX (COLLINS AEROSPACE, PRATT & WHITNEY, RAYTHEON), SAFRAN

Project Workstreams

- PLM Technology Obsolescence Management
- Global Collaboration
- Model-based Definition (MBD)
- Multiple View Bill of Material (Multi-view BoM)
- Interoperability Standards
- Model-Based Systems Engineering (MBSE)
- Digital Twin/Digital Thread
- Manufacturing Engineering Co-development
- PLM for In Service

Research with Solution Providers

- Digital Thread
- Model-based Systems Engineering

Website: www.ad-pag.com

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AD PAG Digital Twin-Digital Thread Project

Purpose

- Define the objectives, requirements, and roadmaps for Digital Twin/Digital Thread solutions for creating and managing the digital representation of a product through the product lifecycle within the A&D ecosystem
- Identify, define and demonstrate use case level value propositions
- Validate benefits to the PLM ecosystem
  - Improved data portability and transparency of PLM events
  - Reduced operational friction resulting in lower operations costs
  - Improved product operational transparency resulted in improved safety, operational efficiencies, and product design

AD PAG Digital Twin-Digital Thread Project

Approach

- Agile methods employed to publish at the speed of consensus
- Release five position papers addressing varying aspects of Digital Twin / Digital Thread concepts and capabilities related to the aerospace industry
  - Phase 1: Digital Twin/Thread – Research & Scoping
  - Phase 2: Digital Twin/Thread Position Paper
  - Phase 3: Digital Twin/Thread Business Architecture / Methodologies paper
  - Phase 4: Digital Twin/Thread Comparative Analysis of Industry Standards paper
  - Phase 5: Value proposition of the Digital Twin/Digital Thread to the A&D industry
  - Phase 6: Forward-looking Digital Twin/Thread Strategy and Roadmap
  - Phase 7: Project Consolidation
- Scope the project to deliver value early and iterate
  - Scope to the A&D industry
  - Time box the effort to approximately 36 months

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Benchmark Plan

Objectives

Primary

- A broad assessment of the capabilities of commercially available digital twin/digital thread solution offerings, including software and services
- Mutual education and alignment of thought leaders from industry and leading solution providers on digital twin/digital thread use cases and solution strategies
- Advancement of industry's awareness and understanding of the current practical value potential of digital twin/digital thread investment

Secondary

- Content that will be useful for future engagement with standards organizations for enrichment of standards to address digital twin-digital thread requirements

Provide a generalized assessment of the state of the industry and not a competitive comparison between the benchmarked solutions

Benchmark Plan

Execution strategy

Tailored Approach

- Partner with other industry organizations
- Invite participation of a broad community of solution providers
- Capitalize on existing use case solutions
  - Natural selection of what is possible today from the virtually unlimited set of possibilities
  - Dramatically reduces the effort required to prepare the benchmark demonstrations

Use Case Selection and Preparation

- Compare the participating solution provider's use case library with the AD PAG's use case library
- Default demonstration environment is that of the participating solution provider

Benchmark Plan

Execution strategy

Recognizing the breadth and the state of maturity of the topic, the benchmark inquiry was not focused solely on "measuring how well it is done" but more broadly on "understanding

- *how* it is done,
- *what* is real today, and
- *where* it is going"

Solution Provider Engagement

Part 1

1. Welcome and Meeting Objectives
2. Solution Strategy
3. Implementation Approach

Part 2

4. Use Case Demonstrations

** Agenda Item 4 to be repeated for each use case **

Part 3

5. Solution Provider's View to the Future
6. A&D industry's view of future
7. Wrap-Up

Benchmark Plan

Industry partners and participating solution providers

Industry Organization Partners

AIAA, Digital Engineering Integration Committee

OMG, Digital Twin Consortium, A&D sub-team

Prostep iViP, Collaborative Digital Twin (CDT) working group

SAE International, G-31 Digital Communications Committee

All contributed use cases from their internal project libraries

Contributed 25 of the 80 use cases in the project Use Case Catalog

Participating Solution Providers

Ansys part of SYNOPSYS

Capgemini

Cortona3D

eQ Technologic

HEXAGON

Infosys

PROSTEP integrate the future

Contributed 24 use cases

Demonstrated 28 use cases from the project Use Case Catalog

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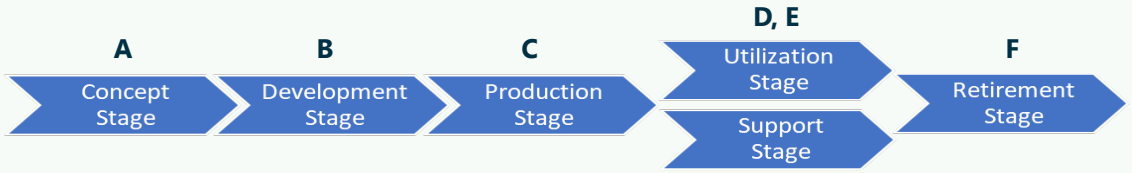
Demonstration Use Cases

