Welcome to the INCOSE Webinar

16 September 2026 INCOSE Webinar #205

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Webinar205:

Accelerating Aerospace & Defense Transformation with PLE: Lessons from Lockheed Martin, Safran Seats & PTC

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The full recording and slide deck will be made available to all INCOSE members and CAB associates within 10-12 business days from the original air date in the INCOSE Library.

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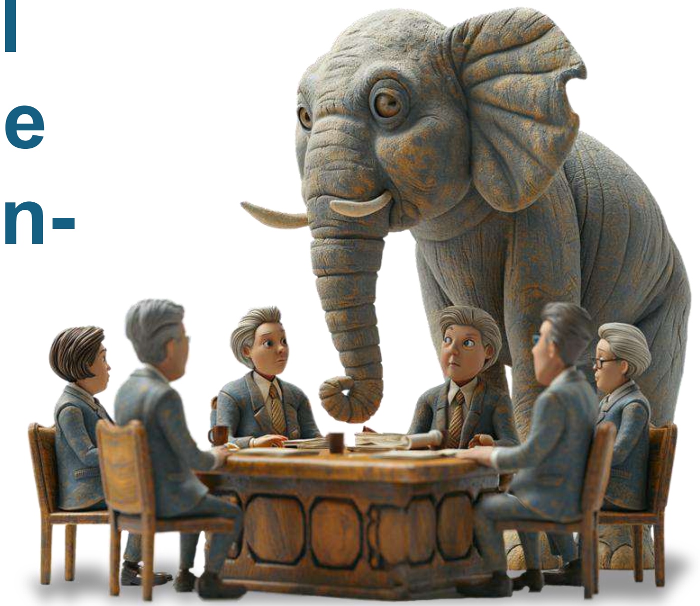
WHAT IS PRODUCT LINE ENGINEERING (PLE)?

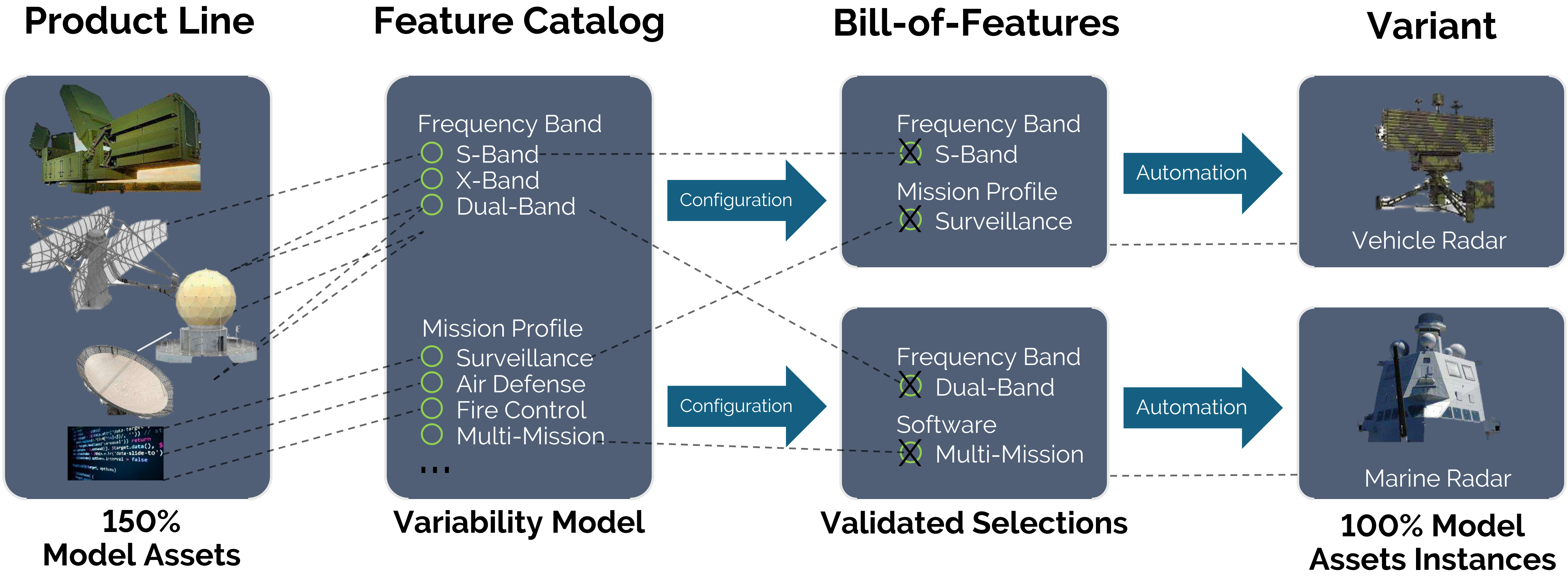
- Rephrased: When is Engineering considered to be Product Line Engineering

> **If organizations manage a family of systems and mission configurations as one digital engineering ecosystem, maximizing reuse while maintaining strict control of mission-specific variations.**



PLE ENABLES A SYSTEM DESIGN FOR MULTIPLE MISSIONS/PROGRAMS

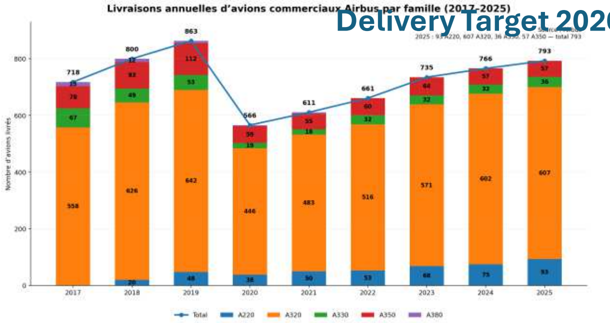
ISO 26580:2021



SAFRAN SEATS POV

Market Overview and Context

Delivery Target 2026 : ~870

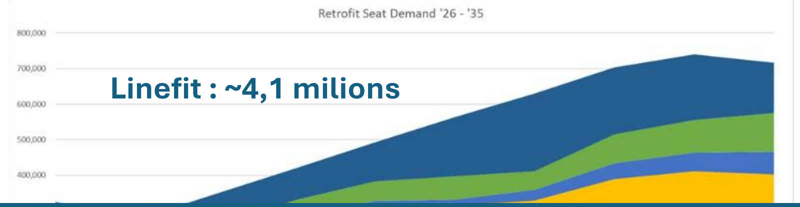


Source :
Flash conjoncture France - Les livraisons d'Airbus progressent en 2024 | Direction générale du Trésor
Airbus reports Full-Year (FY) 2025 results | Airbus
Airbus reports Half-Year (H1) 2026 results

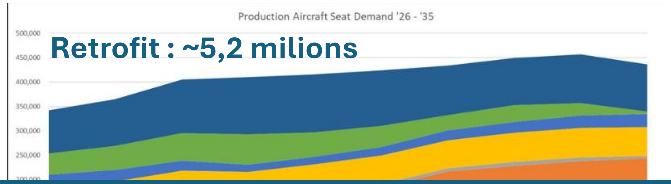
Source : Graphique: Les vols sans escale les plus longs au monde | Statista

Source : Chart: Global Air Passenger Traffic Expected To Grow by 5 Percent Annually | Statista

Linefit : ~4,1 milions



Retrofit : ~5,2 milions



New estimation gives 9.3 millions new seats over the next decade (+9% since 2025 estimation)

The market, encompassing Head of Version and Retrofit Aircraft, is expanding, with new technologies enabling novel aircraft applications that drive demand for innovative interior designs.

