

Digitalization, Model-based x, PLM and the Product Innovation Platform: Where do we go from here?

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Our Mission...

Strategic management consulting for competitive advantage in global markets

CIMdata is the leading independent global strategic management consulting and research authority focused exclusively on the PLM market.

We are dedicated to maximizing our clients' ability to design and deliver innovative products and services through the application of PLM.

Digitalization: Transforming Enterprises

Digitalization requires rethinking the business, product, and data (1 of 2)

- Radical advances in digitalization are underway all around us
 - An obvious example is the intelligent, connected thermostats that mind our homes when we're away
- Digitalization itself as been defined in many ways, but the most succinct is the business strategy best geared to extract real-world value from digital data
- The Internet of Things (IoT) with its billions of connected devices is and will play a major role
 - A source of "big data" and enabling closed loop lifecycle management
 - Making the digital thread and digital twin more achievable



Digitalization: Transforming Enterprises



One cannot escape the on coming data tsunami (2 of 2)

- Driven by the phenomenon of Big Data, information management as we know it is being re-engineered top to bottom
- Big Data threatens to overwhelm long-established workflows and processes and make them obsolete
 - This is especially true in the less computerized segments of the lifecycle such as marketing, regulatory compliance, and field service



New Products Bring More Complexity & Risk

Innovation will require a Simulation-Driven Systems Engineering approach

- Significant electronics & software content 
- New processes & materials- lighter, stronger, green
- Consumers demand “mass customized” products with all the latest technological features... **Now!**
- Shorter lifecycles = continuous product innovation
- “IoT” environment = constant market feedback 

Complex market requirements demand more upfront cross-domain engineering



IoT: Models used from ideation to consumption

Digital Twins- Billions of devices interconnected 24x7x365....coming very soon



Defense Systems Have Unique Requirements

Reliability & Sustainability require a Model-Based Systems Engineering approach

- Must design, build and operate “systems of systems”
- Shrinking DoD R&D & procurement budgets
- Rapidly changing threats & operational requirements
- Rapidly changing electronics & S/W technologies
- Extremely long lifecycles requiring continuous system & subsystem upgrades (LOTAR)
- Cyber security threats to sensitive IP

DoD Digital Thread/Digital Twin Definition

The thread that binds...the product and systems world

- Digital Thread is the creation and use of a digital surrogate of a system to allow dynamic, real-time assessment of the system's current and future capabilities to inform decisions
- The digital surrogate(digital twin) is a physics-based description of the system resulting from the generation, management, and application of data, models, and information from authoritative sources across the system's lifecycle

Digital thread is enabled and supported by a robust systems model and MBE processes

Extracted from: https://www.dodmantech.com/ManTechPrograms/Files/AirForce/Cleared_DT_for_Website.pdf

Also see: <http://www.manufacturing-operations-management.com/manufacturing/2016/04/what-is-the-digital-thread-and-digital-twin-definition.html>