9 Digital Twin Use Cases – Spanning the lifecycle



ISO 15288 System Lifecycle

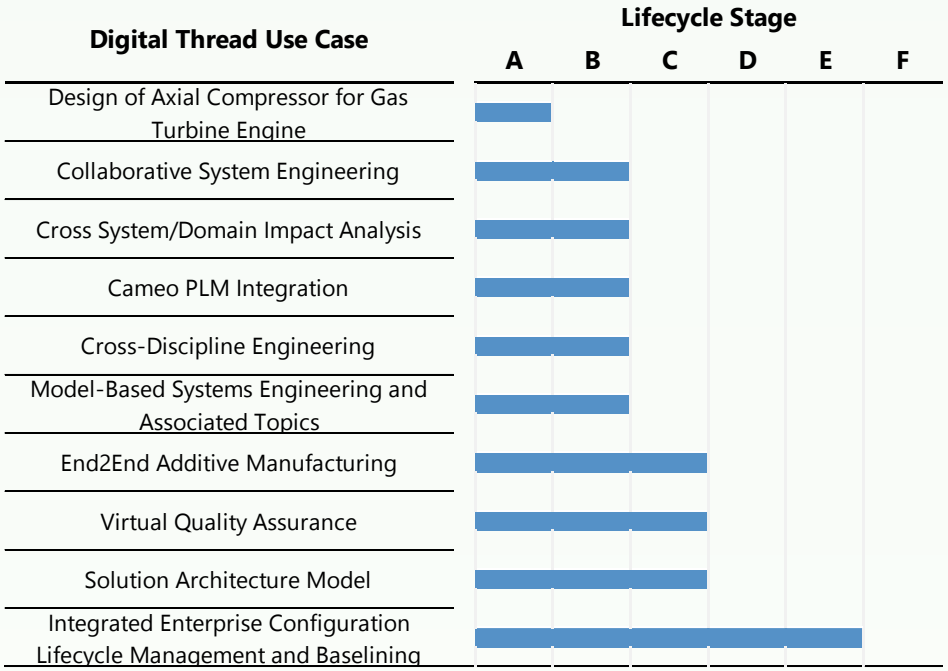
Digital Twin Use Case	Lifecycle Stage A	B	C	D	E	F
Material Modelling Twins As-Built Part / Component Twins for Quality	Create		Consume			
Understanding the Performance of a Solar Aircraft Using Digital Twin	Create		Consume			
OpenPDM - Bi-directional CAD integration between different vendor PLM's	Create		Both			
Virtual Commissioning Automotive Demonstrator for Body-in-White Assembly	Create		Consume			
OpenDXM GlobalX - Collaboration with external partners		Both				

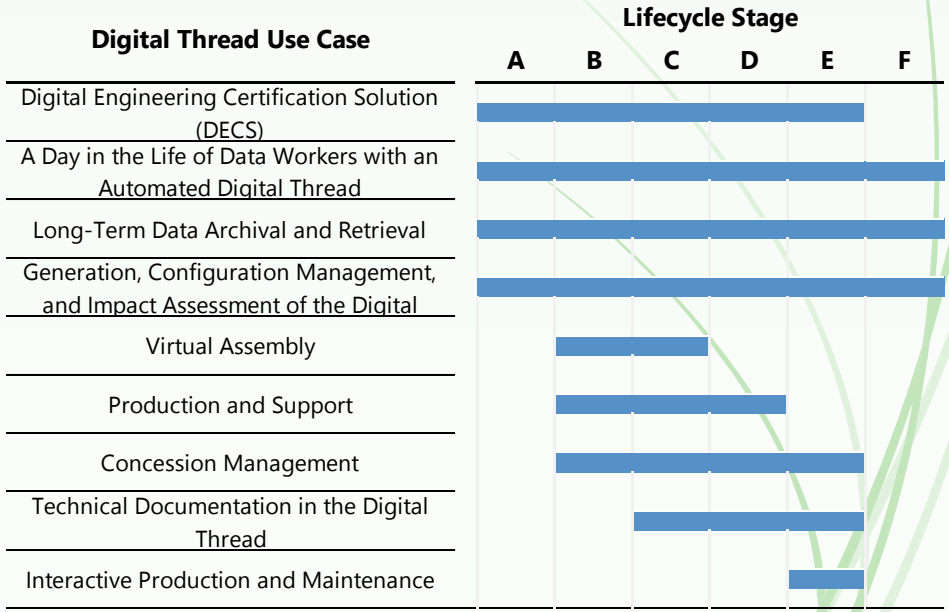
Digital Twin Use Case	Lifecycle Stage A	B	C	D	E	F
Model-Based Systems Engineering (MBSE) and Digital Twin Realization of a Drone	Create			Consume		
Echo Digital Twin Application Development Framework – YVR & Pearson	Create			Consume		
Battery Package Assembly Demonstrator for Creation of an Assembly Concept	Create					
Modelling of Complex Multi-Fidelity, Multi-Domain, System-of-Systems (SoS) Mission	Both					