Source : IAC Interiors Forecast

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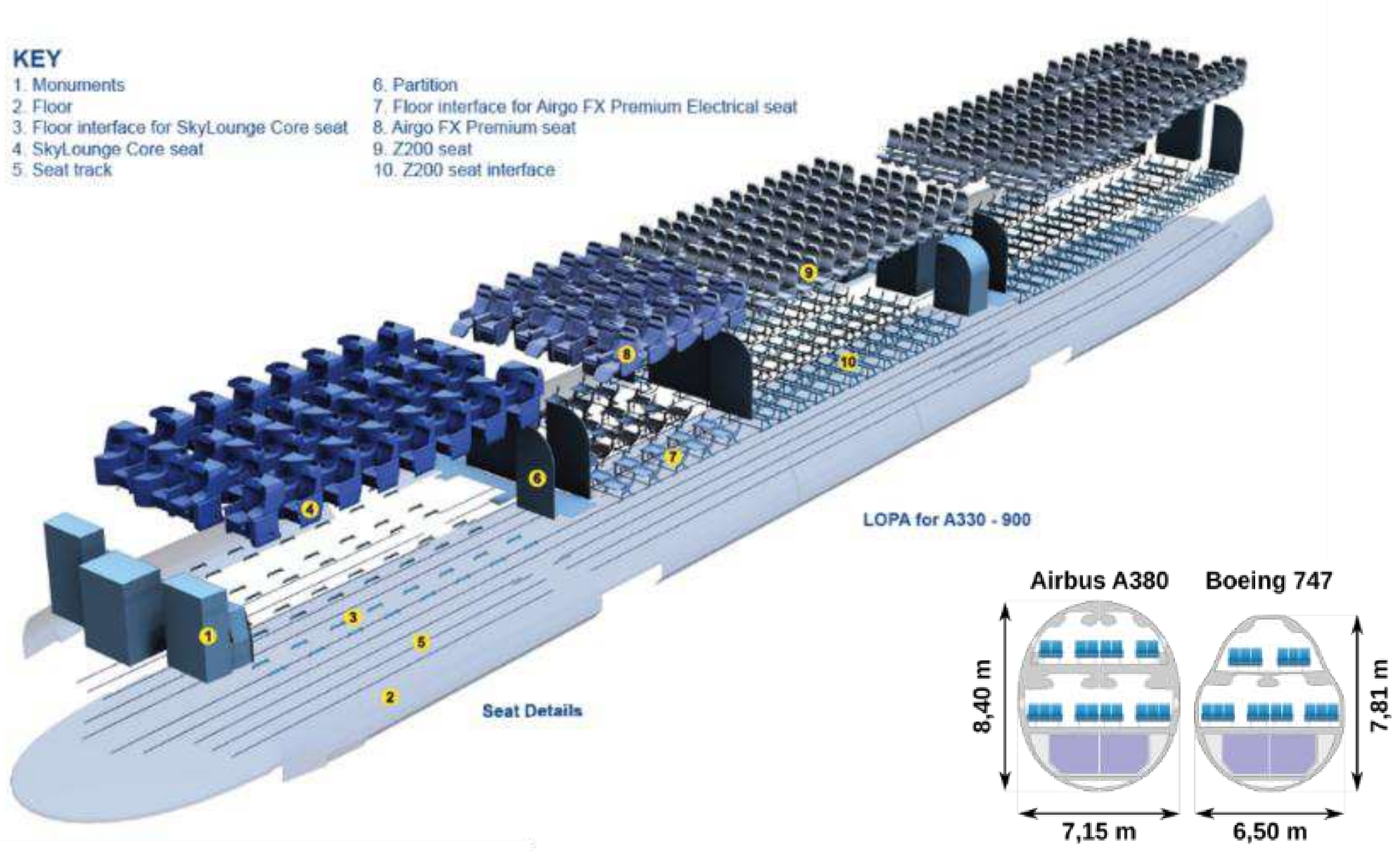
Aircraft interiors are a major factor that distinguishes airlines, serving as a reflection of the brand's identity.

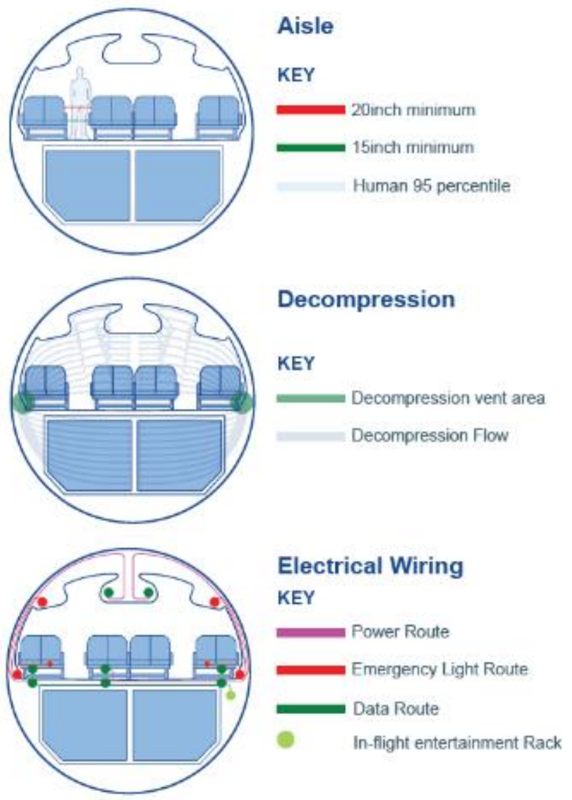





How the Layout of Passenger Accommodation (LOPA) is considered



Source : [Avion à fuselage large — Wikipédia]



Variability is influenced by both the type of aircraft and its integration.

Why PLE matters in the interiors contextes

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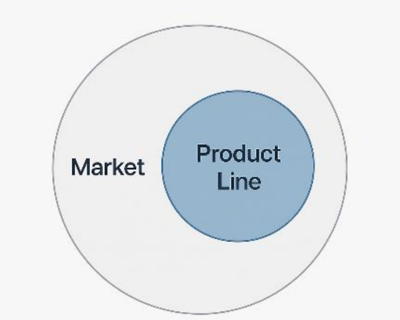
Principal Reasons

- Challenges in Seat Development
  - Repeated redesigns cause inefficiencies and high costs across engineering and supply chains.
- Shift to Function-Centric Design
  - Modularity focuses on reusable core passenger and system function modules instead of full seats.
- Strategic Importance
  - Modularity enables focus on innovation and differentiation while stabilizing proven solutions.



Some others Reason

- Propose flexibility, reusability and customization
- Simplify industrialization and logistic (optimize the assembling flow)
- Improve standardization and quality

Key success factor:

- Align all the organization of the same KPI for RC and NRC costs?

Attention Points

- Manage the loss of break even of the PLE in the early phase of the PLE (3 projects)

A successful product line should be tailored to a well-defined market segment to guarantee a favorable return on investment.