Model-Based Engineering Definition

Model-based Systems Definition, Design, Development, Manufacturing, In Service

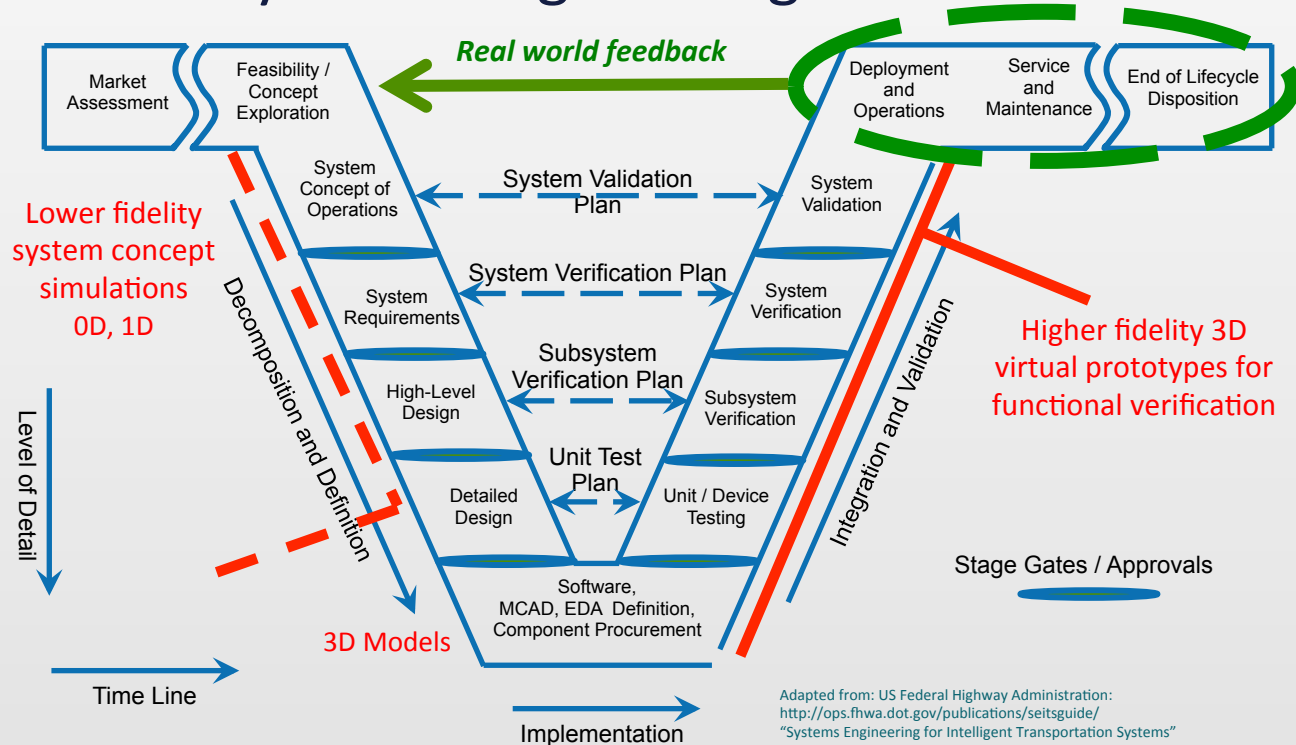
- Processes, data, and tools that support developing, controlling, and maintaining the **digital** definition of products
 - Systems of systems, systems, subsystems, related equipment, spares
 - *Model-based because the digital model (often just 3D CAD today) becomes the master instead of a derivative of the model such as drawings & documents*
- MBE supports the use & re-use of everything: requirements, systems architecture models (from 0D to 3D); 3D design with embedded PMI; manufacturing & in service data as required
 - Supporting collaboration with suppliers, customers and owners to facilitate construction, manufacturing, certification, acceptance, MRO & other activities
 - Across the full life of the product—from concept to retirement
- MBE complements & supports systems engineering by providing high-value data across lifecycle processes

MBE Enables Systems Engineering

MBE provides high-value knowledge continuity across lifecycle processes

- Model-Based Engineering is a systems development paradigm
- MBE supports the application of modeling principles and best practices that enable true systems engineering

- The digital model is key to enable collaboration across domains and data re-use through the system's life



What Companies Are Doing Today

The MBE journey is still at its beginnings—successes are scattered (1 of 2)

- Aerospace and automotive have 20+ years of PLM experience
 - MBE is supported as part of PLM strategies (Maturity levels growing)
 - Boeing, Airbus, Gulfstream, GM, Ford...
 - CIMdata's A&D PLM Action Group actively researching what is needed to fully define PMI (manufacturing data such as GD&T embedded in models)—many unresolved issues
- Aerospace (Gulfstream & Boeing) proactive in getting FAA to accept electronic signoff and flight certification (Maturing)
 - Now use electronic TDPs—including approvals and signoffs
 - Gulfstream very advanced
 - MBE basis for their FAA certification
 - Using embedded PMI with 3D directly to factory
 - Boeing demonstrates massive use of 3D for 777 (mostly 3D) and 787 (all 3D)

