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Global Product Data Interoperability Summit | **2020**

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PDES, Inc.®
Connecting the Digital Enterprise

Welcome to the 2020 GPDIS Virtual Sessions!

History and Focus of GPDIS

- **Global Product Data Interoperability Summit (GPDIS) was formed in 2009. It was the consolidation of two conferences (Data Exchange and SOA Deep Dives) addressing integration technologies along with the non-proprietary exchange of data**

- **GPDIS functions as a communications hub for industry principals to foster knowledge through the exchange of ideas, solutions and methods.**

2020 Theme: The Great Race of Digital Transformation

How is your model based enterprise today?

- **Together we will explore digital transformation and what it will take us to FULLY achieve it. Using the Great Race as a metaphor, we will explore the building blocks of digital transformation and how interoperability will enable the digital transformation journey for industry.**

Mark your Calendars! GPDIS 2021 - September 13-17th Scottsdale, AZ

CAMSC **MBSE** **ET/IT** **3D MBD** **DevOps** **PLM Roadmap** **PDES**

Digital Thread—the PLM Professionals' Path to Delivering Innovation, Efficiency, and Quality

Peter A. Bilello, President & CEO
CIMdata, Inc.

GLOBAL PRODUCT DATA INTEROPERABILITY
SUMMIT
2020

Webinars

Peter A. Bilello, President & CEO

Professional background

- More than 30 years of experience in the development of IT solutions for research, engineering, and manufacturing organizations worldwide
- Run numerous projects in PLM analysis, selection, implementation & management, synchronous and lean manufacturing consulting & software engineering, as well as general data management strategy development and support
- Authored many papers & research reports on PLM and related topics, as well as numerous articles, commentaries, and perspectives that have appeared in publications throughout the NA, EMEA & Asia
- Holds a B.S. in Computer Science (minor in Physics) & M.S.E. in Manufacturing Systems Engineering

CIMdata's 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 PLM and the digital transformation it enables.

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

CIMdata's Services...

Creating, disseminating, and applying our intellectual capital in support of your digital transformation

Research

- *Market research & analysis*
- *Technology research & analysis*
- *Reports & publications across multiple domains*
- *Market news*
- *Member services...*

Education

- Certificate Programs
- Executive seminars
- Technology seminars
- Educational webinars
- Int'l conferences & workshops
- Best practices training...

Consulting

- Strategy & vision
- Needs assessment
- Solution evaluation
- Best practices
- Quality assurance
- Program management
- Market planning...

Delivering strategic advice and counsel through a comprehensive, integrated set of research, education, and consulting services

Key Takeaways

Digital Thread—the PLM Professionals' Path to Delivering Innovation, Efficiency, and Quality

- The Digital Thread is a multifaceted opportunity with implications affecting innovation, efficiency, and quality
  - Unfortunately, many companies view these dimensions as a tradeoff and define improvement goals & strategies to achieve what they see as an optimum balance
  - However, these dimensions are independent imperatives, and improvements in all three dimensions need to be pursued aggressively
- Leading companies are developing strategies and implementing the Digital Thread in ways that…
  - Enhance their innovation platform, increase efficiency of development, production, and service, as well as their ability to assure compliance
- We, as PLM Professionals, need to understand the key components & criteria for achieving a successful digital thread strategy & associated enablement

Agenda

- What Are We Trying to Sew Together
- What Are You Going to Do With It
- What Does It Takes to Get It Done
- Concluding Remarks

Business Drivers Impacting All Companies

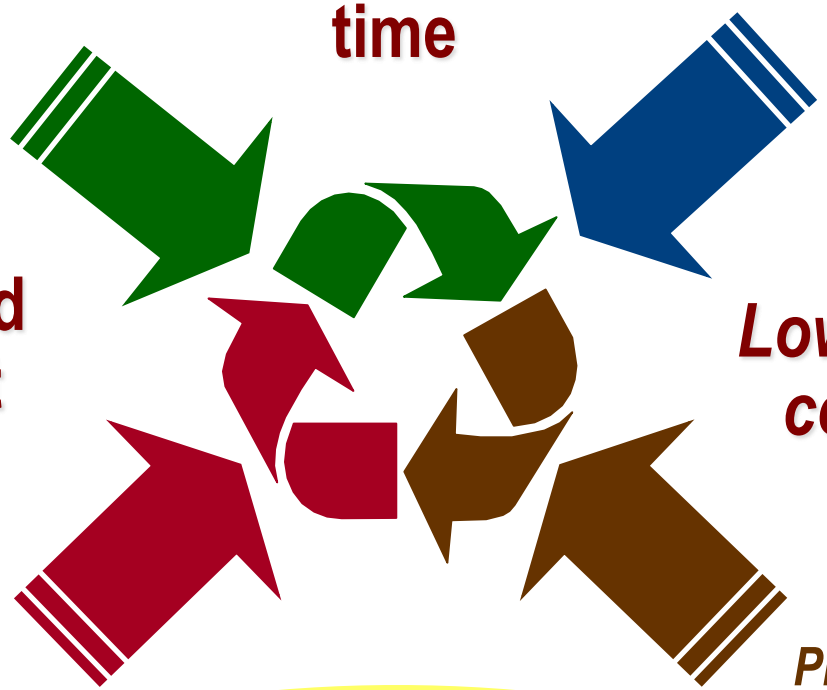
Time, Cost, and Quality equation is no longer sufficient

Globalization

Design anywhere
Build anywhere
Maintain anywhere
All at any time

Product Complexity

Increased number of projects
Increased number of parts
Greater need for standard parts
Build-to-order & increased customization



Competition

The need to differentiate
Increasing scope of services
Focusing on core competencies through, partnerships, JVs, supplier management, etc.

Pricing Pressure

Demand for global pricing
Price right the first time
Understanding real costs
Pressure on product margins

The Basic Lifecycle

Innovation's foundation is the organization's intellectual assets

Innovation does not only take place during the transformation process but also in the definition of the organization's intellectual assets!