Key: Create, Consume, Both

Demonstration Use Cases

19 Digital Thread Use Cases – Spanning the lifecycle





Demonstration Use Case

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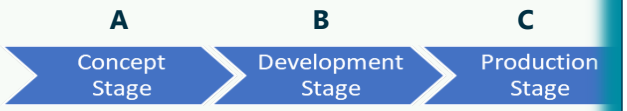
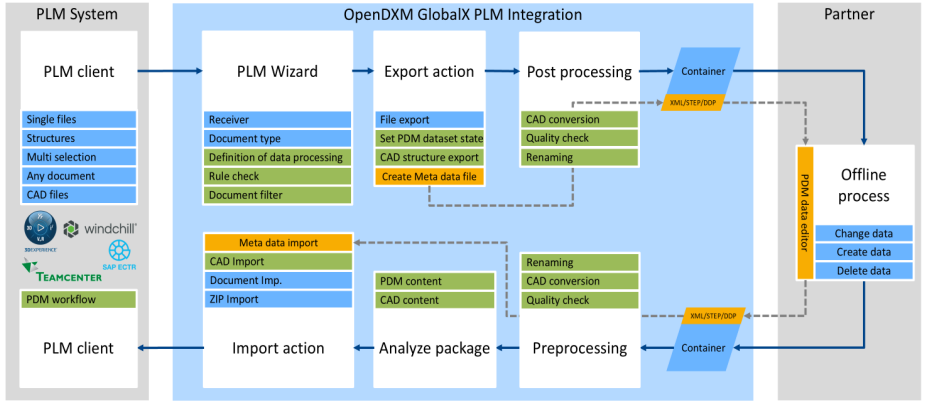


OpenDXM GlobalX PLM Integration

PROSTEP

Roundtrip process workflow for automating collaboration with external partners



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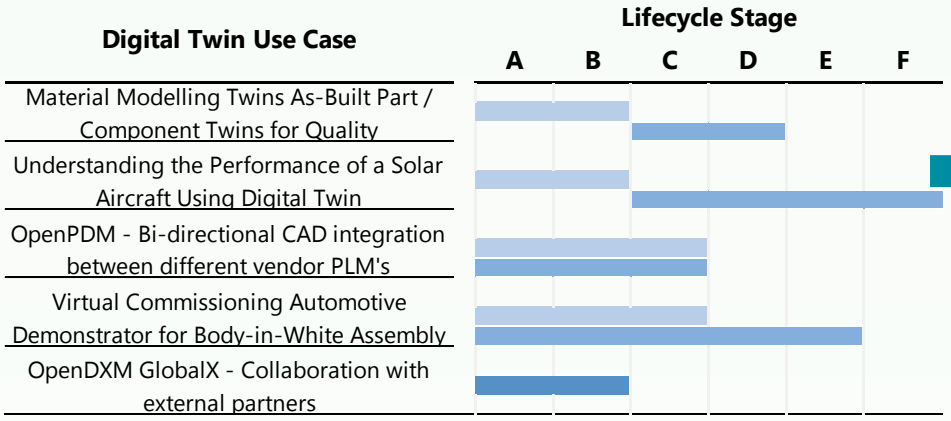
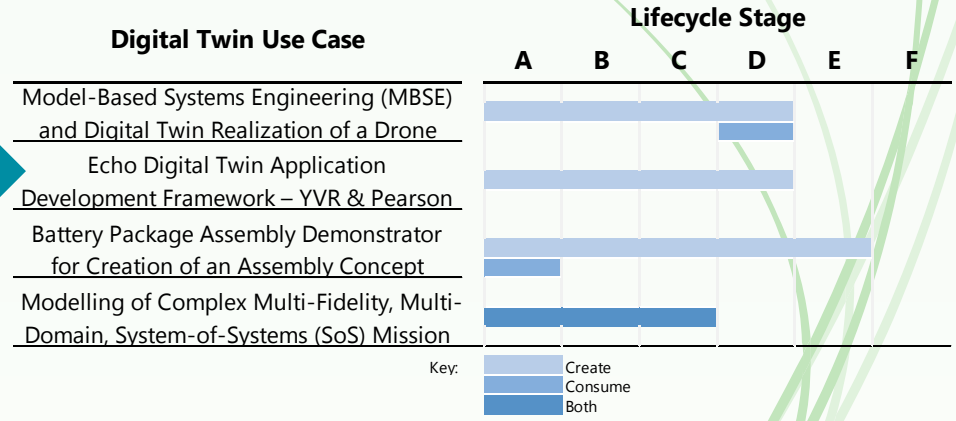
Demonstration Use Case