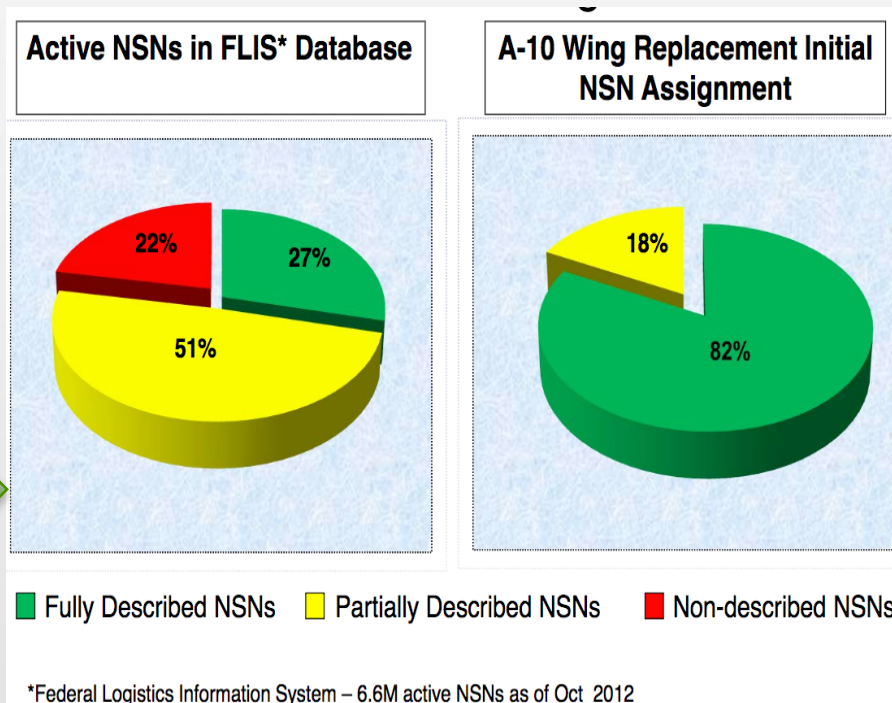
What Companies Are Doing Today

The MBE journey is still at its beginnings—successes are scattered (2 of 2)

- DLA (Defense Logistics), NAVAIR, Army and others working on MBE-based TDPs (Still relatively low maturity levels)
 - Standardize the acquisition and sustainment of TDPs
 - Provide work force with the tools, training, infrastructure, and processes required to be successful
 - Army prototyping a 3D TDP for gun barrel (with Army Materiel Command)
 - U.S. Army & Boeing A-10 wing replacement

A-10 Wing Replacement Metrics—Results of Using Model Data Vs. Paper Drawings

- Significant reduction in NSN errors and missing information
- Elimination of non-described NSNs



*Federal Logistics Information System – 6.6M active NSNs as of Oct 2012

NSN = National Stock Number

Source: http://www.nist.gov/el/msid/upload/D1_2_Norton-DLA-A-10-Overview-DLA-MBE-Engagement.pdf

MBE Implementation Issues

Missing strategies & capabilities

- MBE focus today is often limited to developing & managing electronic work packages (3D viewable data + some PMI) for downstream manufacturing and in-service use
- MBE too often is not supported by an enterprise product innovation platform strategy and related IT environment
 - Lack of a single (logical), consistent product data repository across the lifecycle and across domains (i.e., hw/sw/electrical multi-BOM in PLM speak)
 - Typically see huge number of disconnected and inconsistent data repositories
 - Inefficient and costly data duplication, master model difficult to find (if it can be identified at all); Systems models disconnected from design BOMs
 - Strategies for long term data support are not in place (i.,e., LOTAR)
- Organizations and people are not well prepared (educated, trained) to adopt a systems-driven MBE approach