A universal product line that suits everyone remains an idealistic notion (PLE perimeter)

End-to-end Digital Transformation : from ALM to ERP for a optimize MLPE sizing

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Application Lifecycle Management (ALM)

- **Requirements**
- **Functions**
- **Usage scenarios**
- **Functional variants**

Product Lifecycle Management (PLM)

- **Components**
- **Engineering Bills of Materials (eBOMs)**
- **Manufacturing Bills of Materials (mBOMs)**
- **Physical configurations**
- **Standards and compliance**

Enterprise Resource Planning (ERP)

- **Production planning and scheduling**
- **Work Instructions and tools set up**
- **Procurement and supply chain management**
- **Inventory and logistics**

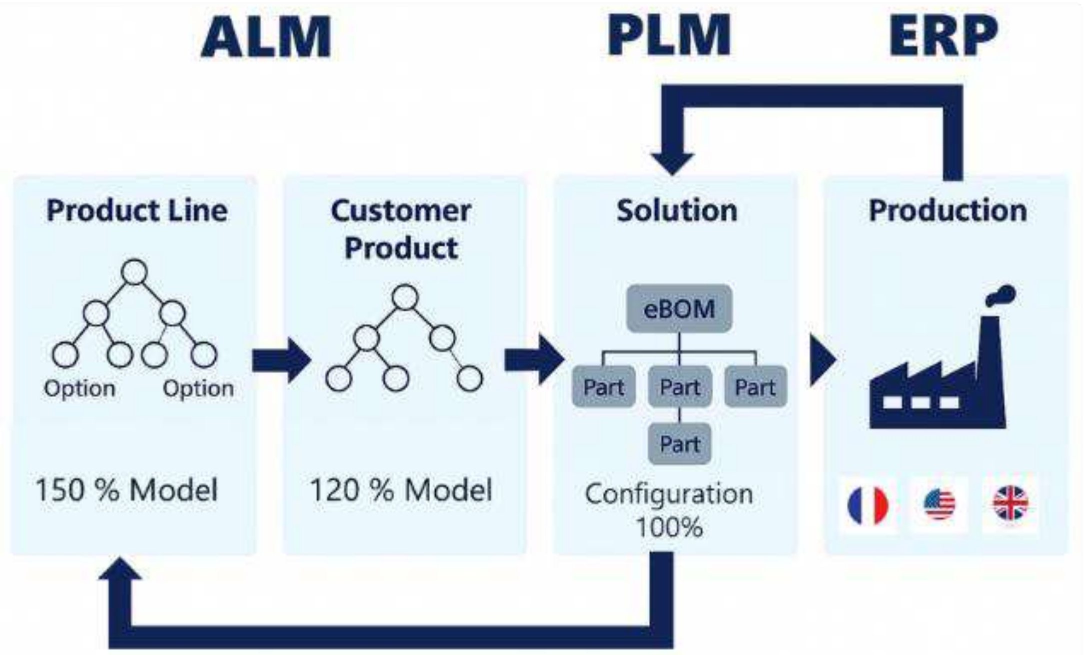
CATIA No Magic · pure variants · Jazz

SMARTEAM → windchill

infor M3

MBPLE

From theory to legacy world into SoS world



In a theoretical framework, the process flows from Requirement to Product Delivery

However, since the product often predates system engineering, the product line should be supplemented with legacy information.

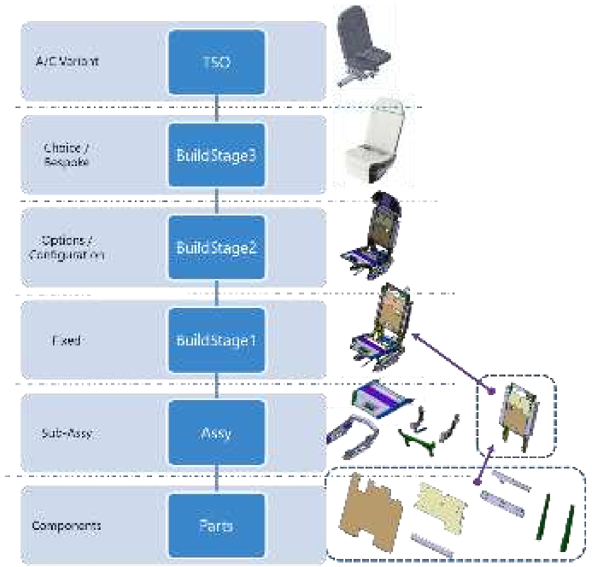
NEXT STEPS

PLM and ALM Integration (after in the presentation)

- ALM and PLM to share platform definition, logic and rules for variability

Skills Assessment and Enterprise Architecture

- Extension of the INCOSE Competency Framework for the product line with INCOSE PLE WG
- The automotive sector has widely embraced and implemented practices associated with the customize-to-order model.
- In contrast, instances of the engineering-to-order approach are relatively rare and generally confined to aerospace firms.
- We are interested in collaborating with INCOSE or a small team to develop engineering-to-order best practices.



Which is the good level of reuse in engineering-to-order processes

LOCKHEED MARTIN POV

LOCKHEED MARTIN BUSINESSES

Our corporation, headquartered in Bethesda, Maryland, is organized around our core business areas specializing in defense tech.

Aeronautics, with approximately $30.3 billion in 2025 sales which includes tactical aircraft, airlift, sustainment and aeronautical research and development lines of business.

Missiles and Fire Control, with approximately $14.4 billion in 2025 sales, which includes innovative and competitive integrated air and missile defense, strike, precision fires, air superiority and close combat weapon systems.

Rotary and Mission Systems, with approximately $17.3 billion in 2025 sales, which includes Sikorsky helicopters, maritime systems, sensors, radar systems, command and control, combat simulation and training, undersea systems and full-spectrum cyber capabilities.

Space, with approximately $13 billion in 2025 sales, which includes development of national security, civil, commercial and weather spacecraft, strategic and missile defense solutions and hypersonics missions.

"THE PROBLEM" - CURRENT STATE

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Large enterprise, Business Areas