The Real & Complete Product Lifecycle

Product data touches all phases of a product's life—end-to-end connectivity is critical

Portfolio Management

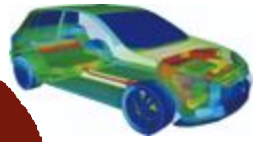
Planning

Conceptual Design

Product Engineering

Manufacturing Engineering

Simulation & Validation

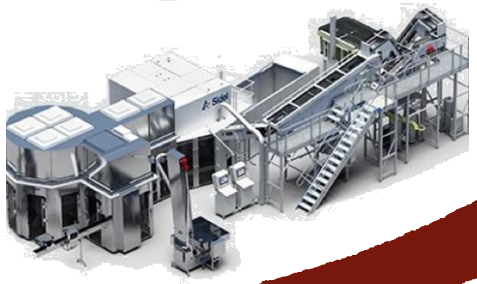


Requirements

Info

Re-use
Re-purpose
Re-mfg.
Re-cover
Re-cycle
Re-tire

Disposal & Recyciing



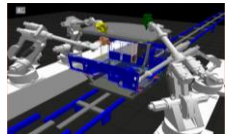
Maintenance & Repair

In-service Operation

Sales & Distribution

Test & Quality

Build & Produce



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

Lifecycle Information is Represented by Structures

Managing relationships between structures throughout the lifecycle—they must be managed throughout

Portfolio Management

Planning

Conceptual Design

Product Engineering

Manufacturing Engineering

Requirements

As-Simulated Requirements

As Designed

As-Planned

As-Validated

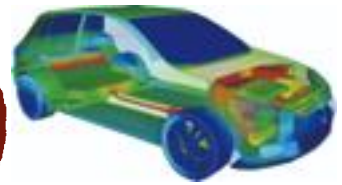
As-Built

As-Delivered

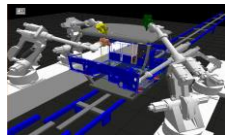
As-Installed

As-maintained

Simulation & Validation



Build & Produce



Test & Quality

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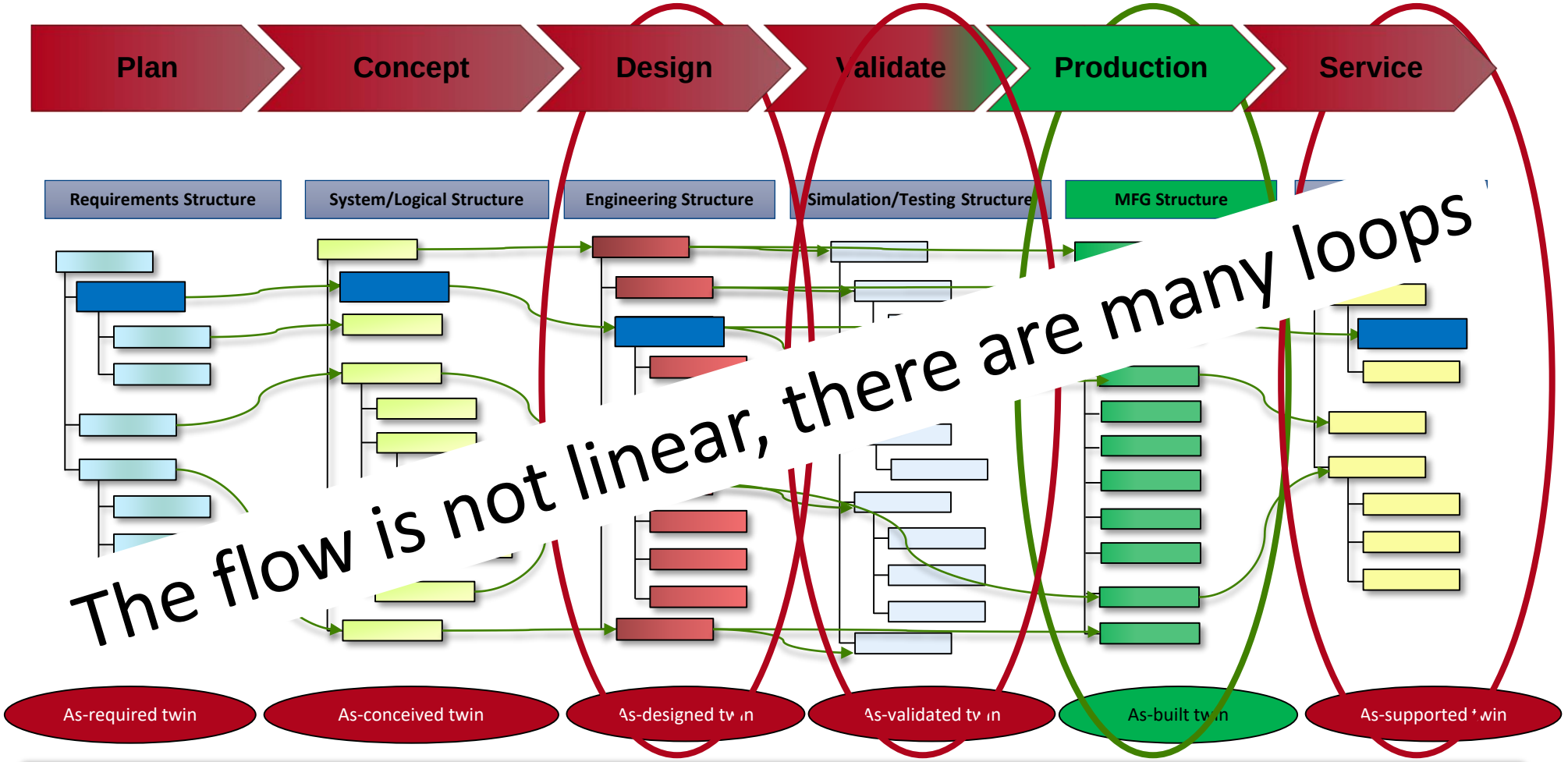
xBOM

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

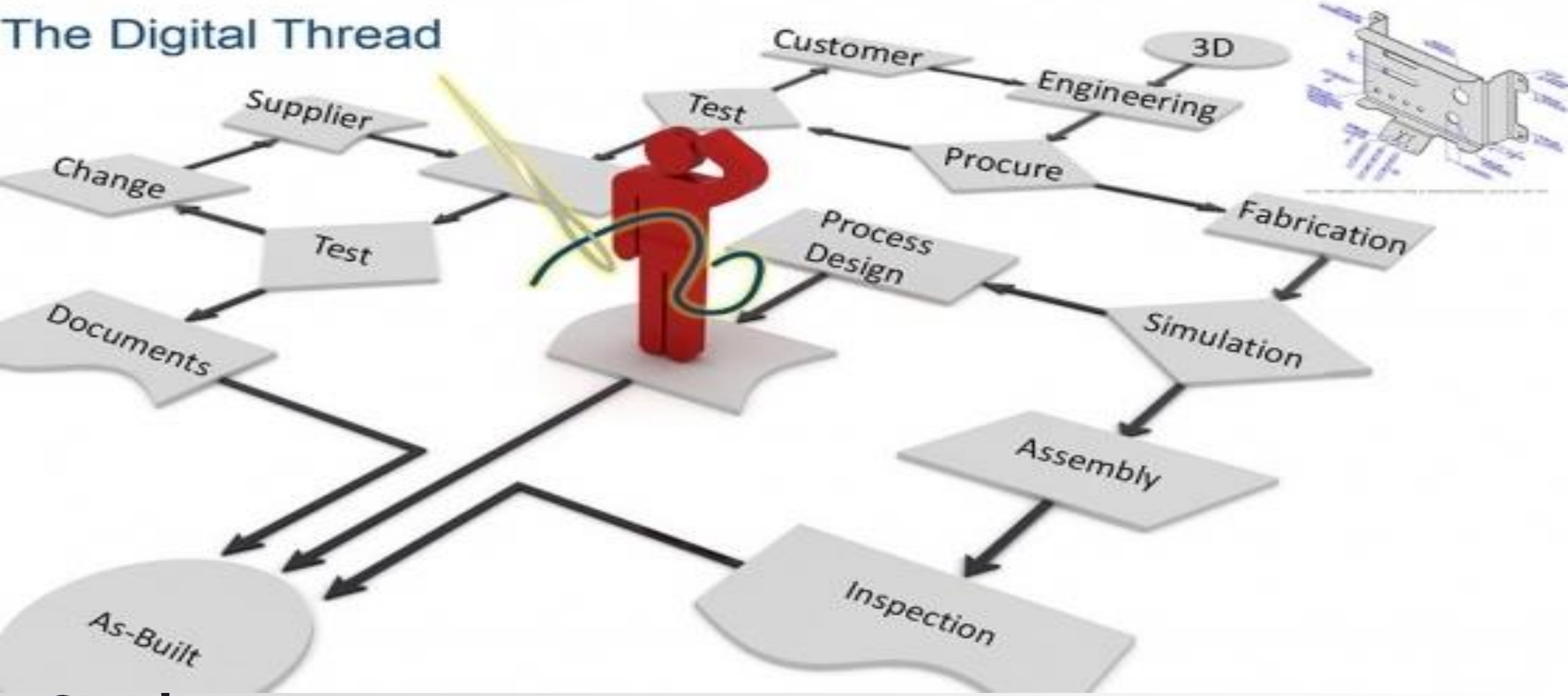
Digitalization Requires End-to-End Connectivity