The Emergence of the Digital Platform

Platformization, the next evolution of PLM, required to support digitalization

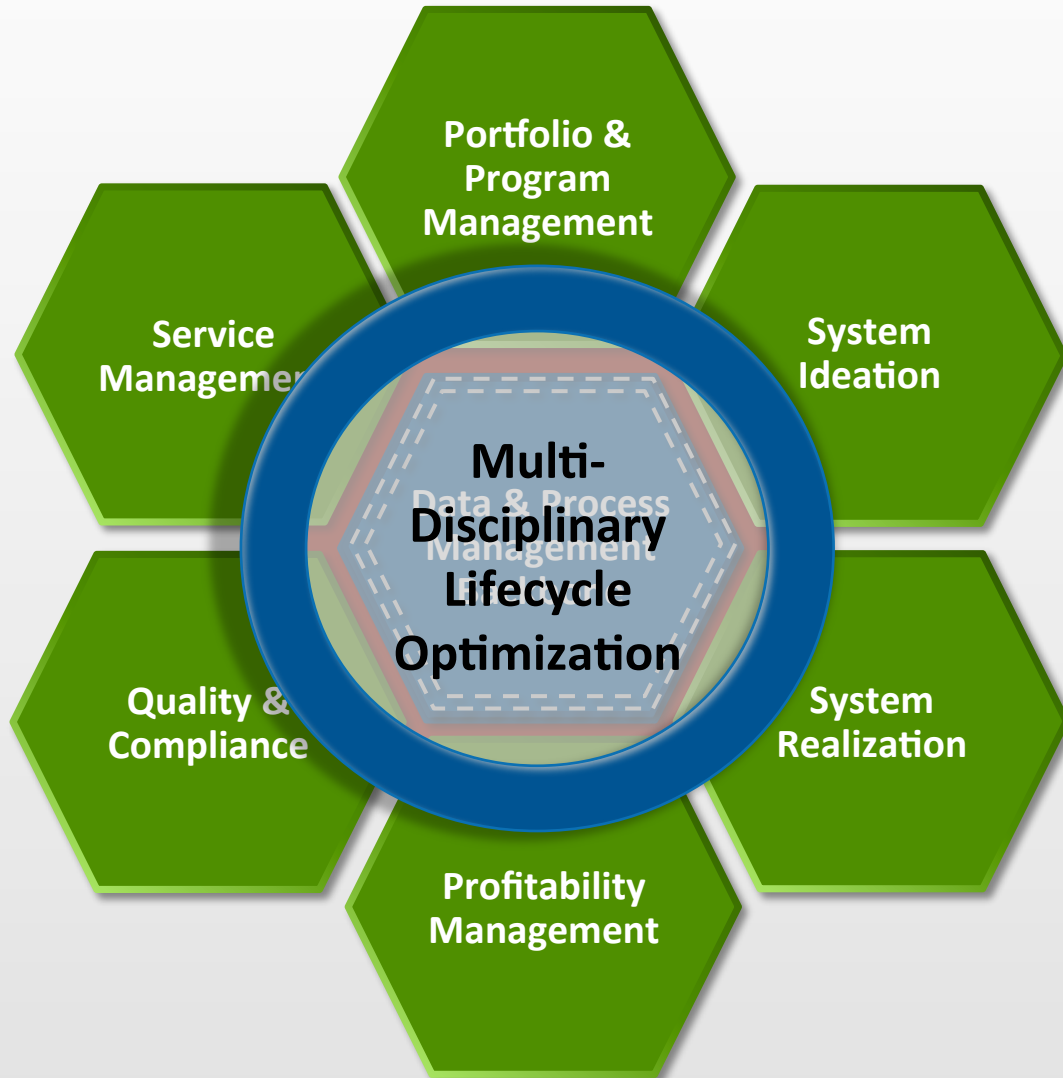
*Proliferating digital platforms
will be at the heart of
tomorrow's economy,
and even government...*



The Economist, January 18th, 2014

CIMdata's Product Innovation Platform Model

A key element of the Digital Enterprise Innovation Model



*A set of evolving
Functional Domains
orchestrated by an
enterprise level “systems
of systems” approach*