9 Digital Twin Use Cases – Spanning the life

Capgemini





Demonstration Use Case

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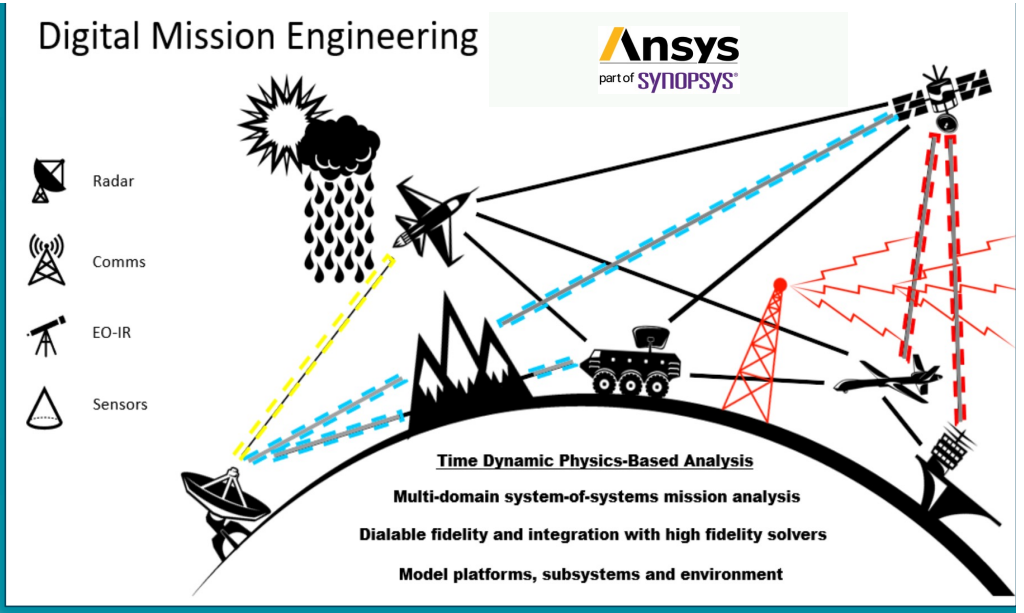
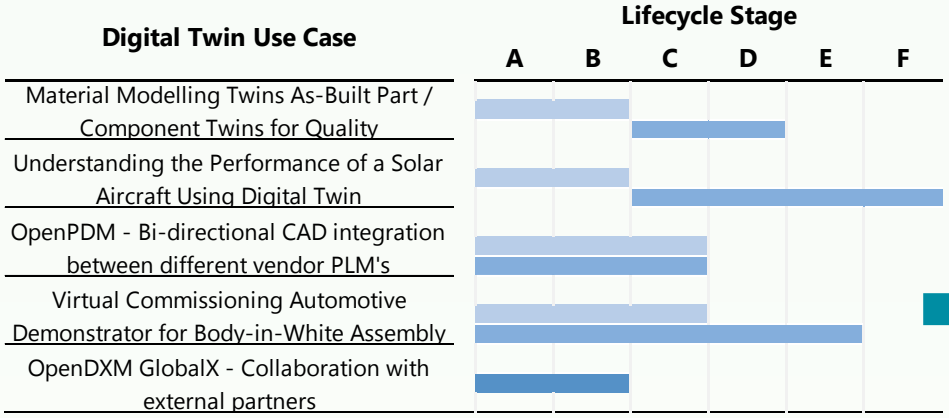
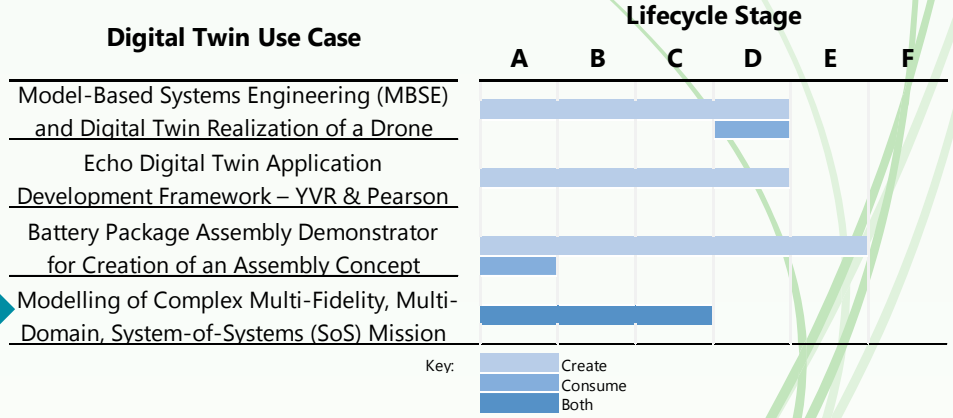
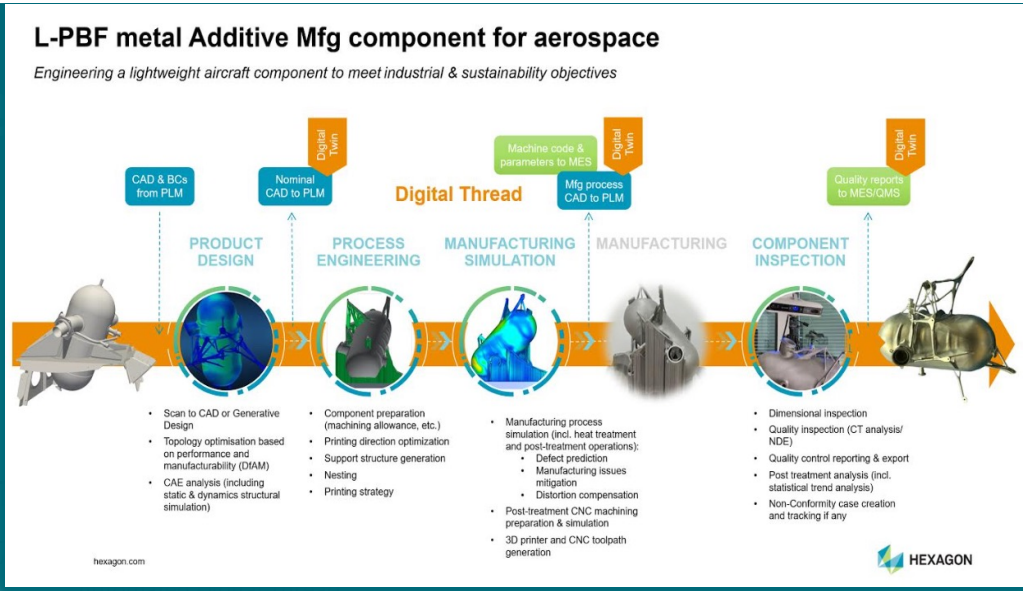