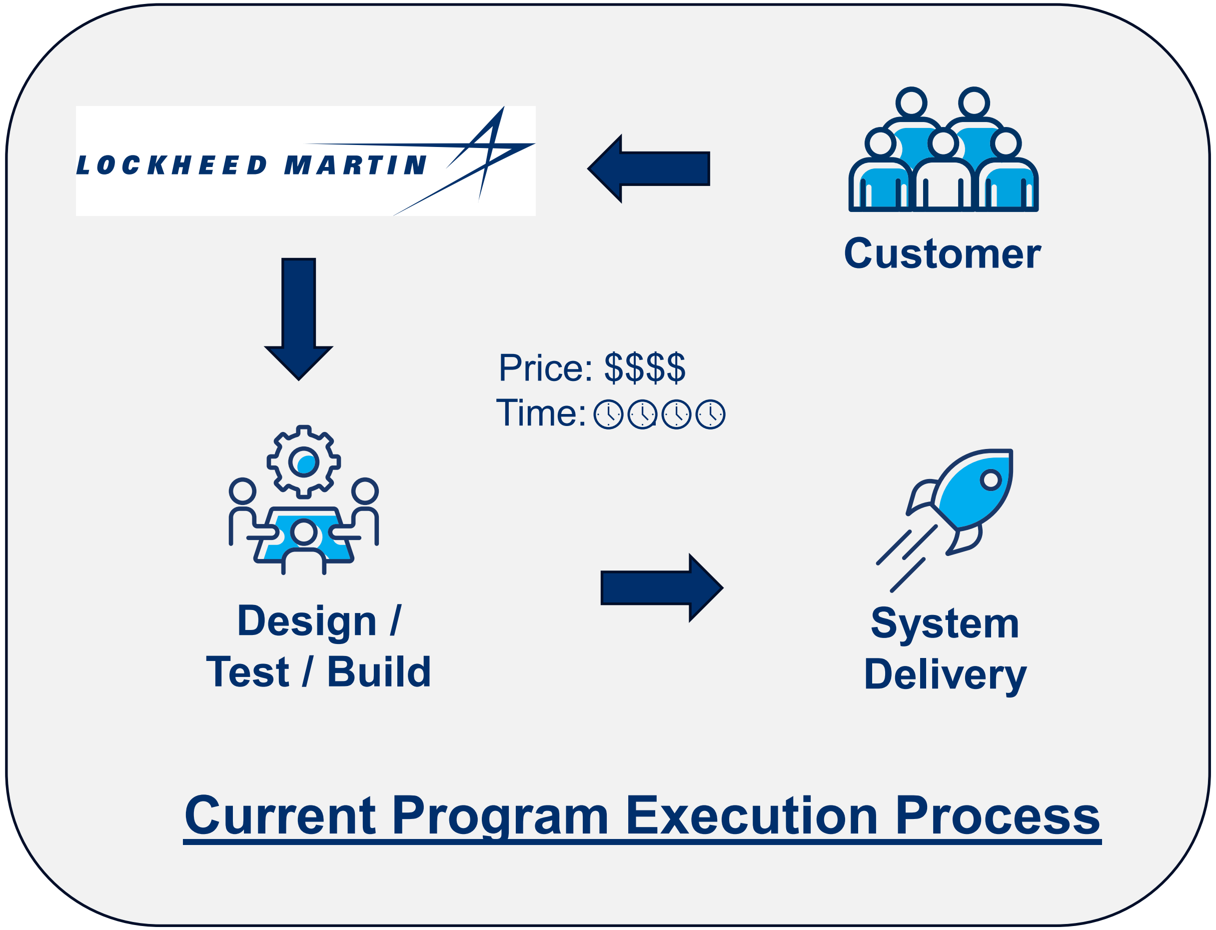
- Many programs within a Business Area

Current Approach

- Program centric
- Customer centric
- "Clone and own"

Customer Needs

- Increased volume
- Decreased cost
- Faster delivery
- Custom, made-to-order solutions



How do we change our approach to more effectively meet customer needs?

PLE Strategy

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1 Strategic Vision

- Establish top-down support
- Establish policy alignment (MBSE, Concurrent Engineering, Digital Threads, etc.)

2 Methodology Setup

- Establish:
  - Processes
  - Governance
  - Organization functions (R&Rs)

3 Infrastructure Setup

- Establish:
  - Tools
  - Networks
  - Capabilities

4 Product Line Identification

- Perform domain analysis & identify market opportunities
- Define product line scope
- Define value proposition

5 "First Movers" / Pilot Implementation

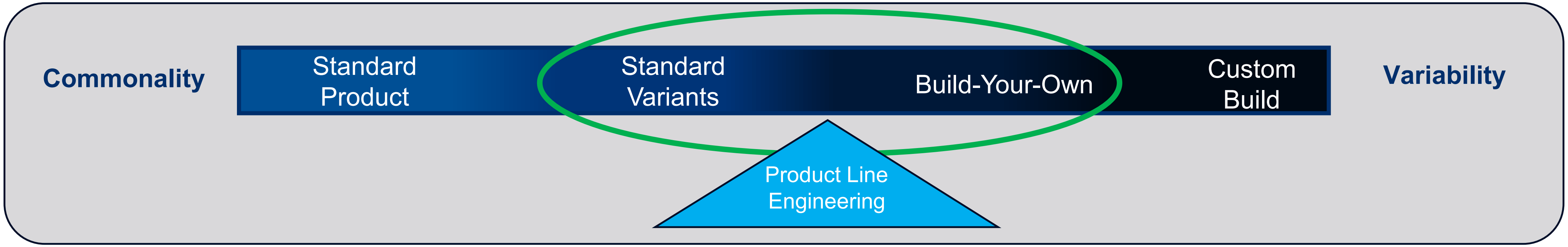
- Prove value with representative use cases
- Drive towards a "mission focused" approach

6 Institutionalize & Scale

- Formalize governance
- Expand adoption
- Expand offerings

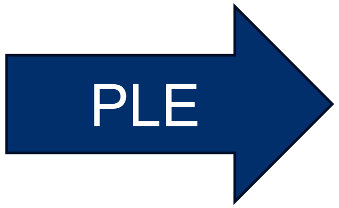
Lockheed Martin recommends a phased PLE Strategy that continuously evolves/adapts.

Turning Complexity into Competitive Advantage



The Complexity

- PLE complexity
  - Many different variants
  - Many different assets
  - Many different programs / BA
  - Many different customers / missions
  - Standards, Compliance
  - Rapid technology changes
- Customer needs complexity



Competitive Advantage

- PLE Strategy
  - Centralize & systemically capture knowledge / artifacts
  - Improve speed, cost, quality, adaptability, flexibility
- **Measurable PLE Savings**
  - Combat system: 53% cost avoidance for requirement changes
  - Radar program: 33% reduction in product labor cost
  - Satellite proposal: configuration time savings, weeks → hours

(cited from 2019 internal Lockheed Martin White Paper)

PLE empowers teams to deliver diverse, high-performance systems faster and with greater confidence.

PTC POV

THE REUSE PITFALL: WHEN THE LAW OF INTENDED CONSEGUENCES IS AROUND THE CORNER

Tailored MBSE with Low Reuse of the Model

Although MBSE introduces libraries, patterns, and reusable components, most implementations remain focused on a single development effort and clone-and-own. The result is improved engineering rigor, but limited reuse across the enterprise.

PLE-Focused Reuse of Realized BOMs

Organizations often attempt to reuse finished designs, products, and BOMs rather than reusable engineering knowledge. By the time a system is realized, program-specific decisions and IP constraints have already limited its reuse potential.

Breaks the Digital Thread between Models. The MBSE Silo!

Reuse approaches are often limited to a single engineering domain.

Models, requirements, software, and product data evolve in separate silos.

Valuable engineering knowledge is transferred between tools but rarely reused as an end-to-end digital asset.

PLE: A REAL-LIFE EXAMPLE OF BUSINESS CLASS SEATS

STARTING FROM PROTOTYPING*

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- Prototype seat used for **Hardware-in-the-Loop simulation**
- Variants: **Fully Simulated**, **Physical Prototype** and **Hybrid Prototype**
- Represents actuation, control, instrumentation
- Used as **demonstrator** for **variability propagation**
- Reduced variability, but **fully representative**

*This example is based on a real-world Safran Seats use case and has been adapted to illustrate the broader digital engineering workflow, including PTC enhancements such as the Codebeamer integration.