PLM: The Required End-to-End Connectivity

PLM touches all phases of a product's life—digitalization demands it

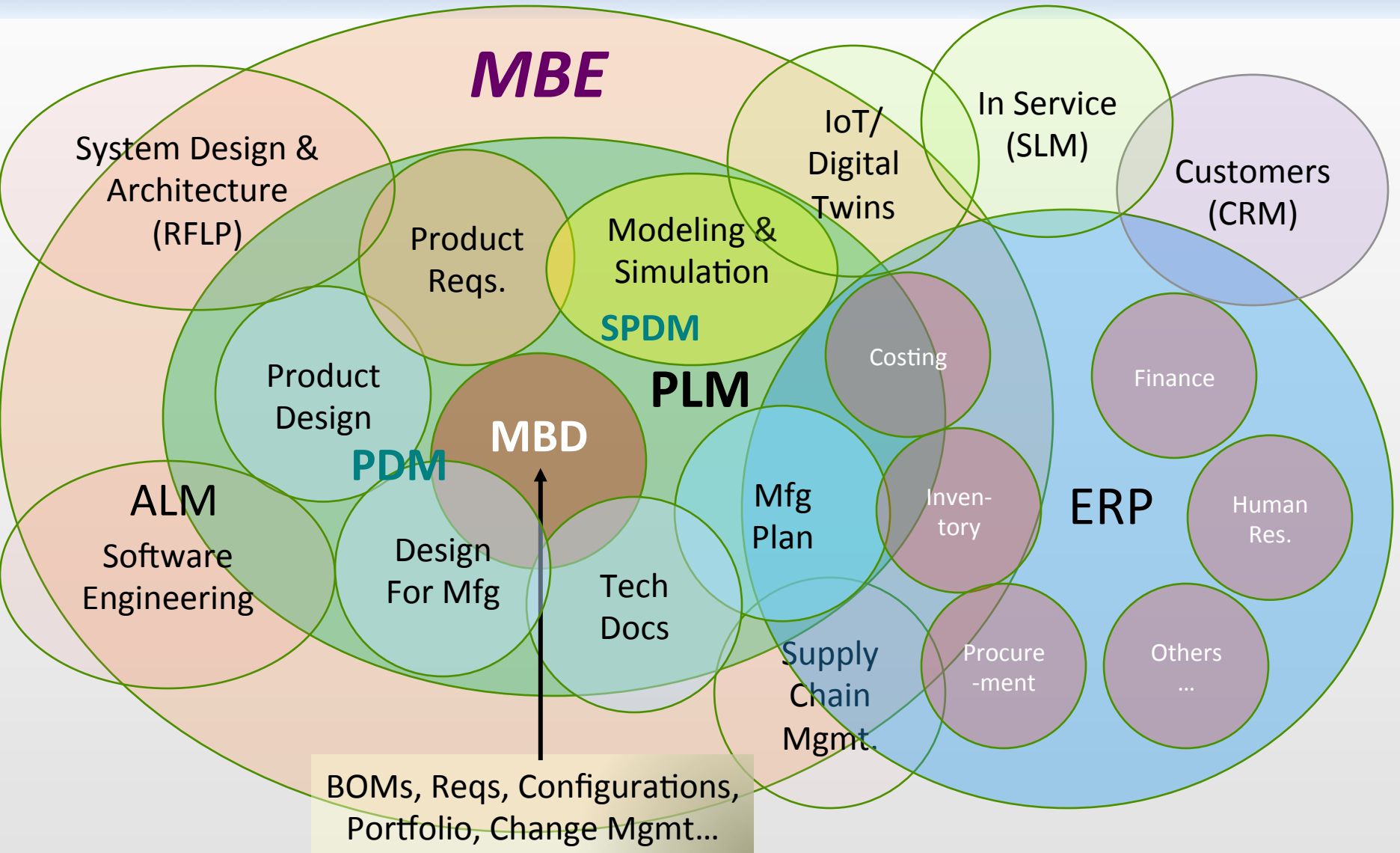


PLM Solutions—Information Management across Media, Process, Time, Geography, & Enterprise



Relationship of Model-Based Initiatives to PLM

MBSE, MBD & PLM support all domains involved in Model-Based Engineering (MBE)