Demonstration Use Case

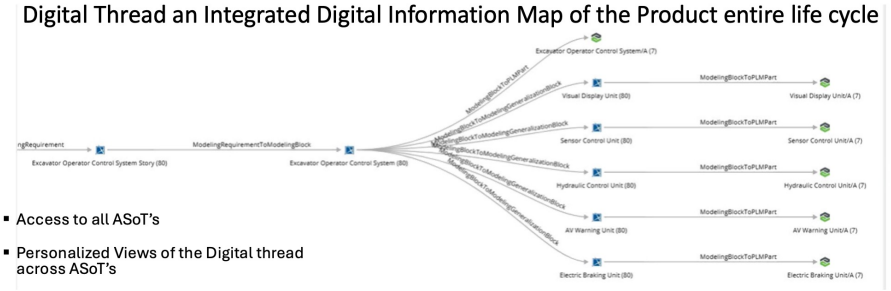
19 Digital Thread Use Cases – Spanning the



Digital Thread Use Case	Lifecycle Stage A	B	C	D	E	F
Design of Axial Compressor for Gas Turbine Engine						
Collaborative System Engineering						
Cross System/Domain Impact Analysis						
Cameo PLM Integration						
Cross-Discipline Engineering						
Model-Based Systems Engineering and Associated Topics						
End2End Additive Manufacturing						
Virtual Quality Assurance						
Solution Architecture Model						
Integrated Enterprise Configuration Lifecycle Management and Baselining						
Long-Term Data Archival and Retrieval						
Generation, Configuration Management, and Impact Assessment of the Digital						
Virtual Assembly						
Production and Support						
Concession Management						
Technical Documentation in the Digital Thread						
Interactive Production and Maintenance						

