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MBSE, PLM and the Digital Thread: Business Opportunities & Challenges

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Digitalization: Transforming Enterprises

Digitalization requires rethinking the business, product, and data

- Radical advances in digitalization are underway all around us
- 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 (e.g., Airbnb, Amazon, etc.)
- The Internet of Things (IoT) with its billions of connected devices is now and will play a major role in the future
  - A source of "big data" and enabling closed loop lifecycle management
  - Making the digital thread and digital twin more achievable

Complexity = Risk, Digitalization = Opportunity

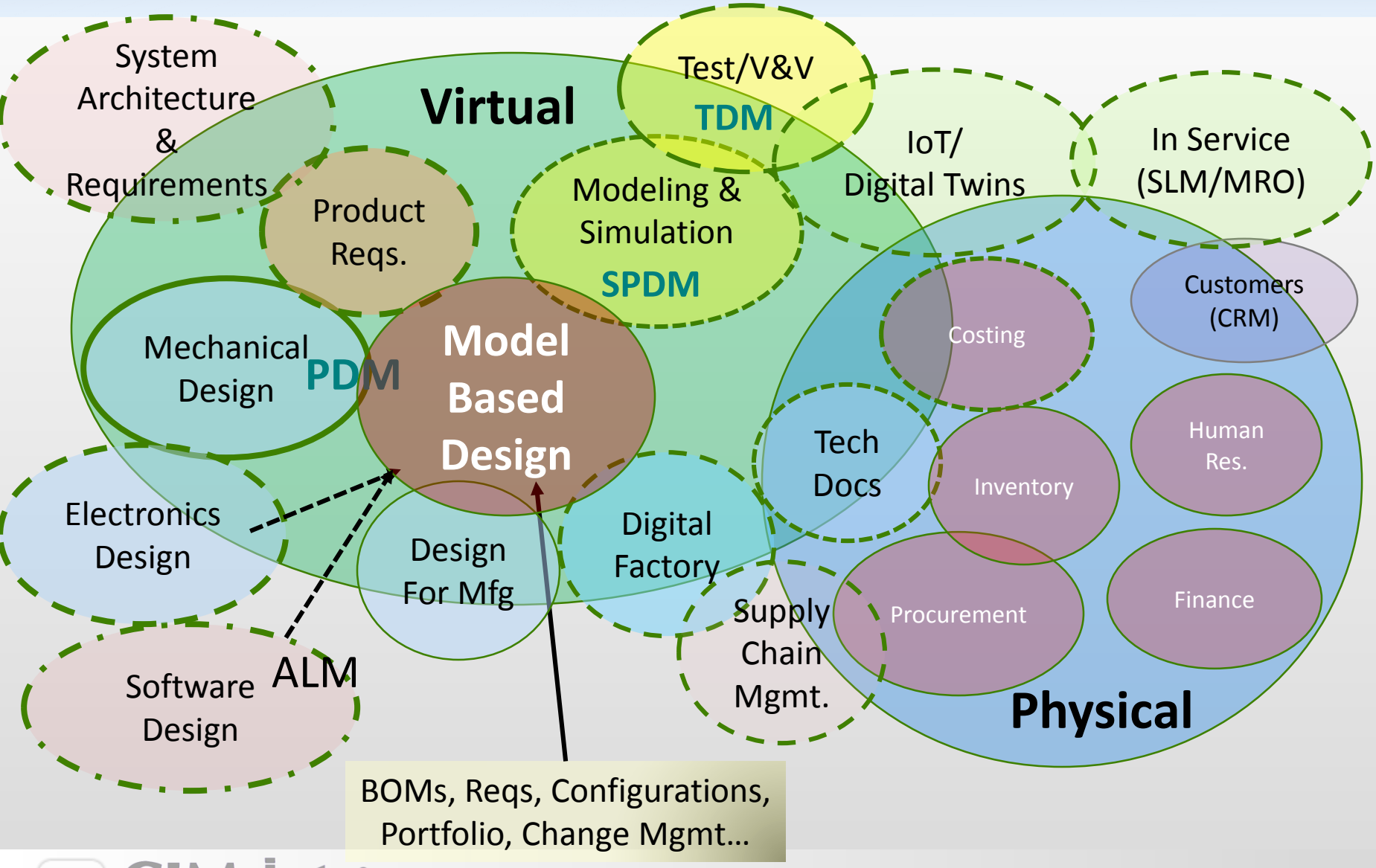
Business Success now requires a Model-Based Engineering approach