MBSE Implementation Issues

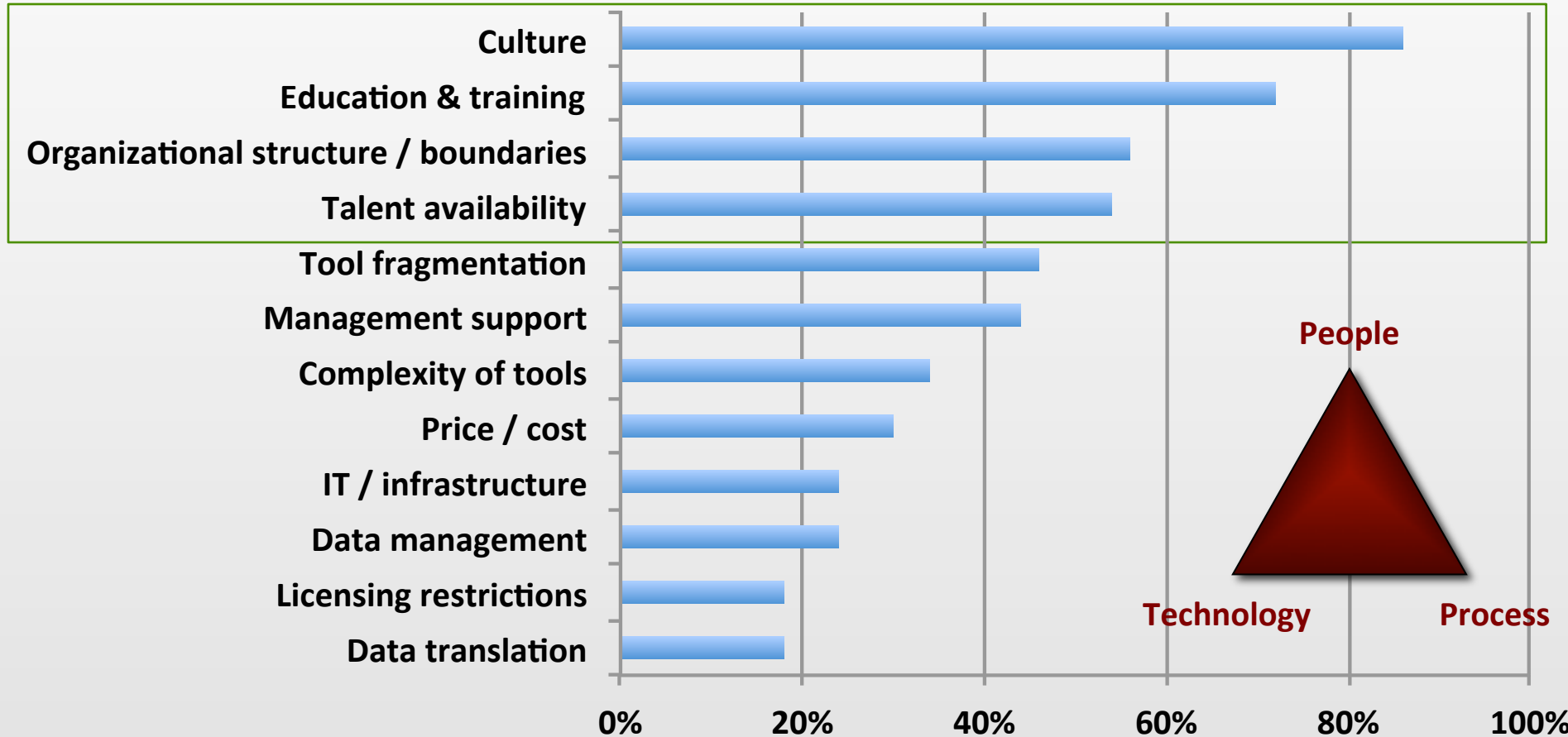
Barriers to more widespread adoption

- In practice, the ‘system models’ used in model-based SE today do not readily support **knowledge sharing and collaboration across domains**, especially for globally distributed product/project teams
- **System requirements definition and functional flow-down** to key sub-systems & components providing design traceability to performance verification and validation is extremely lacking or sometimes even non-existent today
- **Data management with version and configuration control** is a major issue—virtually non-existent today at the conceptual stage
- **Data exchange & interoperability** across engineering functional domains, tools & applications is very difficult—but promising standards are emerging (FMI, OSLC, AP2xx , SysML2, MoSSEC, etc.)