PLE & APPLICATION LIFECYCLE MANAGEMENT

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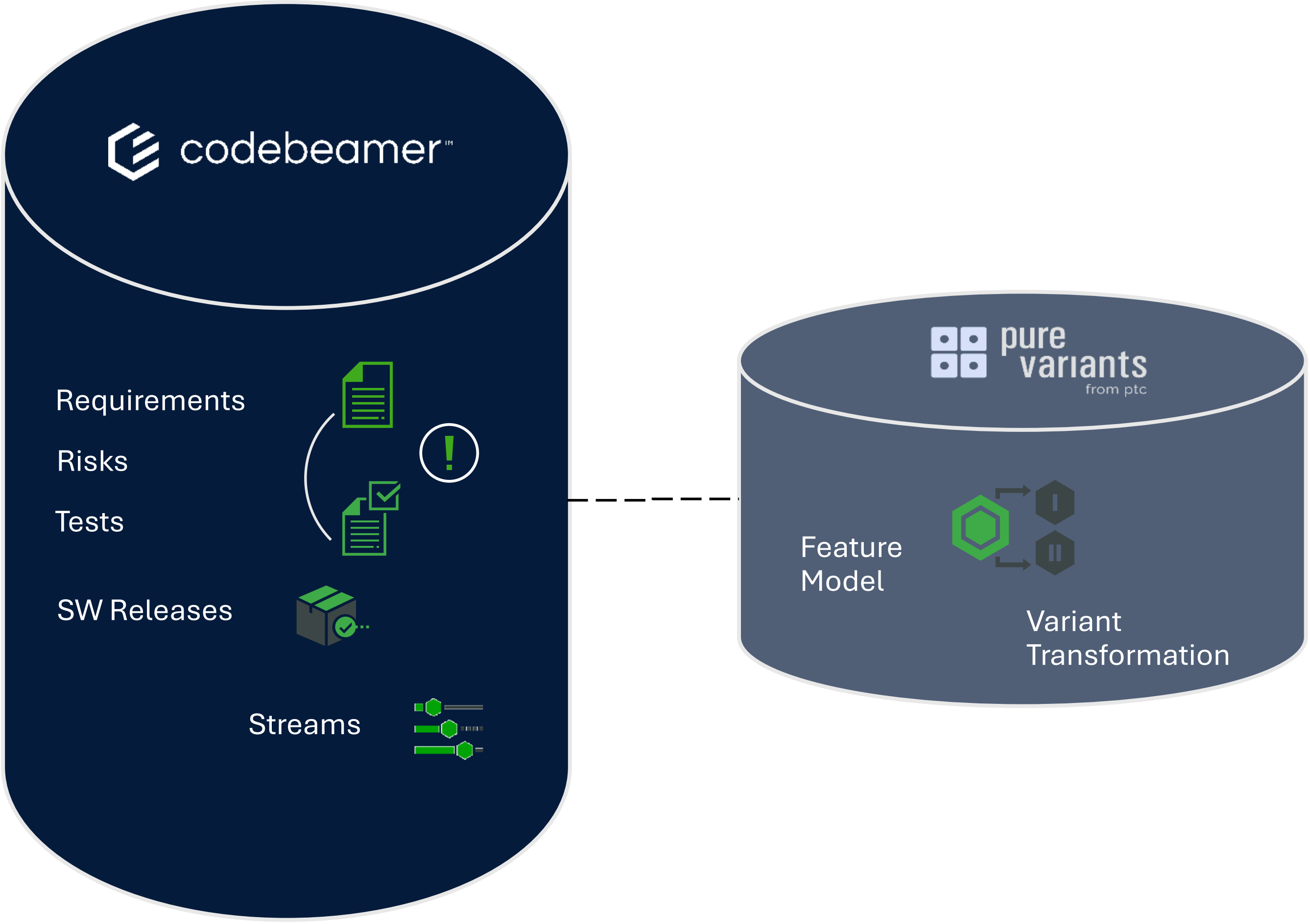


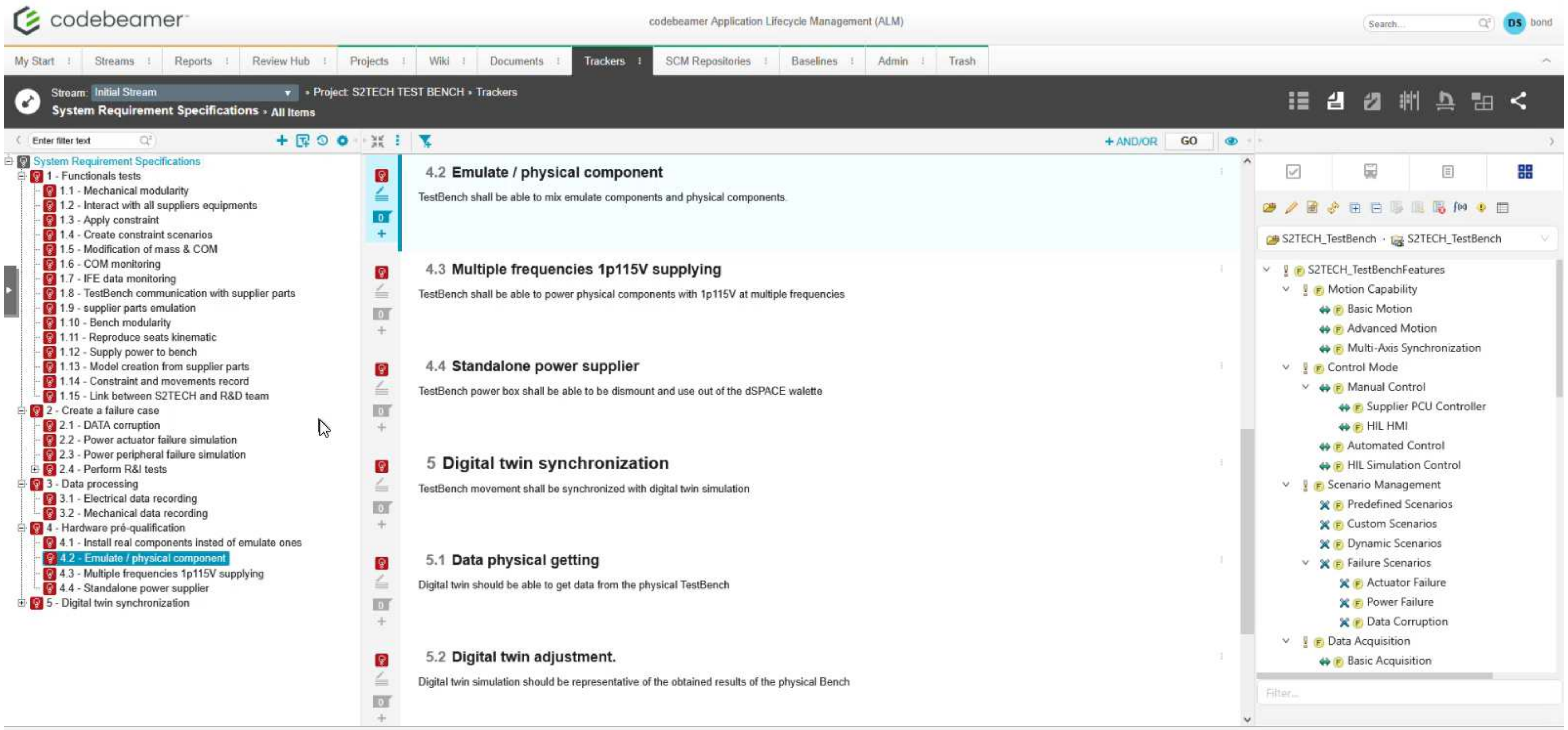
CODEBEAMER

- **ALM platform** built for complex **product development**
- End-to-end **traceability** across **requirements**, **risk**, **test**, and release management
- **Flexible templates** accelerate compliance and streamline audits.