- Cyber-physical systems- Electronics & software growing
- New mfg processes & materials—lighter, stronger, green
- Increased regulatory requirements across all industries
- Consumers demand “mass customized” products… Now!
- Shorter lifecycles = continuous product innovation
- Yet extremely long systems lifecycles in select industries
- “Industrial IoT” environment = constant market feedback

Complex market requirements demand more upfront cross-domain engineering

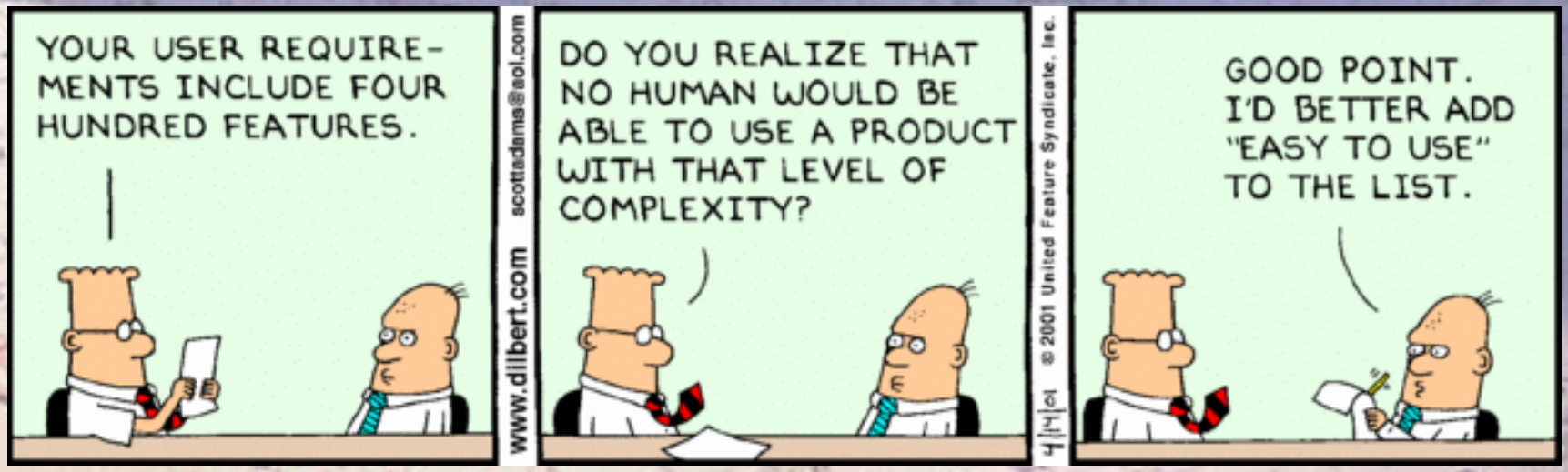
Status of Digitalization Initiatives ("As Is")

Key domains in model-based are typically managed partially or totally in silos today