Barriers To Industry Implementation

What people cited as problems to overcome in adopting & using MBE/MBSE

- It is about people & process—not just technology



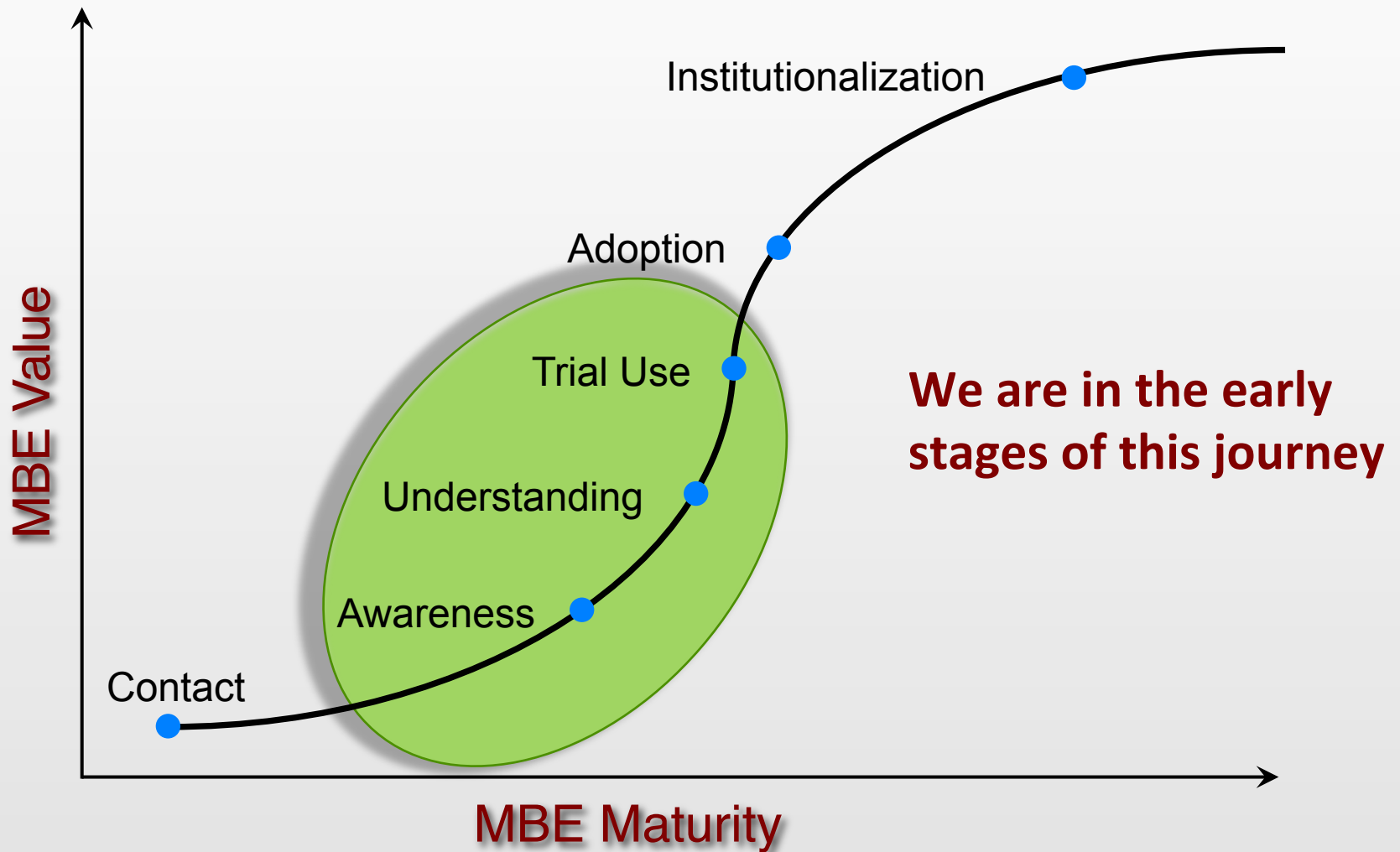
Lessons Learned- Key Factors for MBE Success