PURE VARIANTS

- **PLE solution** that manages complexity across **product variants**
- **Systematic reuse** of **requirements** and **test cases** across your product family
- **Automated** and **traceable**
- **Centralized** variability and asset control

PLE & APPLICATION LIFECYCLE MANAGEMENT



PLE & MODEL-BASED SYSTEMS ENGINEERING

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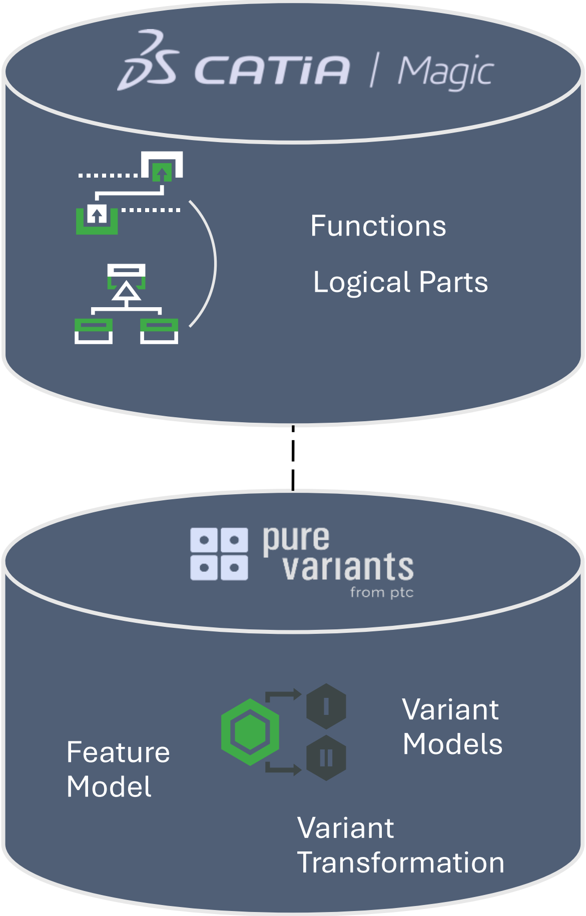


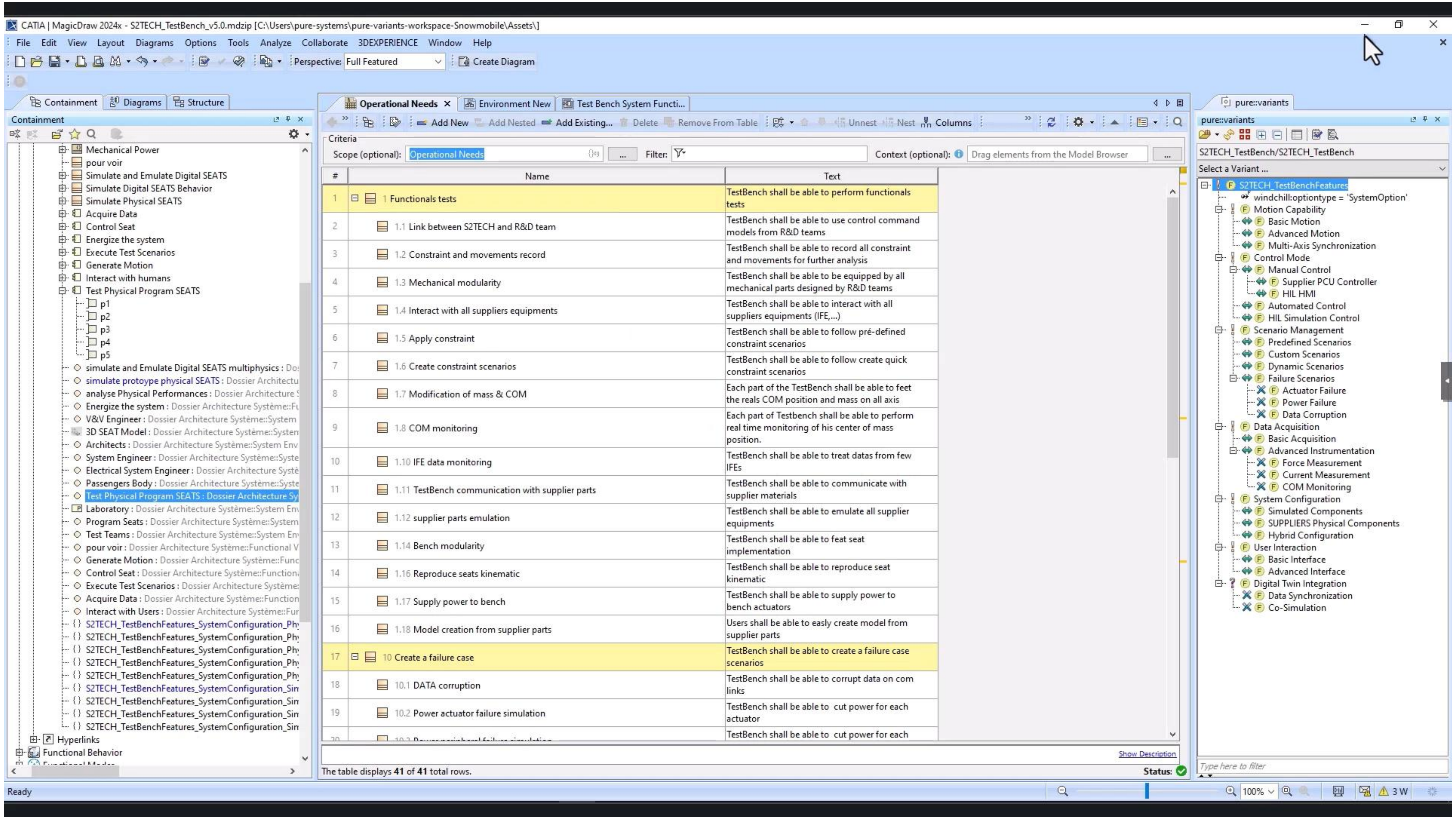
CATIA MAGIC

- **MBSE Solution** built for complex **product development**
- **Multiple projects** enable architecture **composability**
- **Model Collaboration, Traceability and Model Execution** as enablers of Complex Systems Development

PURE VARIANTS

- **PLE solution** that manages complexity across **product variants**
- **Systematic reuse** of **system models** across your product family
- **Automated** and **traceable**
- **Centralized** variability and asset control