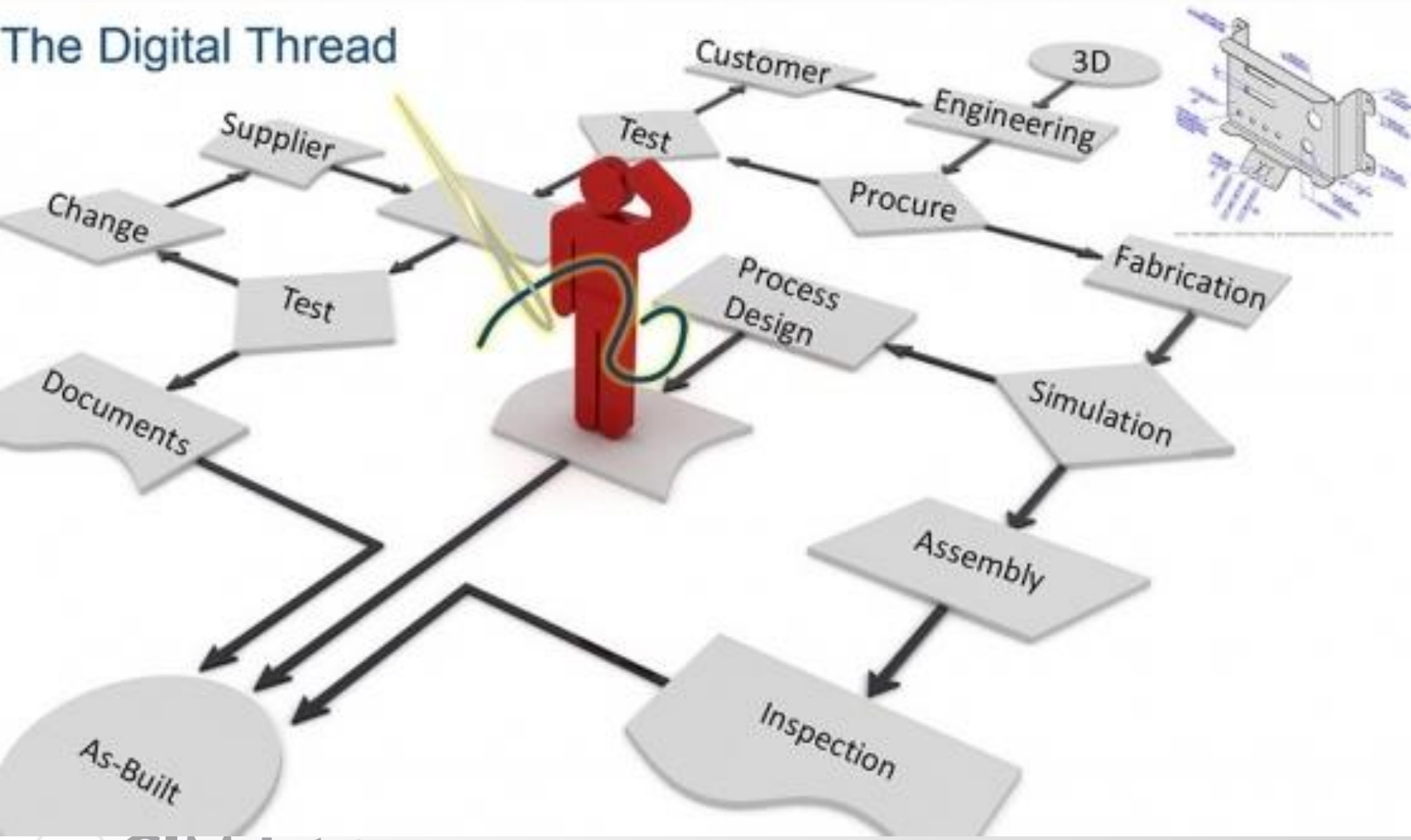
Is there really a master model?