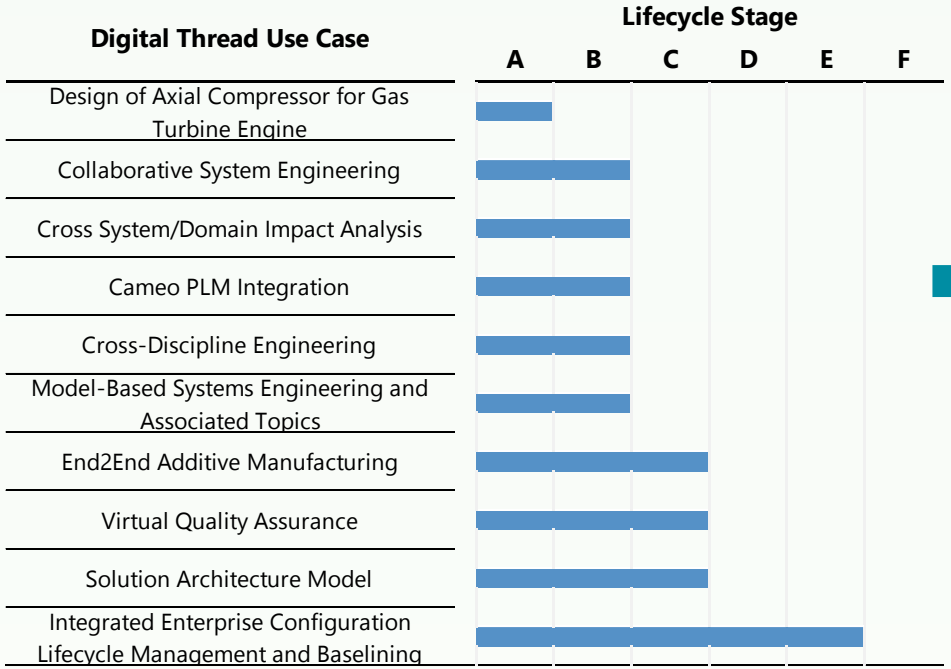
Demonstration Use Case

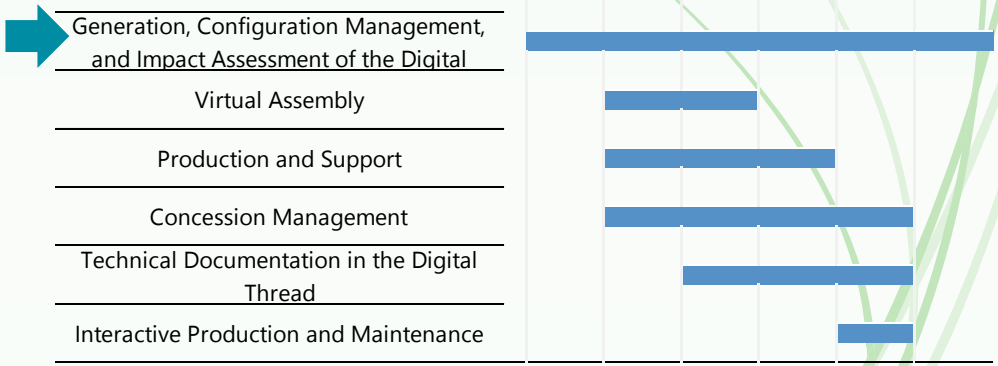
19 Digital Thread Use Cases – Spanning the



- Access to all ASoT's
- Personalized Views of the Digital thread across ASoT's
- Digital Thread constructed automatically
- No data is replicated in DTA
- Elimination of Clerical activates
- User ability to enrich the manually
- Baselining capabilities
- Search, Pedigree and impact assessment

Simplifies: Installation, Learning, Usage while
Reducing: Time to Market and Investment





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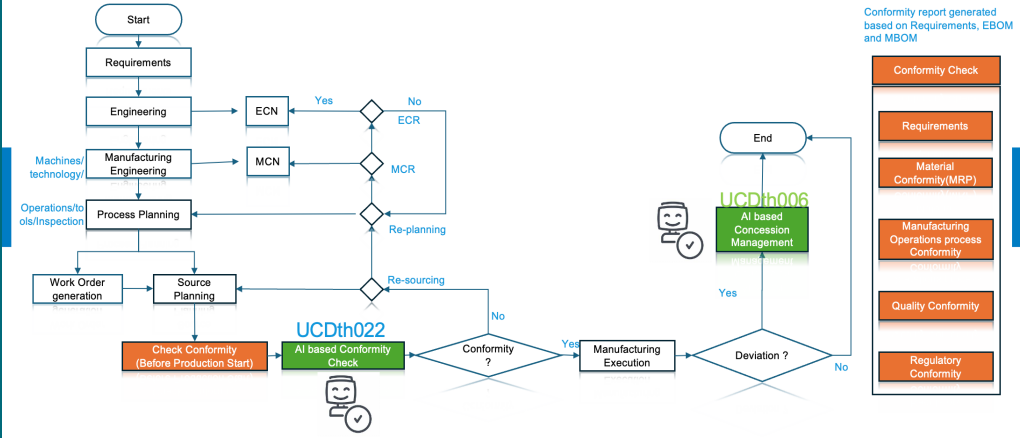
Demonstration Use Case

19 Digital Thread Use Cases – Spanning the

Solution Architecture: Digital Thread capabilities to address Non-Conformities



3

Infosys
Navigate your next

Digital Thread Use Case	Lifecycle Stage A	B	C	D	E	F
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Demonstration Use Case