PLE & MODEL-BASED SYSTEMS ENGINEERING



PLE & PRODUCT LIFECYCLE MANAGEMENT

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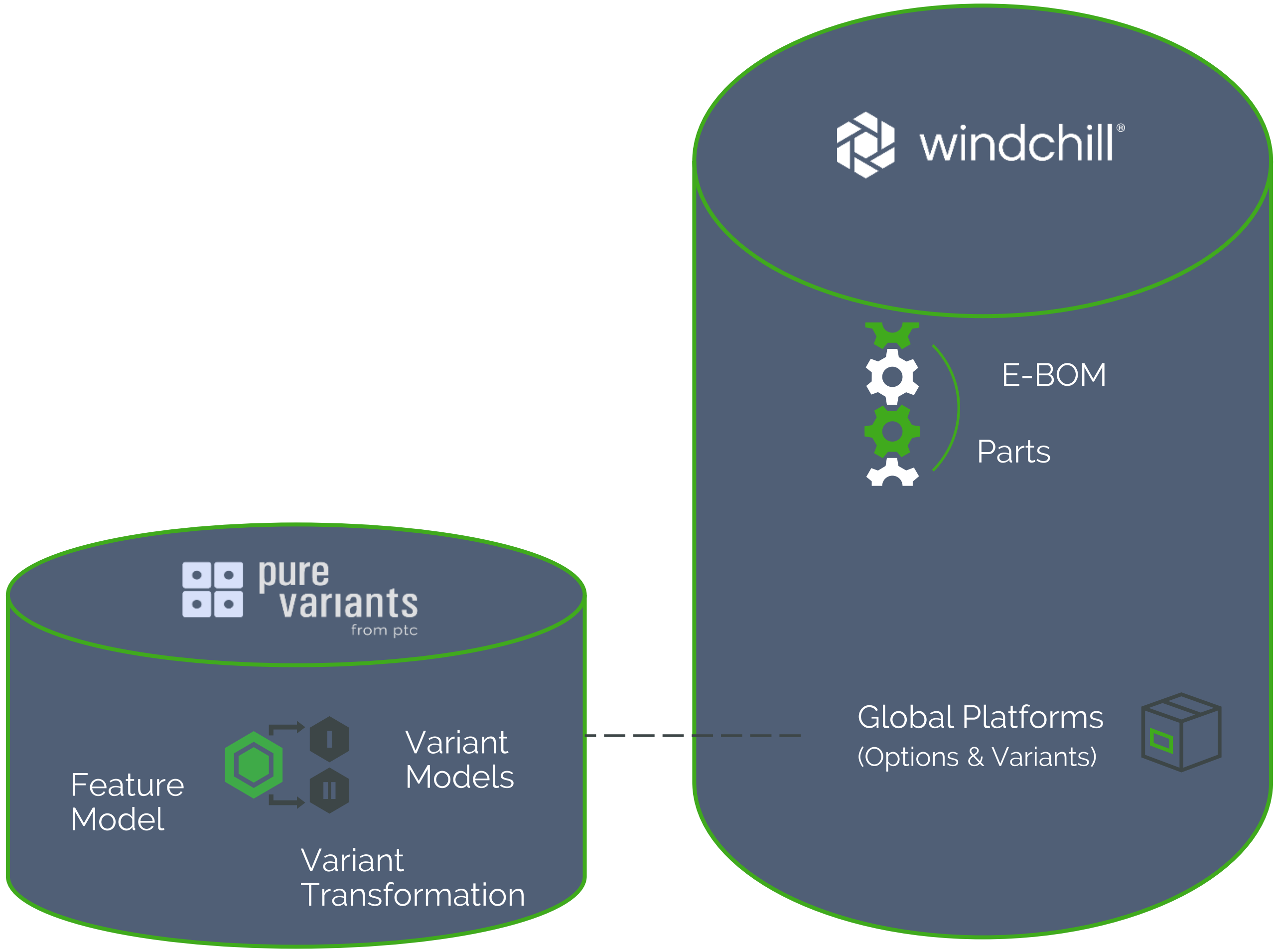
WINDCHILL

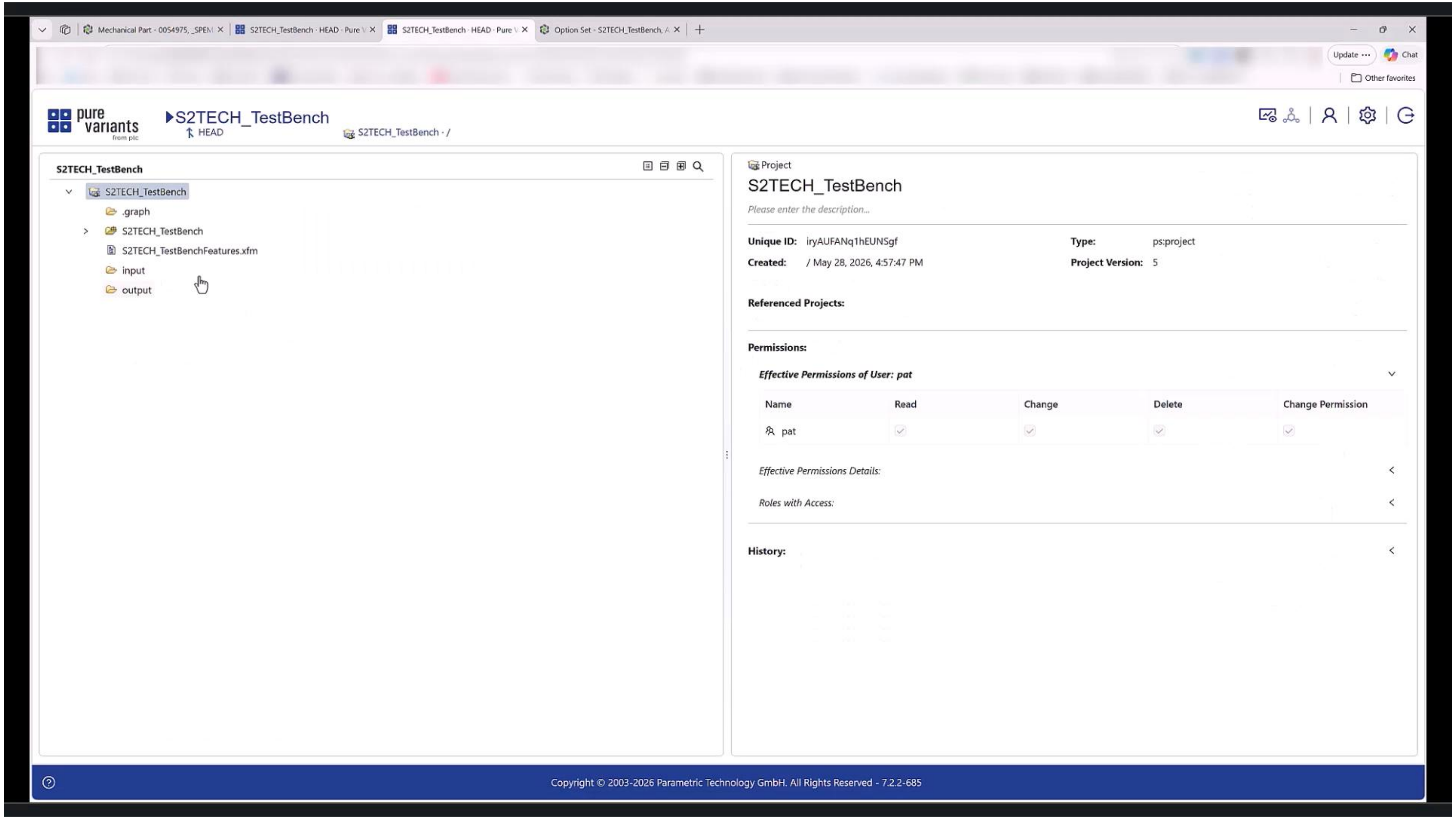
- **Enterprise PLM platform** for managing product data across the lifecycle
- **Configuration and change management**
- **Digital threads** across requirements, designs, BOMs, software, and manufacturing data