This is the Digital Thread, which in turn supports multiple Digital Twins



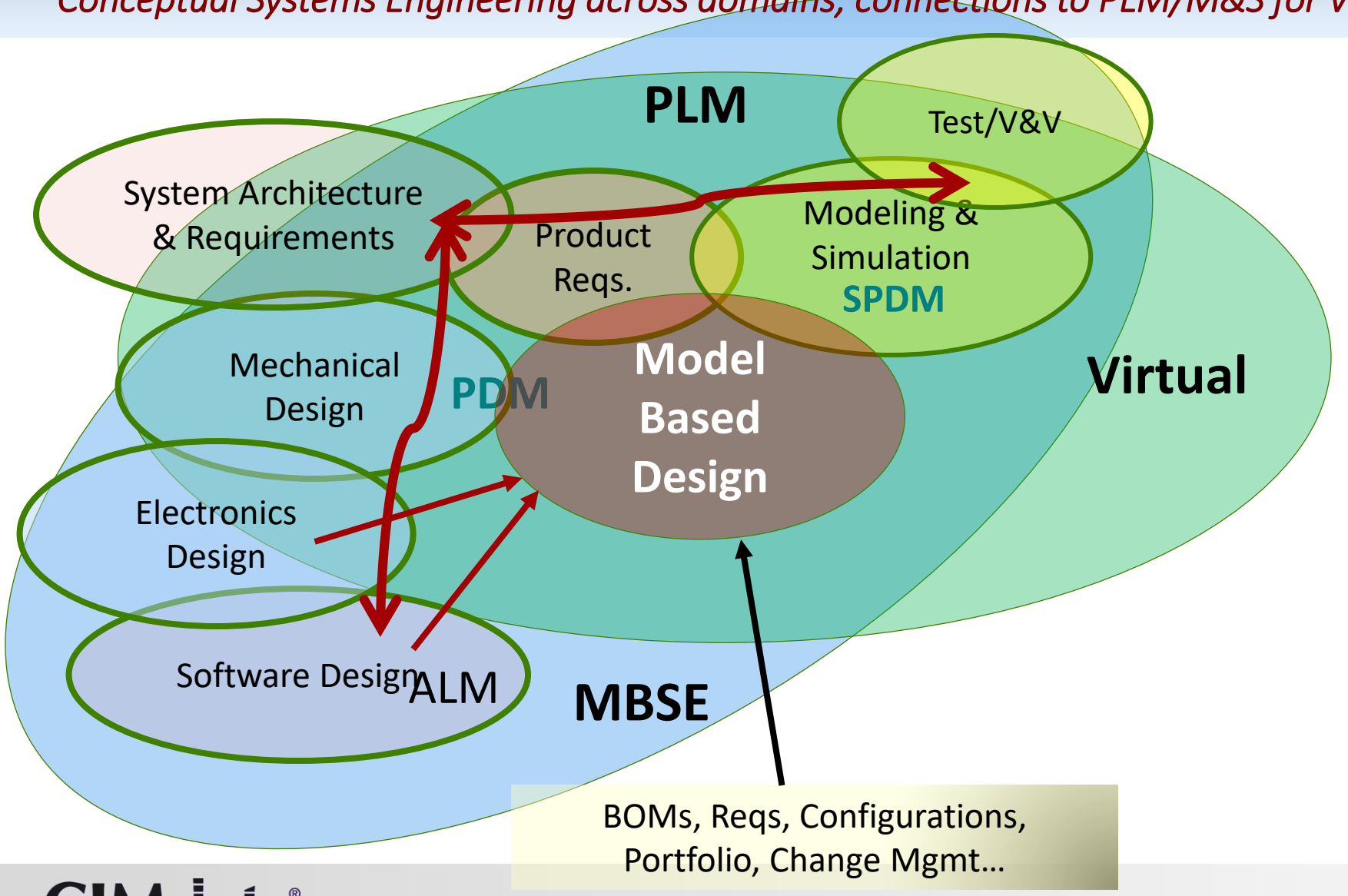
Closed-Loop Impact Analysis and Traceability of Changes

“Sewing the Digital Thread”



Sewing the MBSE Digital Thread ("To Be")

Conceptual Systems Engineering across domains; connections to PLM/M&S for V&V



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

The thread needs to connect information across domains:

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

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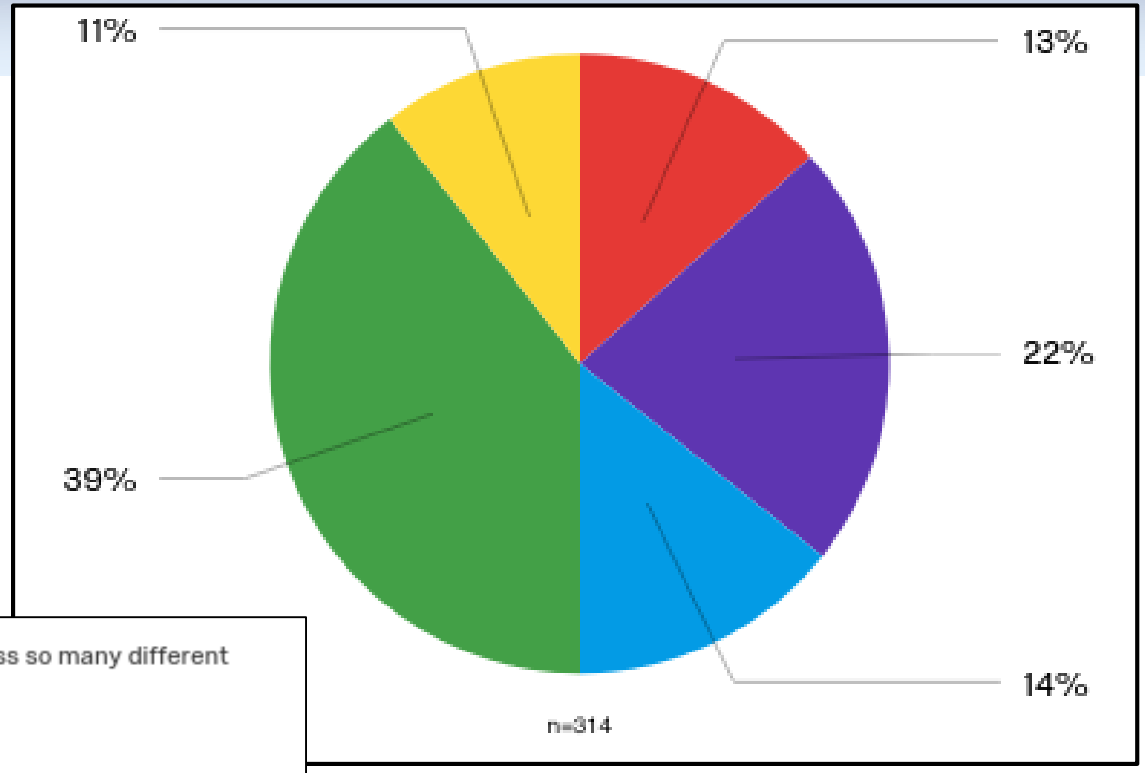
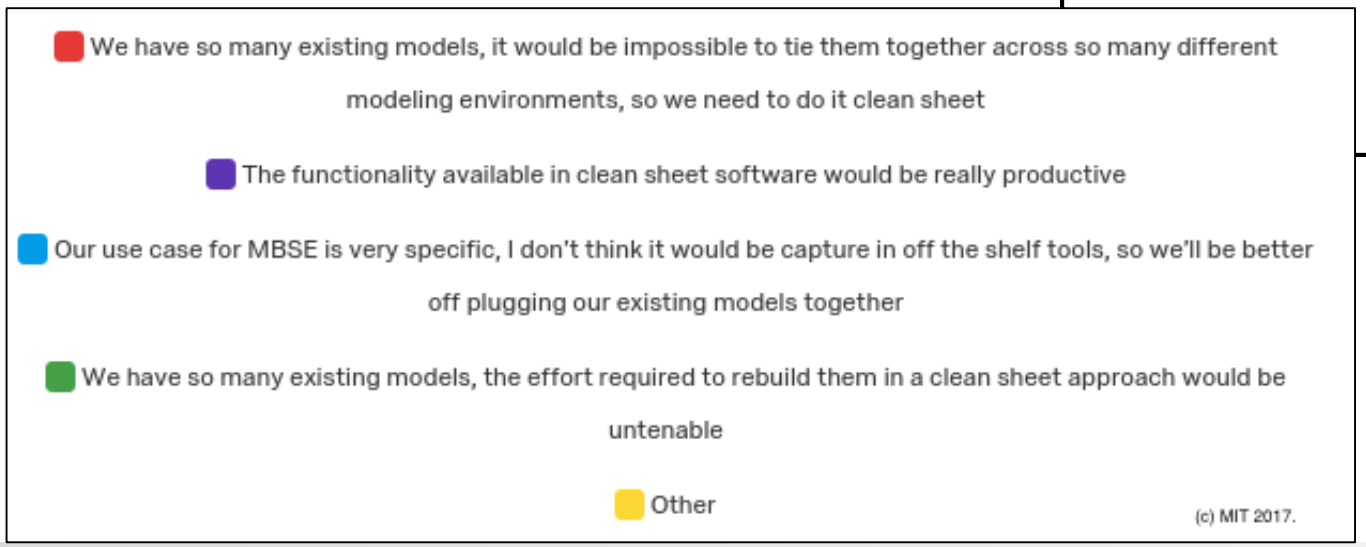
Challenge: Tool Integration & Data Interoperability

Challenges to the digital thread

- If you pursued MBSE, would you start with a clean sheet in specific MBSE software, or would you write custom software to tie your existing models together? Why?
  - Majority indicated need to tie together existing models in some manner



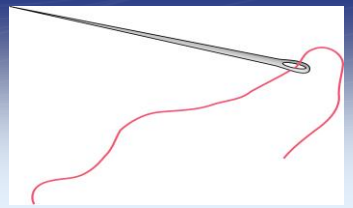


MIT MBSE On-line Course
Survey of 300+ Engineers

Bruce Cameron, TSP
MBSE LinkedIn blog post
May 17, 2017

Sewing the MBSE Digital Thread ("As Is")