Driving the strategy to realization

- MBE needs to be developed and supported in the context of an enterprise “platform of platforms” solution but.....
- *Implemented and promoted based on specific MBE business use case success and measurable ROI* **Crawl....Walk.....Run!**
 - Define and pilot well-defined MBE processes in specific business focus areas—
Must account for cultural change and the people buy-in/training required
- OEMs need to understand what they are asking suppliers to do—the paradigm shift, benefits, and issues of MBE
- Industry & DoD need to support new contractual concepts *AND* accept electronic project deliverables/signoffs—TDPs

MBE Value Comes Over Time

It takes time, commitment, and change



Final Thoughts

Digitalization, MBE, PLM and Product Innovation Platform: What does it all mean?

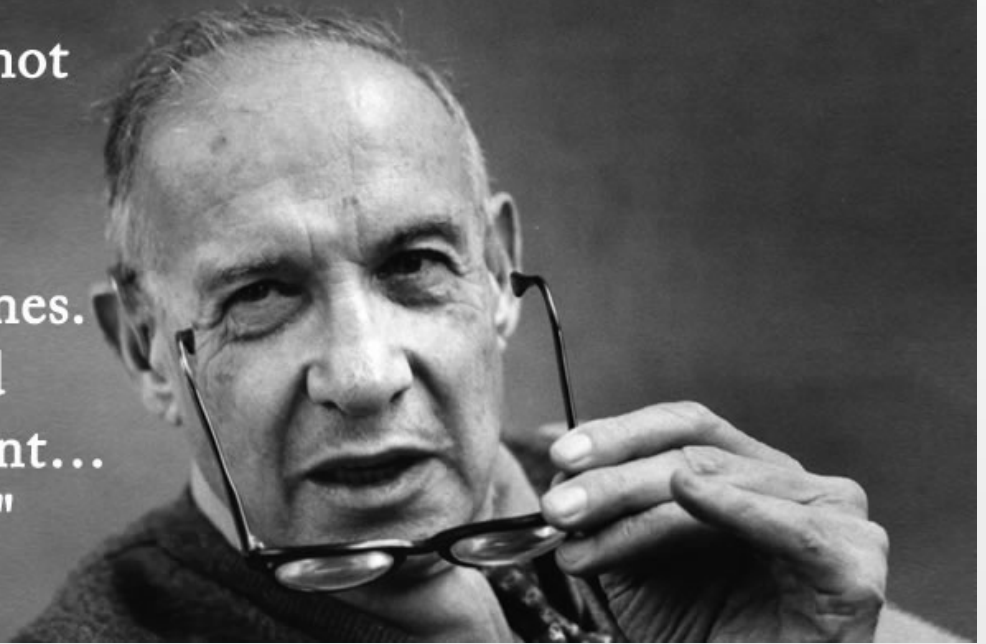
- The emergence of the product innovation platform concept has the potential to not only enable the end-to-end digitalization required to be successful, but to *thrive*
- Need to continually rethink PLM/MBE/MBSE to enable our ability to design and deliver innovative products and services
 - Business models (e.g., the digital enterprise, IoT, etc.), platform strategies, solution/services offerings, delivery & pricing models... all may have to change
- The march of technology, digitalization included, is widely recognized as both unstoppable and incomprehensible
- ***It's not about what we call it; It's about delivering value to customers and all other stakeholders of the enterprise***

“Digitalization” accelerates change & innovation

"The enterprise that does not
innovate

inevitably ages and declines.
And in a period of rapid
change such as the present...
the decline will be fast."

-Peter F. Drucker



“Digitalization is the main reason just over half of the companies in the Fortune 500 have disappeared from the list since 2000.”

Pierre Nanterme, CEO Accenture, World Economic Forum





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