PURE VARIANTS

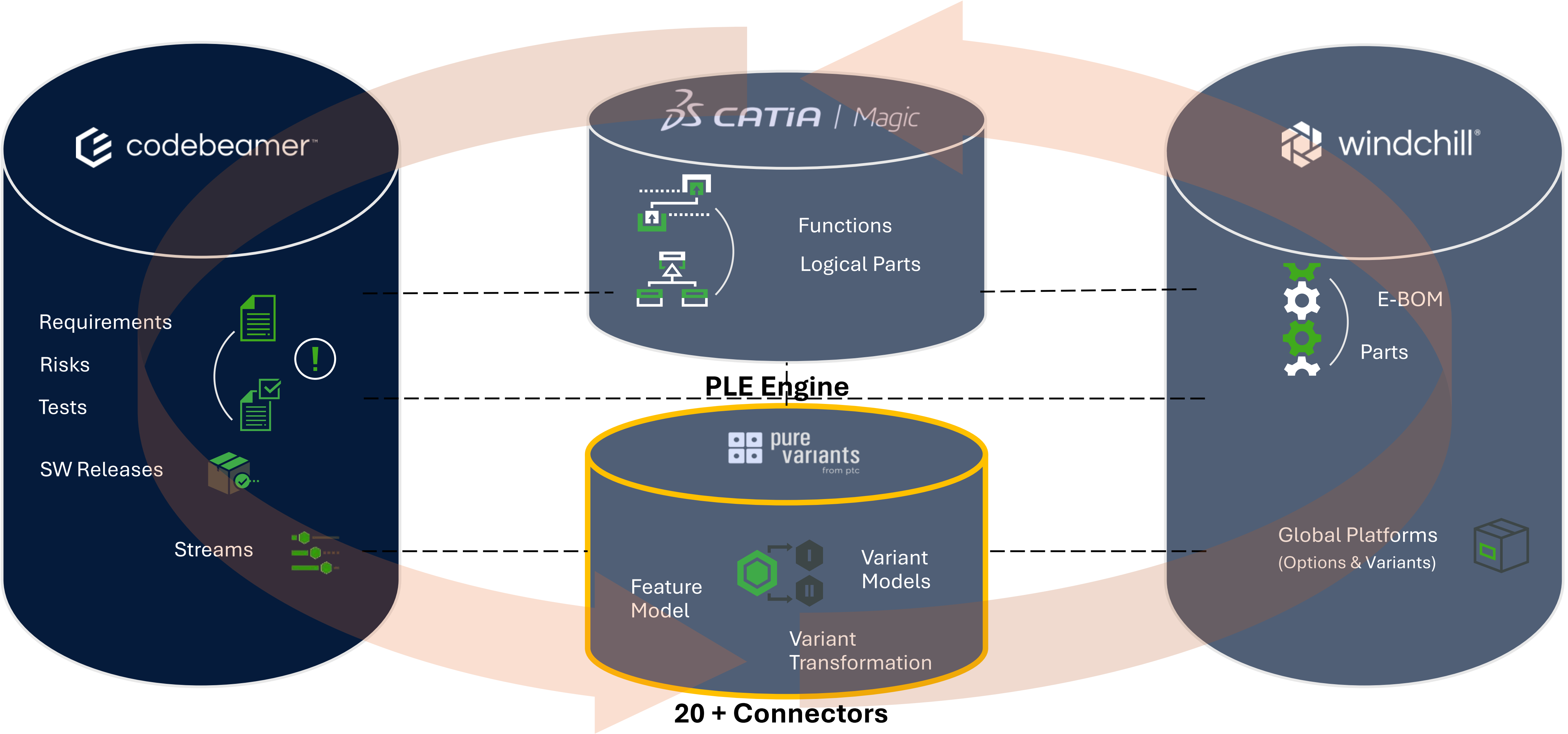
- **PLE solution** that manages complexity across **product variants**
- **Systematic reuse** of **BOM** assets across your product family
- **Automated** and **traceable**
- **Centralized** variability and asset control



PLE & PRODUCT LIFECYCLE MANAGEMENT



END-TO-END PRODUCT LINE ENGINEERING: BREAKING THE SILOS



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Q & A

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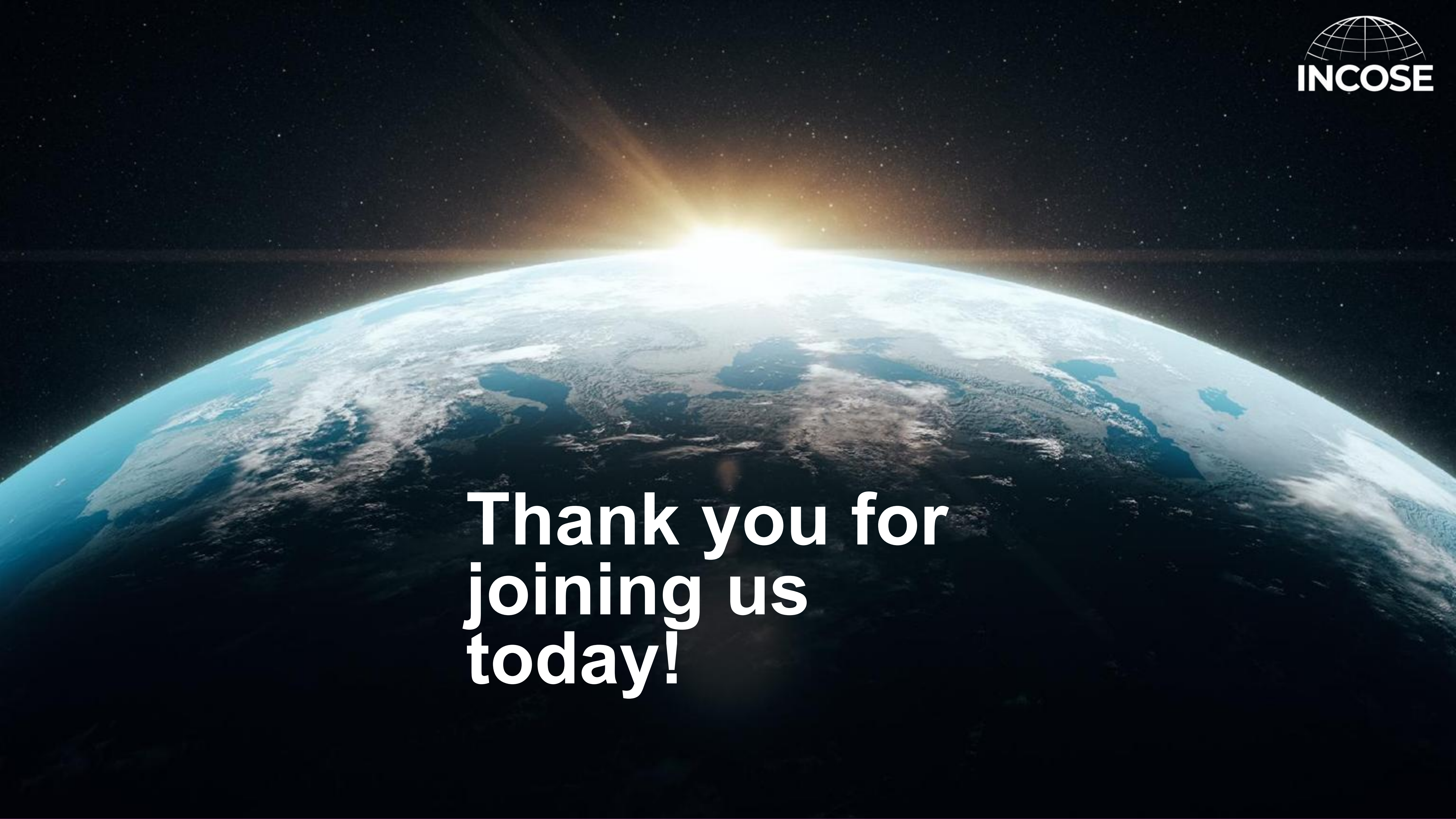

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