Significant collaboration efforts underway to integrate data and processes

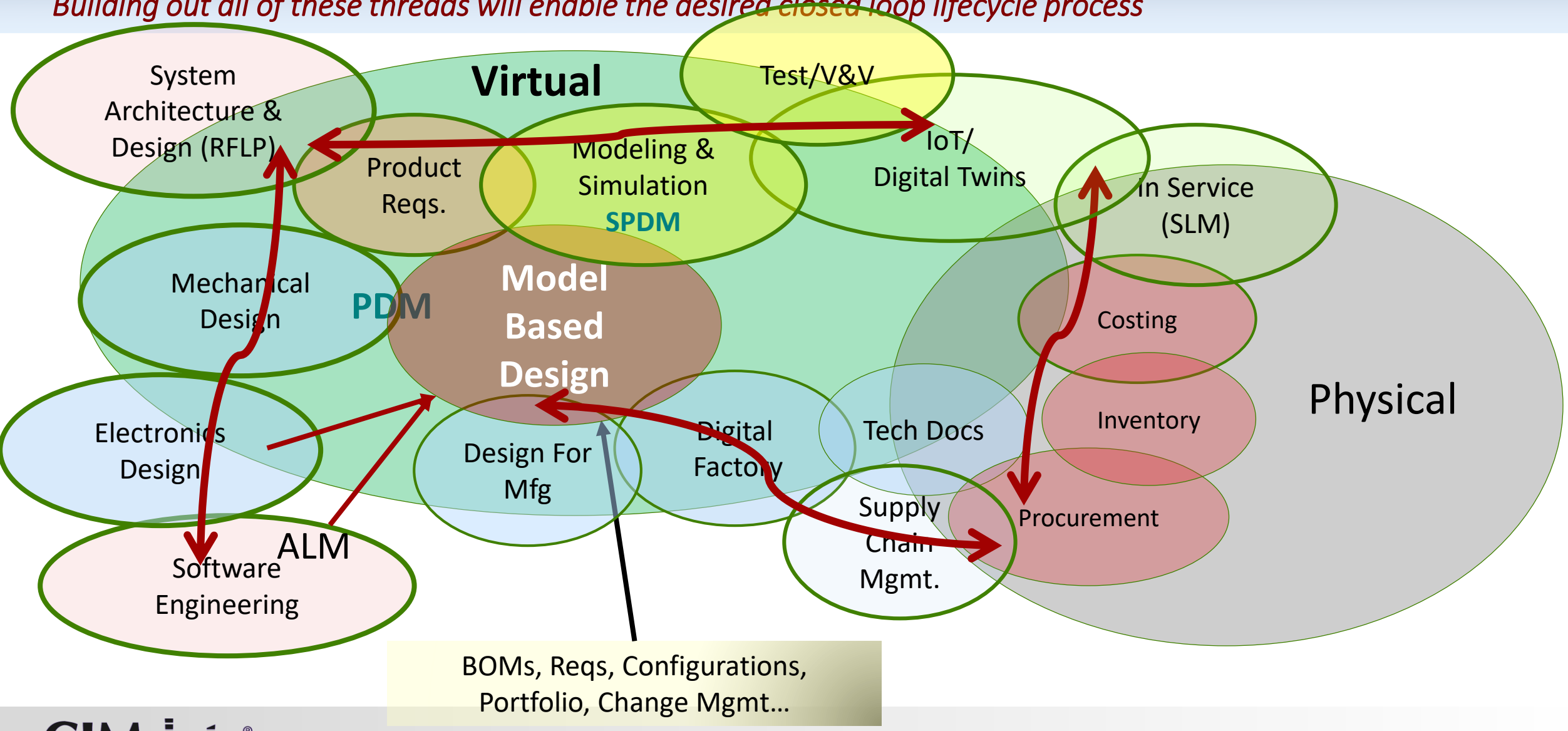


Evolving standards for cross-domain data linking & interoperability

- SysMLv2.0 & UPDM– Next generation systems modeling languages
- STEP AP 233/239/242 & 209 – New unified data architecture
- OSLC – Open Services for Lifecycle Collaboration (www.oasis.org)
- PDES Requirements Traceability Project – Connect requirements information across the domains of MBSE, PLM/MCAD & ECAD
- AVSI SAVI Program- A&D Systems Architecture Virtual Integration
- FDX- German initiative for Functional Data Exchange file format
- Modelica & FMI/FMU (Functional Mockup Interface/Mockup Unit)
- MoSSEC – Modeling & Simulation information in a collaborative Systems Engineering Context. See http://www.mossec.org/

Connecting the Lifecycle Digital Thread

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

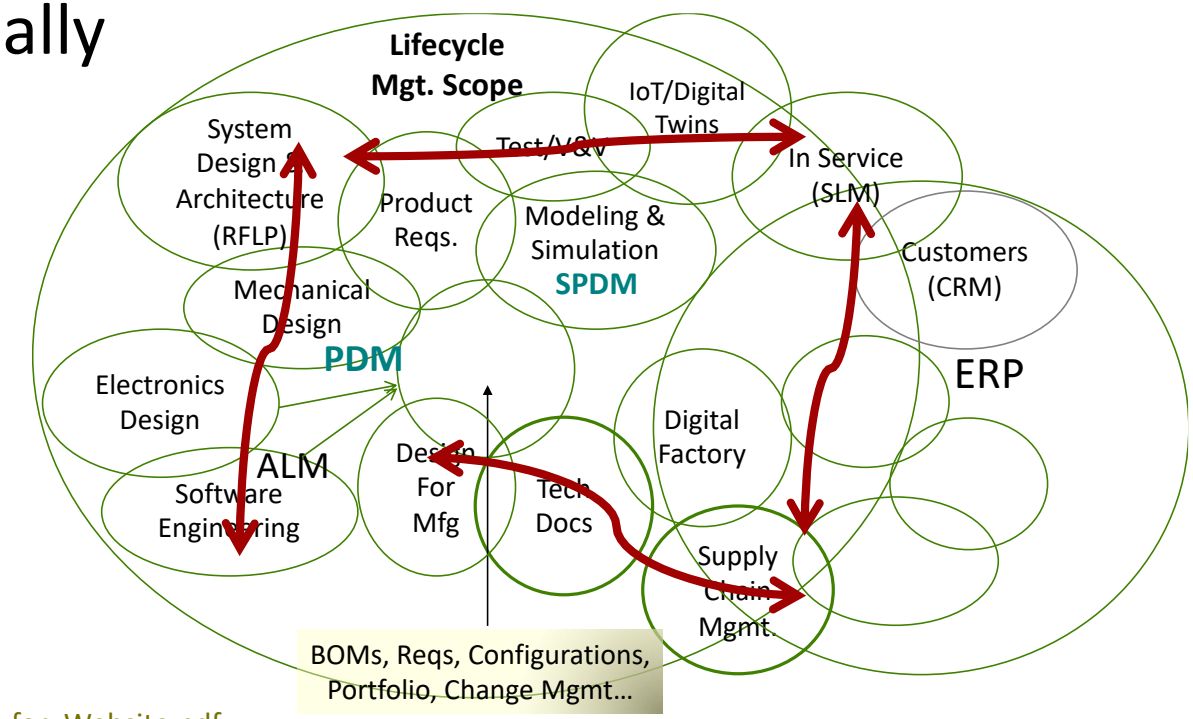


Digital Thread

CIMdata's preferred definition

- ***Digital Thread*** A digital thread is **a communication framework** that connects data flows, which can be used to produce an integrated and holistic view of an asset's data from physical and virtual systems (i.e., its digital twin) throughout its lifecycle across traditionally siloed functional perspectives.

Digital thread is enabled and supported by a robust end-to-end and connected systems model and MBSE processes