Often competing requirements and digital data distributed across domains



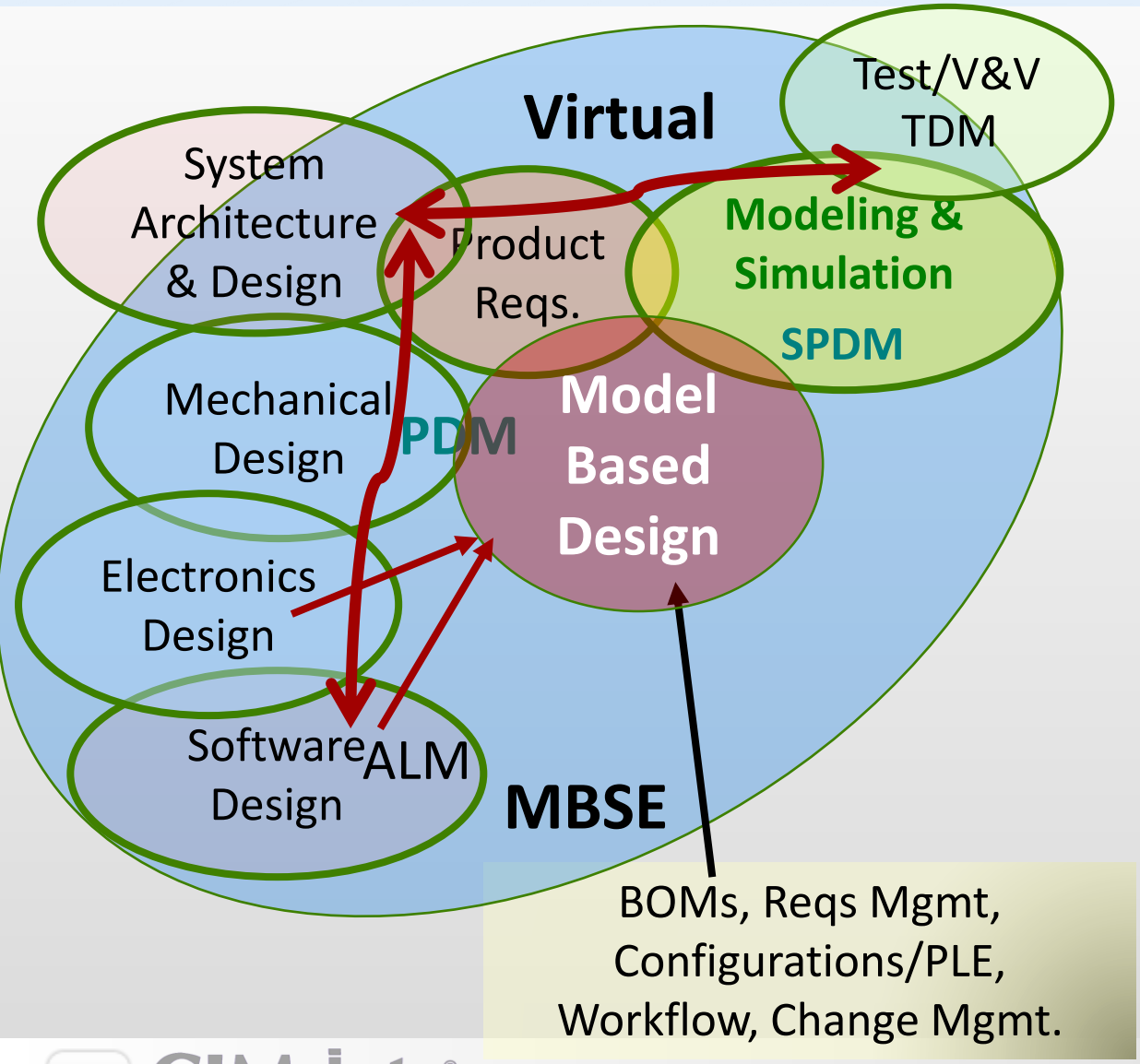
Which models are most critical to connect in meeting the overall design requirements and with lifecycle traceability? …some…all…?

“Sewing the Digital Thread”



Sewing the MBSE Digital Thread ("To Be")

Conceptual Systems Engineering across domain silos; Iterative & agile processes



MBSE Use Case:
Conceptual Design, Optimization and Validation Of Cyber-Physical Systems

The MBSE thread needs to connect information across:

* Systems Architecture & Requirements
* Software/ALM
* EDA/ECAD/EBOM
* MDA/MCAD/PDM
* M&S/CAE/SPDM
* Test/V&V/TDM

Enabling the Digital Thread Vision for MBSE

What is needed to address the industry's business needs?

MBSE solutions will ultimately require a combination of:

1) ***Process change*** leveraging MBSE best practices across industry leaders
   - This element of success is vastly underrated and may be more important as any below

2) ***Common ontology, semantics & languages*** for systems architecture design
   - *AP 2xx Unified Architecture, UML/SysML, UPDM/UAF, AADL, OWL, ST4SE, others?*

3) ***Innovation platforms & software tools*** for PLM/MBSE/M&S integration
   - Across engineering domains- mechanical, electrical, software, chemical, etc.
   - Across the product lifecycle- Requirements, System architecture design and V&V, detailed design, simulation and validation, manufacturing, IoT/in-service operations
   - Across the global enterprise including OEM/Design Chain collaboration