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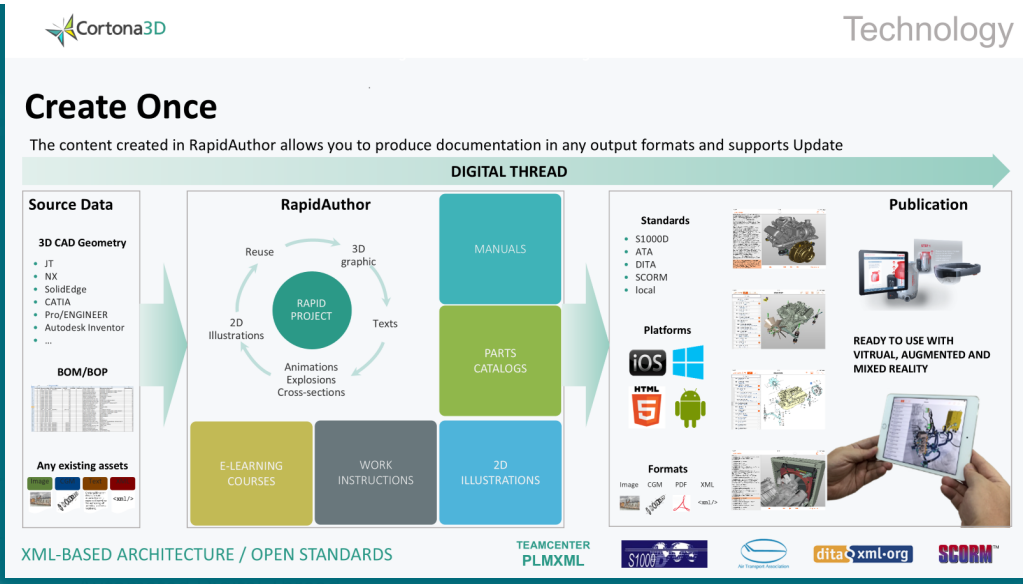

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Use Case Demonstrations

Evaluation dimensions and rating scale

Evaluation Dimensions

Use Case Goal
The intended outcomes and business value

Use Case Actions
The standard sequence of actions and their corresponding outcomes

Robustness
The ability of a system or solution to consistently perform well under various conditions

Ease of Use
The simplicity and intuitiveness of the system or solution

Adaptability
The ability to adjust in response to changing requirements, environments, or user needs

Rating Scale

0-Not shown

1-Minimally meets requirement

2-Mostly meets requirement

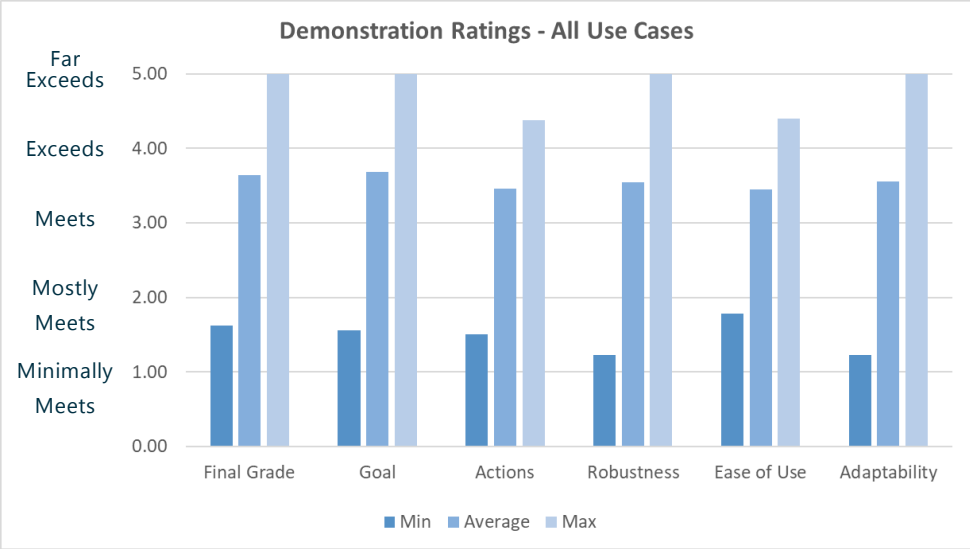
3-Meets requirement

4-Exceeds requirement

5-Far exceeds requirement

Use Case Demonstrations

Results – All use cases



- The demonstration ratings showed an overall positive outcome
- Average scores above 3.0, indicate that most use case demonstrations met or exceeded expectations in all evaluation categories
- Minimum scores between 1.0 and 2.0 suggests that a few demonstrations fell short of expectations.
- Most solution demonstrations were viewed as mature and strategically aligned
- Some solution demonstrations prompted concerns regarding their practical readiness and quality of execution

Use Case Demonstrations

Summary assessment of value (1 of 2)*

- Evaluator ratings
  - Overall, demonstrations rated as exceeding requirements
  - Individual provider demonstrations rated from meets to far exceeds
- Participants emphasized that
  - The collective learning experience and cross-industry exposure were invaluable,
  - Providing insights that could only be gained through a collaborative benchmark of this kind
- The sessions fostered a clearer understanding of where the industry stands today revealing both technical progress and conceptual divergence