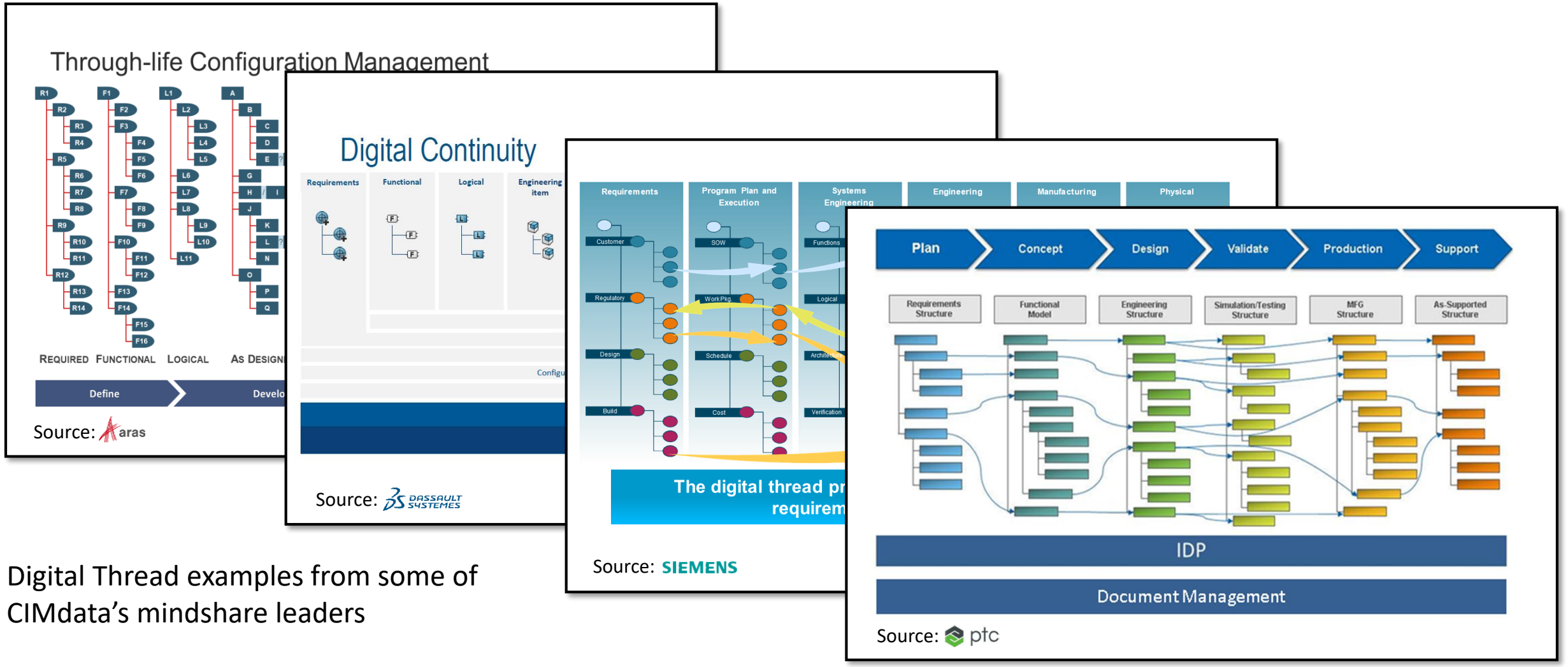


Extracted from: https://www.dodmantech.com/ManTechPrograms/Files/AirForce/Cleared_DT_for_Website.pdf

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

Technology Exists…But

What are you going to do with it?



Digital Thread examples from some of CIMdata's mindshare leaders

Agenda

- What Are We Trying to Sew Together
- What Are You Going to Do With It
- What Does It Takes to Get It Done
- Concluding Remarks

Imagine…What You Could Do?

…if you had a digital thread that provided the end-to-end connectivity we are talking about

Portfolio Management

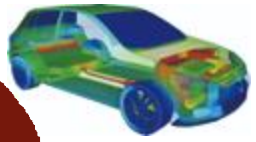
Planning

Conceptual Design

Product Engineering

Manufacturing Engineering

Simulation & Validation



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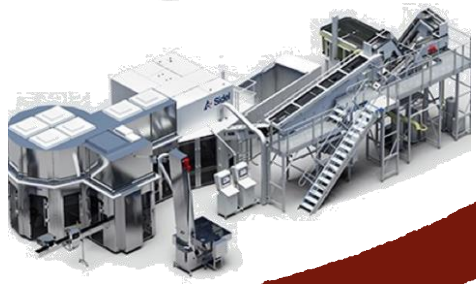

Maintenance & Repair

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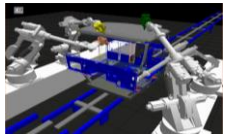
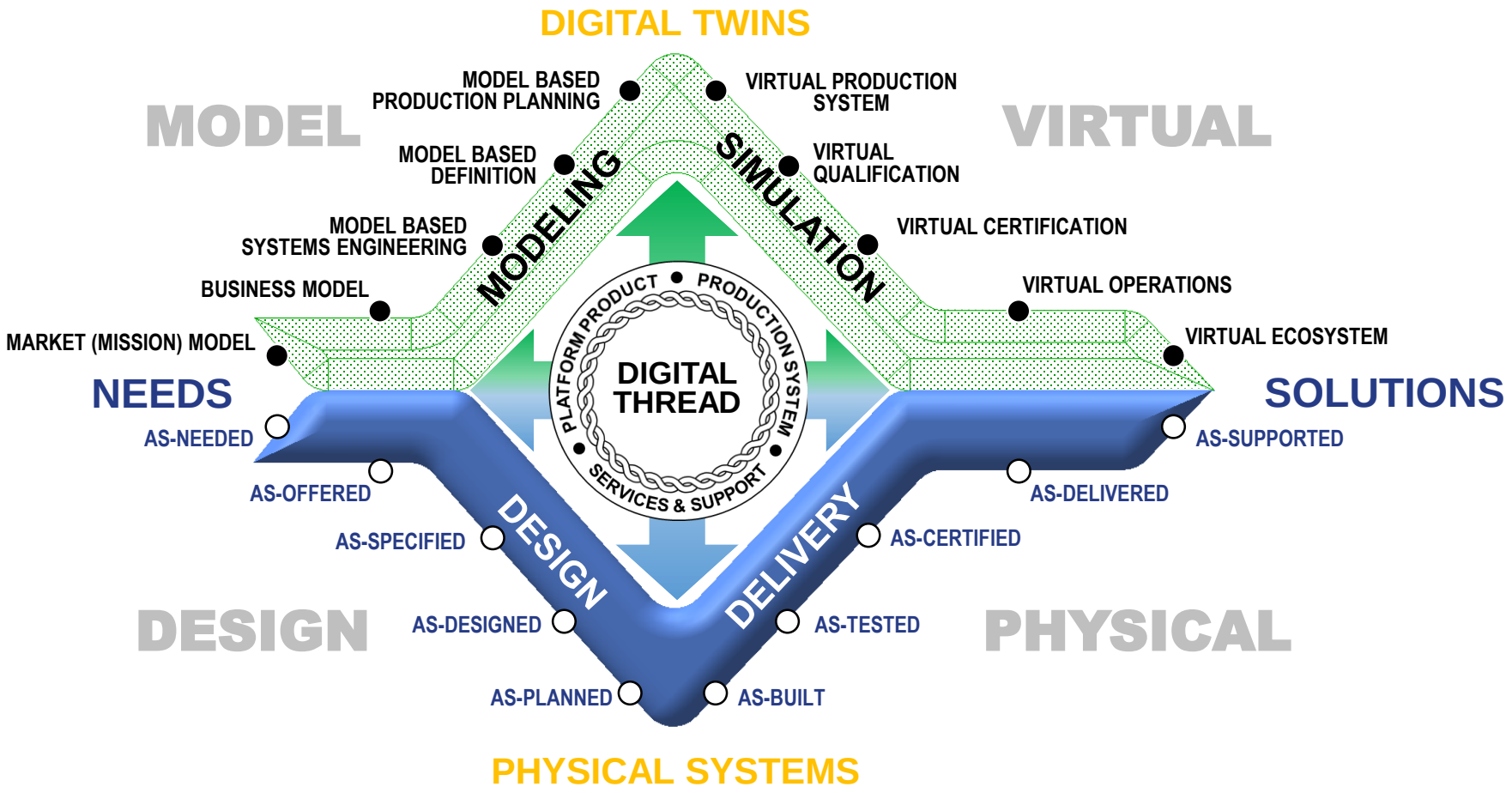


PLM Solutions—Information Management across Media, Process, Time, Geography & Enterprise

Imagine…What You Could Do?