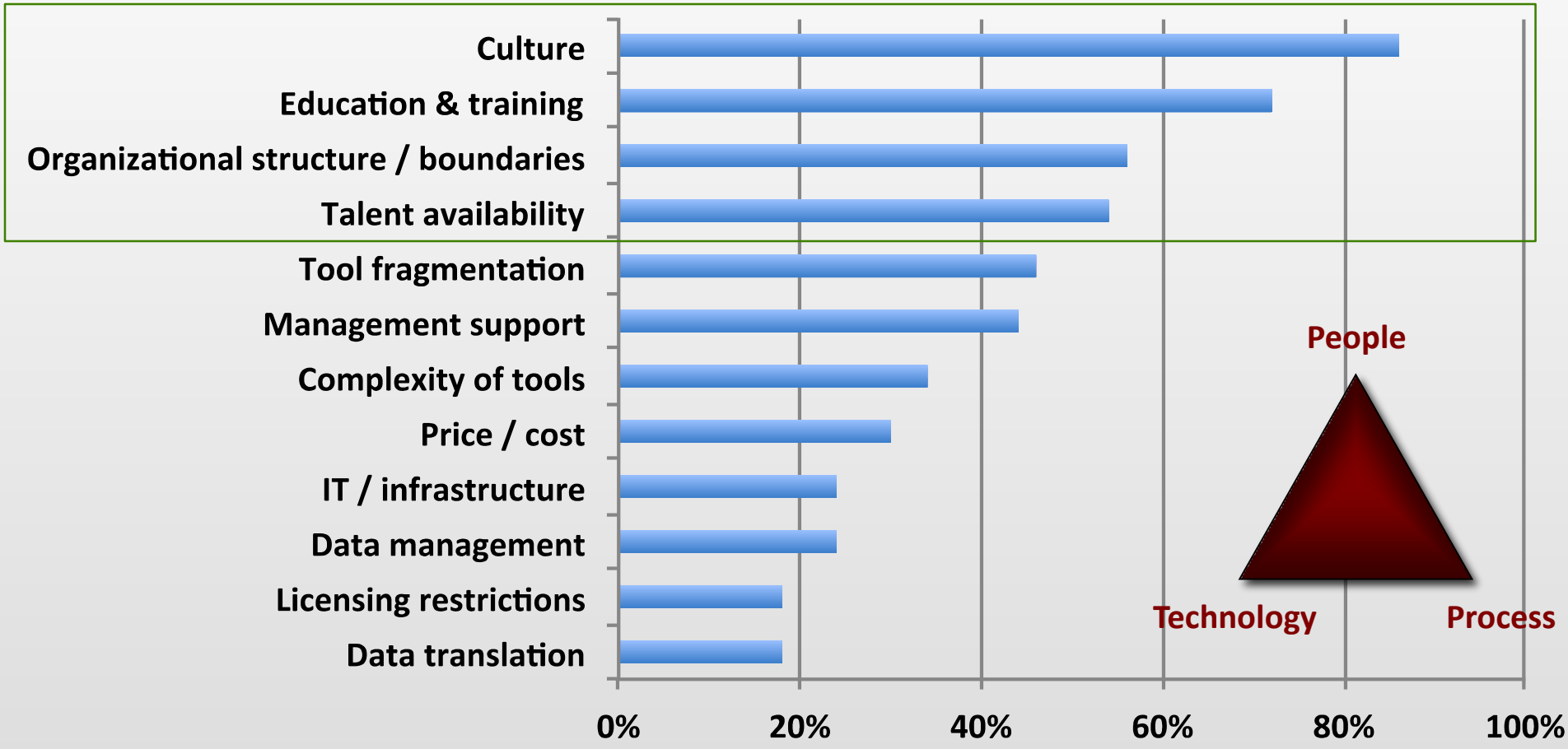
4) ***Model management*** across the engineering domain data silos
   - Key business metrics- Requirements Traceability, Change Management, Configuration Management, Long-term Archiving and Retrieval (LOTAR)

5) ***Robust standards*** for PLM/MBSE/M&S data interoperability
   - XML/XMI, OSLC/RDF, ReqIF, FMI/FMU, FMI/SSP, MoSSEC (AP 234), etc.