* - Twelve senior domain experts from AD PAG member companies served as demonstration evaluators

Use Case Demonstrations

Summary assessment of value (2 of 2)

- Across all sessions, the collective experience offered exceptional educational value and industry insight
  - Evaluators described the demonstrations as “impressive” and “convincing,” though not all were at the same level of maturity or completeness
- While no single provider offered a complete Dtw-Dth platform, the collective demonstrations
  - Provided critical comparative insights
  - Revealed emerging best practices
  - Reaffirmed the collaborative benchmark’s value as a unique industry learning experience

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Conclusions

Key findings and dominant themes (1 of 3)

- Divergent strategies and uneven maturity
  - Two dominant strategic approaches have emerged
    - Focused Solutions – These providers offer deep, mature capabilities in a specific domain (e.g., simulation-led design, technical publications, or metrology)
    - General Solutions – These providers focus on the broader challenge of connecting disparate enterprise systems (PLM, ALM, MES, ERP) to create a cohesive data thread
  - This divergence results in a market where overall maturity is inconsistent
    - While individual solutions are technologically strong, no single provider demonstrated mastery across all benchmarked use cases
    - The industry's ability to create a truly seamless, end-to-end Dth is still evolving
- Architectural evolution from connectors to digital fabric or virtual-data-landscape
  - Move from point-to-point integrations towards more sophisticated architectural patterns
  - Concept of a federated digital fabric or digital backbone was a notable innovation

Conclusions

Key findings and dominant themes (2 of 3)

- Role of the major PLM platform solutions
  - Foundational but evolving within the broader Dth and Dtw ecosystem
  - Continues to serve as the authoritative source for ‘as-designed’ product data and the backbone for configuration and change management
  - Its position as the central program hub is increasingly being challenged and redefined by more open, federated, and data-centric architectures
- Pragmatic integration of AI
  - AI and ML have transitioned from conceptual ideas to practical enablers for advanced Dtw-Dth functionalities. Applications are concrete and focused on delivering specific business value
    - Predictive analytics and mode recalibration
    - Operational efficiency
    - Data quality management

Conclusions

Key findings and dominant themes (3 of 3)

- Critical prerequisites for success
  - Integrated multi-domain models
    - The ability to connect models from various domains (e.g., design, cost, supply chain, physics-based simulation) is essential for holistic analysis
  - PLM-MES integration
    - A seamless, bidirectional link between the PLM system ('as-designed/as-architected') and the MES ('as-manufactured/as-built') is fundamental
  - Open standards and interoperability
    - A reliance on open, neutral standards (e.g., STEP, JT, OpenUSD) is crucial for avoiding vendor lock-in and ensuring long-term data exchangeability and collaboration across the ecosystem
  - Robust data governance and archival
    - For industries like A&D, a strategy for archiving and accessing data for decades is a non-negotiable requirement

Conclusions

Persistent challenges and industry gaps

- Legacy System Integration
  - The rip-and-replace approach is not feasible
  - Integrating with deeply entrenched legacy systems remains a primary technical and financial barrier
- Long-Term Maintainability
  - The total cost of ownership is a major concern
  - The long-term effort required to maintain a complex web of connectors, adapters, and data models as underlying systems evolve is substantial and must be planned for
- Organizational Readiness
  - The technology is often more mature than the organization's ability to adopt it
  - A lack of clear vision, robust data governance, and effective Organizational Change Management (OCM) are significant impediments to realizing ROI
  - The A&D industrial community's readiness, while growing, is still in its early stages

Questions & Answers

What's on Your Mind?

To Learn More…

- Access A&D PLM Action Group resources at QR code shown here
  - Digital Twin-Digital Thread Use Case Catalog, Mar 2026
  - Digital Twin-Digital Thread Solution Evaluation Benchmark Report of Findings, Dec 2025
  - Model-Based Systems Engineering Research, report, Dec 2024
  - Digital Twin-Thread: Phase 4 – A&D Industry Digital Twin/ Thread Standards, position paper, Nov 2023
  - Digital Thread Collaborative Research, report, Aug 2023
  - Digital Twin-Thread: Phase 3 – Business Architecture Frameworks/Methodologies, position paper, Feb 2023
  - Digital Twin-Thread: Phase 2 – Problem, Objectives, Proposed Definitions, position paper, Jul 2022
- Access CIMdata resources at www.CIMdata.com
  - The What and Why of Digital Threads and Twins - A Report from the Field, webinar, Mar 2025
  - How to Build Out an Enterprise Digital Web, webinar, Mar 2024
  - Promise and Reality of the Digital Thread - Results of Industry Research, webinar, Mar 2023
  - Multi-view BOM Value Potential, webinar, Apr 2022
  - The Digital Thread is Really a Web, with the Engineering BoM at Its Center, webinar, Sep 2021

Thank You

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