…if you had a Digital Thread that tied the virtual world to the physical world—MBE "Diamond" Symbol



(Courtesy of The Boeing Company)

Imagine…What You Could Do?

…if your product information was always accurate & complete throughout the entire product lifecycle

- The integrity of information and effectiveness of the organization are linked
  - Integrity = accuracy and completeness of the information you use to make decisions
  - Effectiveness = the ability to respond accurately and quickly

Adapted from ICM's CM2 materials.

You Could Enable the Digital Twin

An accurate digital representation of your products and/or services at any point throughout the lifecycle

- A ***virtual representation*** (i.e., digital surrogate) of a physical asset or collection of physical assets (i.e., physical twin) that exploits data flow to/from the associated physical asset(s).

Digital twin is enabled and supported by a robust end-to-end and connected systems model and MBSE processes

Adapted from input from ASSESS (see www.assessinitiative.com)

Key Characteristics of Digital Twins

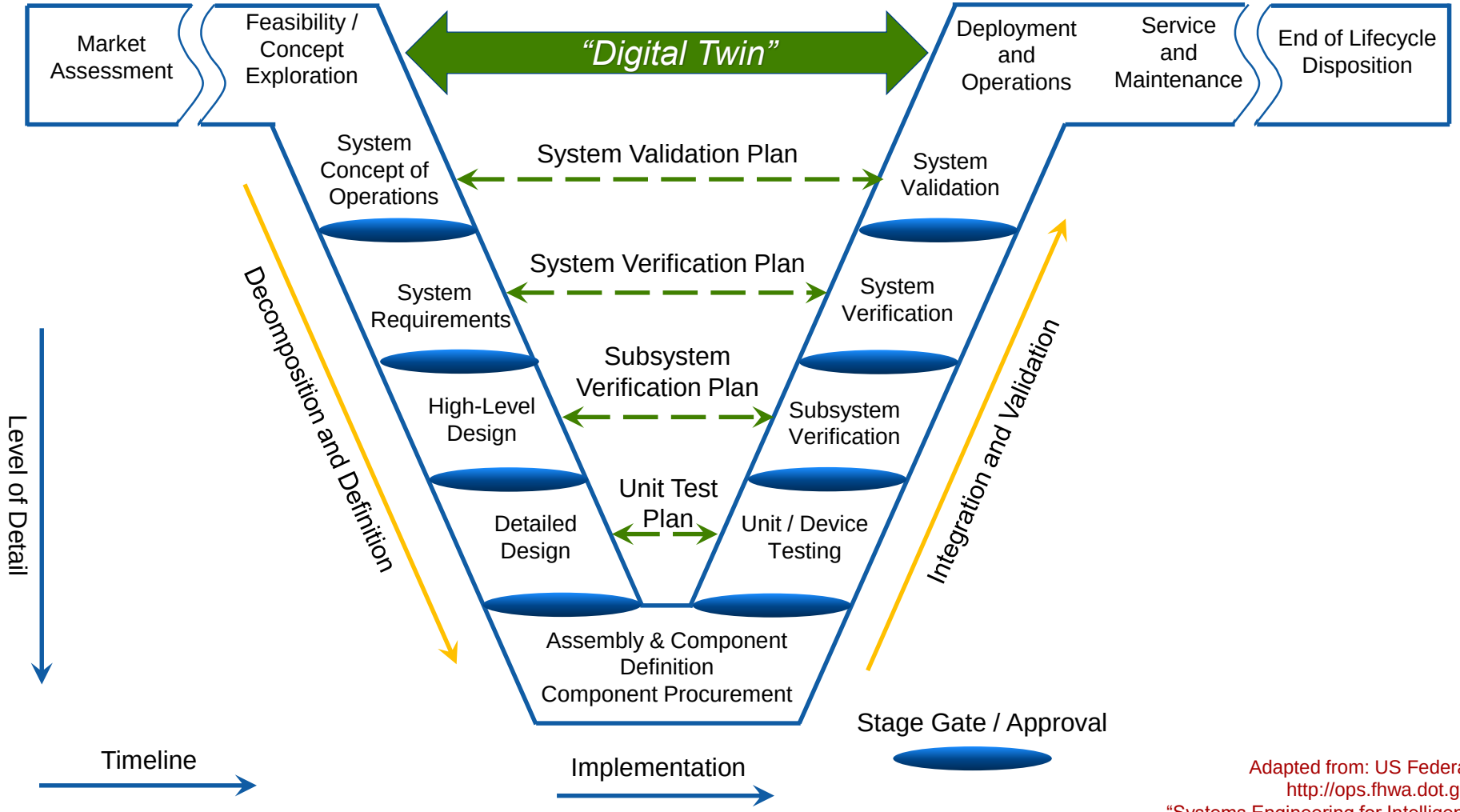
Noteworthily characteristics of digital twins

- There is never a single Digital Twin
  - There are multiple Digital Twins for different purposes, each of which have specific characteristics
    - For example, Data Analytics Digital Twins, MRO Digital Twins, Financial Digital Twins, Engineering Digital Twins, and Engineering Simulation Digital Twins
- Each Digital Twin must have a physical twin (i.e., a physical asset)
  - A virtual representation can and should exist prior to the physical twin
  - The physical asset can be a plant, a ship, infrastructure, a car, any type of product
- Each Digital Twin must have some form of data communication with their Physical Twin
  - Does not have to be real time or electronic

Adapted from input from ASSESS (see www.assessinitiative.com)