Barriers to Industry Implementation

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

- It is about people & process as well—not just technology



Source: CIMdata MBSE web survey conducted with ANSYS & INCOSE (2015)

Business Opportunity – Key Factors for Success

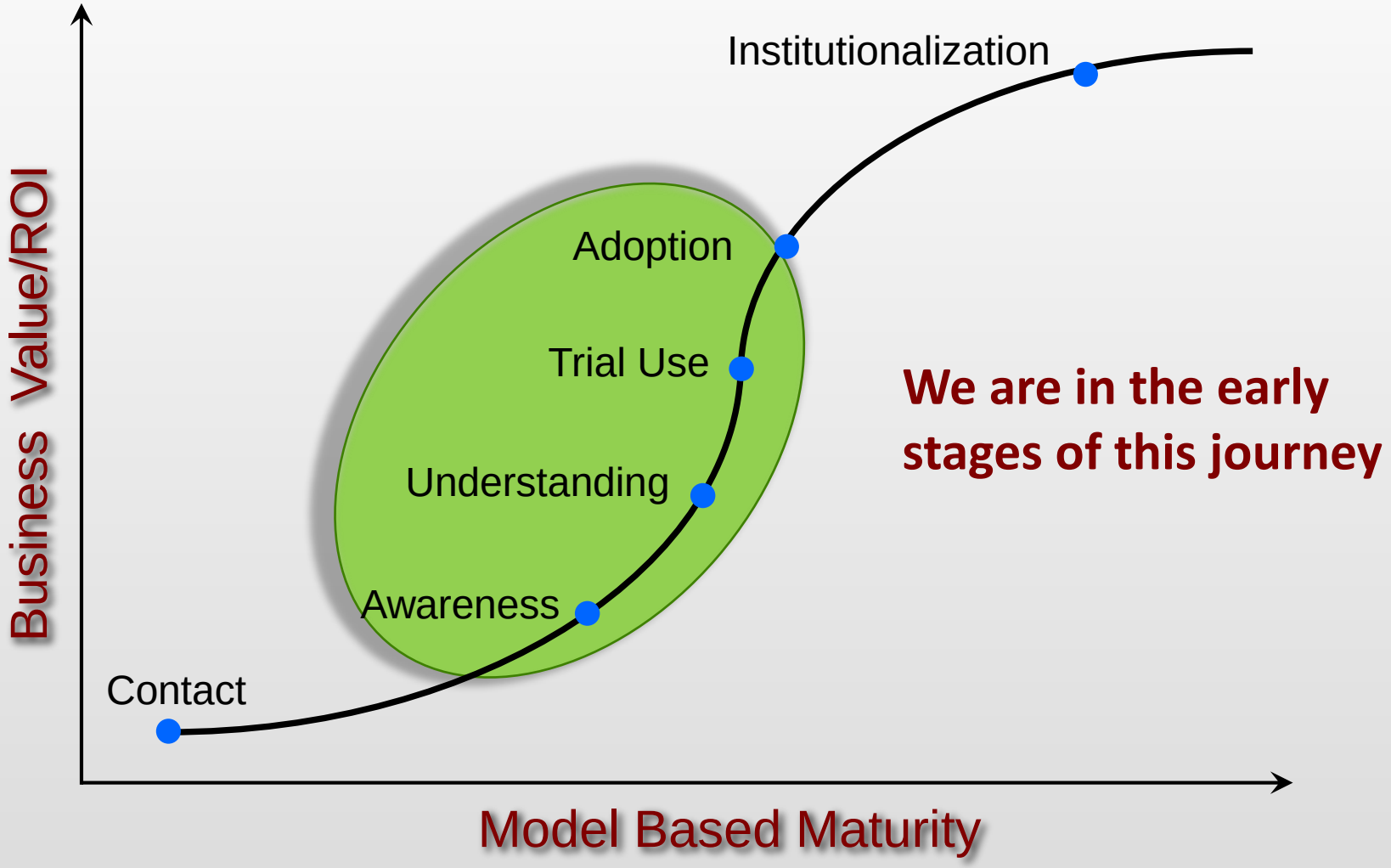
Driving the PLM/MBSE/Model-Based Digital Thread strategy to realization

It's not about what we call MBx; It's about delivering value to customers and all other stakeholders of the enterprise

- MBSE strategy needs to be defined and implemented based on specific application use cases and quantifiable ROI metrics
  - *Industry solutions will be based on a "platform of platforms" approach*
  - *Must account for cultural change, training & MBSE maturity growth over time*
- Open standards will be critical to achieving Digital Thread(s)
- Industry & DoD need to support new contractual concepts *AND* accept electronic project deliverables/signoffs/TDPs
  - For digital information and models to replace paper and 2D drawings, OEMs need to understand what they are asking suppliers to do to change processes and the business case/ROI for adoption of an MBSE approach