You Could Enable A Robust MBSE Environment

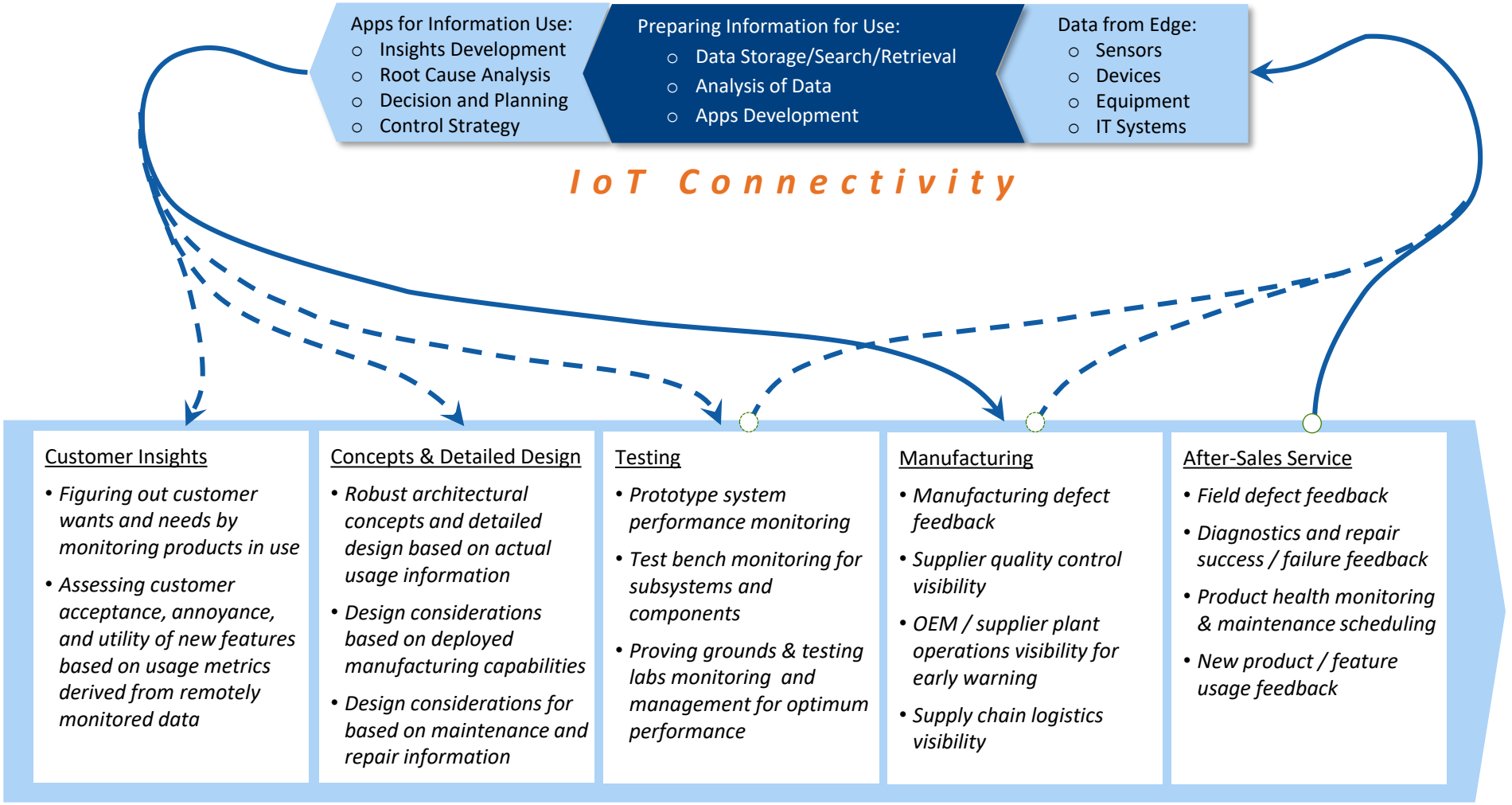
True end-to-end lifecycle management with multiple feedback loops



Adapted from: US Federal Highway Administration:
http://ops.fhwa.dot.gov/publications/seitsguide/
"Systems Engineering for Intelligent Transportation Systems"

You Could Also Do All of This…

Product & process innovation, efficiency & quality—the opportunities provided are numerous



Agenda

- What Are We Trying to Sew Together
- What Are You Going to Do With It
- What Does It Takes to Get It Done
- Concluding Remarks

Tackling A Multifaceted Opportunity

A set of independent imperatives and improvements in all three dimensions need to be pursued aggressively

- Industry leaders are developing strategies and implementing the Digital Thread in ways that enhance their **innovation** platform
  - Results include increased **efficiency** of development, production, and service, as well as their ability to assure compliance with the highest standards of product **quality**
- Independent, as well as interdependent imperatives and improvements in all three dimensions mentioned above must be pursued aggressively to maximize value potential
- The development of and resulting value from a digital thread initiative will require a multifaceted approach—on that is on-going and requires changes in people, processes, and technologies

If the digital thread is the desired end-state, what are the elements that must be considered to achieve it?

Select Enabling Elements

Key enabling elements of an end-to-end digital thread that you can't and/or shouldn't live without

1. Data & process management
2. Bill of Information & other model-based structures
3. Ensure all data are under configuration management control
4. IoT & other "connecting" technologies
5. Allowing for a changed view on what your "Product" is
6. Big data & analytics
7. Data governance
8. Digital skills transformation

Agenda

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- What Are You Going to Do With It
- What Does It Takes to Get It Done
- Concluding Remarks

Concluding Remarks

Digital Thread—the PLM Professionals' Path to Delivering Innovation, Efficiency, and Quality

- Enabling an end-to-end Digital Thread is a multifaceted effort & opportunity with implications affecting innovation, efficiency, and quality
  - Doing so requires a rather robust set of independent, as well as interdependent imperatives and improvements in all three dimensions in an aggressive manner
- Leading companies are developing strategies and implementing the Digital Thread in ways that…
  - Enhance their innovation platform, increase efficiency of development, production, and service, as well as their ability to assure compliance
  - Allows them to rethink their products in ways that were previously not possible
- We, as PLM Professionals, need to understand the key components & criteria to achieving a successful digital thread strategy & associated enablement
  - Like most things, it requires adjustments in people, processes, and technologies

PLM Road Map & PDT 2020

Annual PLM Road Map conference

- PLM Road Map & PDT 2020
  - Virtual-live Event
  - November 17-19 – comprising 3 right-sized sessions of +/- 3.5 hours each
- Theme: Digital Thread—the PLM Professionals' Path to Delivering Innovation, Efficiency, and Quality
- Agenda includes report outs from 4 AD PAG workstreams:
  - Multiple-View Bill of Materials Solution Evaluation Benchmarks
  - Global Collaboration - Defining a baseline for data exchange processes and standards
  - MBSE Data Interoperability - Architecture Model Exchange Solutions
  - Model-based Definition Information Requirements for Type Design

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Thank you attending this session

Please join us for the next Session on Tuesday, November 10th.

David Odendahl, Technical Fellow
The Boeing Company
Manufacturing Data Standards 2020

2020 GPDIS Virtual Sessions Agenda

All Sessions From 2:00 PM ET to 3:30 PM ET

Session 6: Tuesday, November 10th

Session 7: Thursday, November 12th

Session 8: Tuesday, November 24th

Recordings and presentation decks can be found under the 2020 Presentations at https://gpdisonline.com/event-history/

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