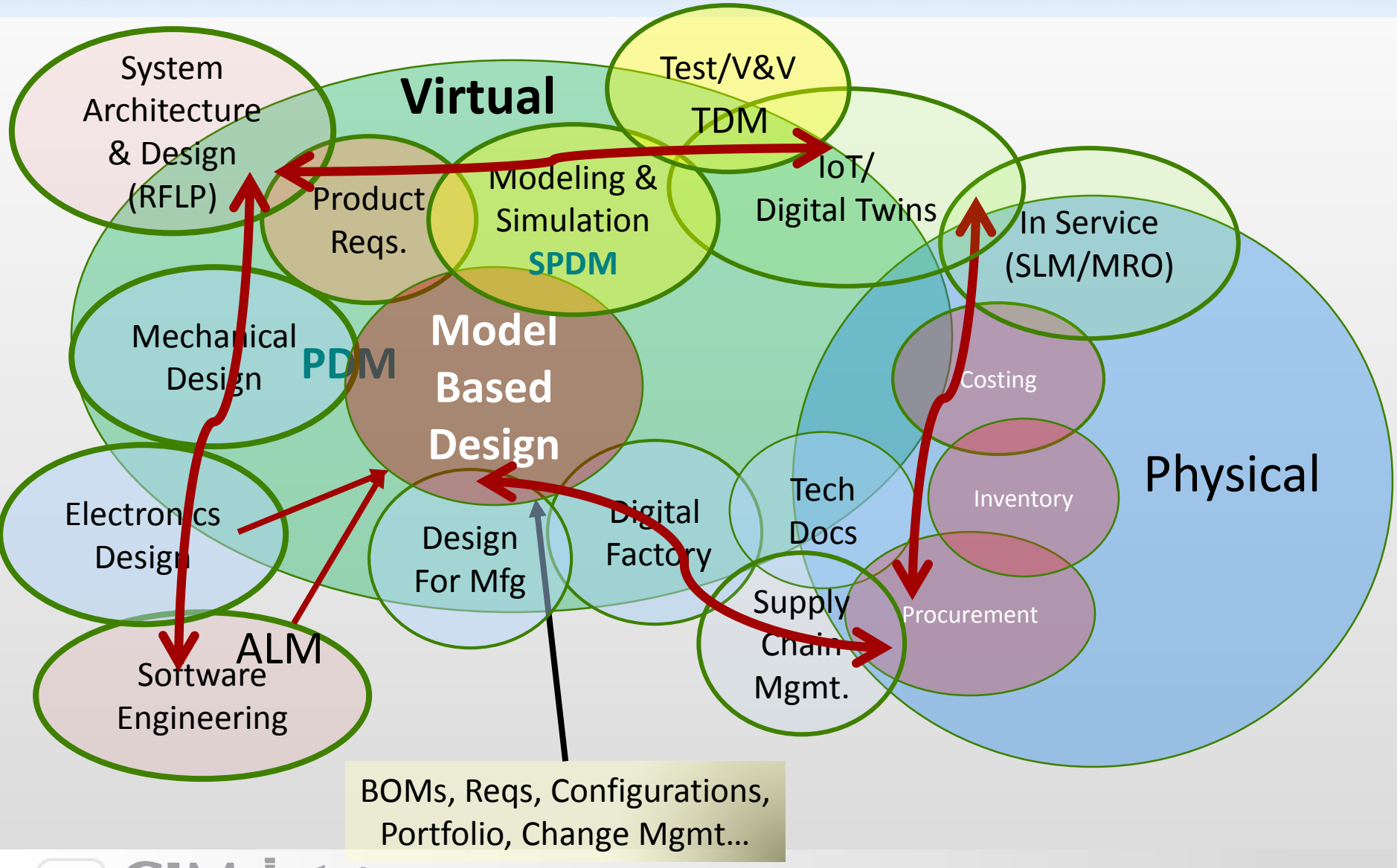
Business Value Comes with Adoption Maturity

It takes time, management commitment and cultural change



Connecting the Lifecycle Digital Thread

Building out all of these threads will enable the desired closed loop lifecycle process



MBSE, PLM and the Digital Thread

Where do we go from here?

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