PDM/PLM Industry Trends and Best Practices

A consulting company specializing in Product Lifecycle Management

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Introduction

Henry Lewis Kennebrew, II

- **Senior Director, *Business Process Consulting Group* @ ArcherGrey LLC**
- **Responsible for:**
  - PLM Strategy
  - Business Process Enablement
  - Organizational Change Management
- **20+ years of PLM Experience**
- **3 years Engineering/CAD Experience**
- **BS in Aerospace Engineering**
- **MBA in New Product Development**

Presentation Objectives

The objective of this presentation is to define and provide an overview of the *current trends* related to PDM, PLM, and related technologies (e.g. MDM, MBD) involved in product development and related value-chain activities.

Additionally, we will cover *best practices* within a few top corporate PLM initiatives.

DEFINITIONS

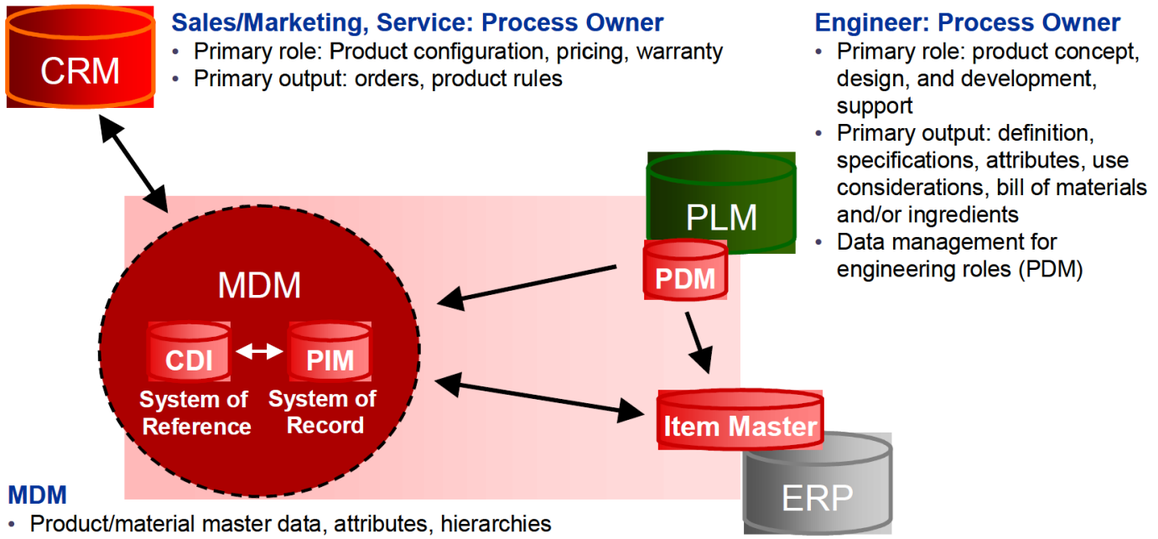
PDM,PLM, MDM and other Enterprise Platforms

- **PDM (Product Data Management) –** primarily manages CAD and document, product data, limited capabilities in Change and Configuration Management (BoMs); a sub-set of PLM capabilities
- **PLM (Product Lifecycle Management)** - the process of managing the entire lifecycle of a product from inception, through engineering design and manufacture, to service and disposal of manufactured products. PLM integrates people, data, processes and business systems and provides a product information backbone for companies and their extended enterprise
- **MDM (Master Data Management)** - in business, master data management (MDM) comprises the processes, governance, policies, standards and tools that consistently define and manage the critical data of an organization to provide a single point of reference (Ex.: ERP=SON, PLM= EndItemSerialNum, CRM=VIN > MDM=VehNum)

How PLM, PDM and MDM Relate in an Ideal World

- Figure 1 shows several simplified business application domains (ERP is not really used alone by manufacturing, but the idea holds).

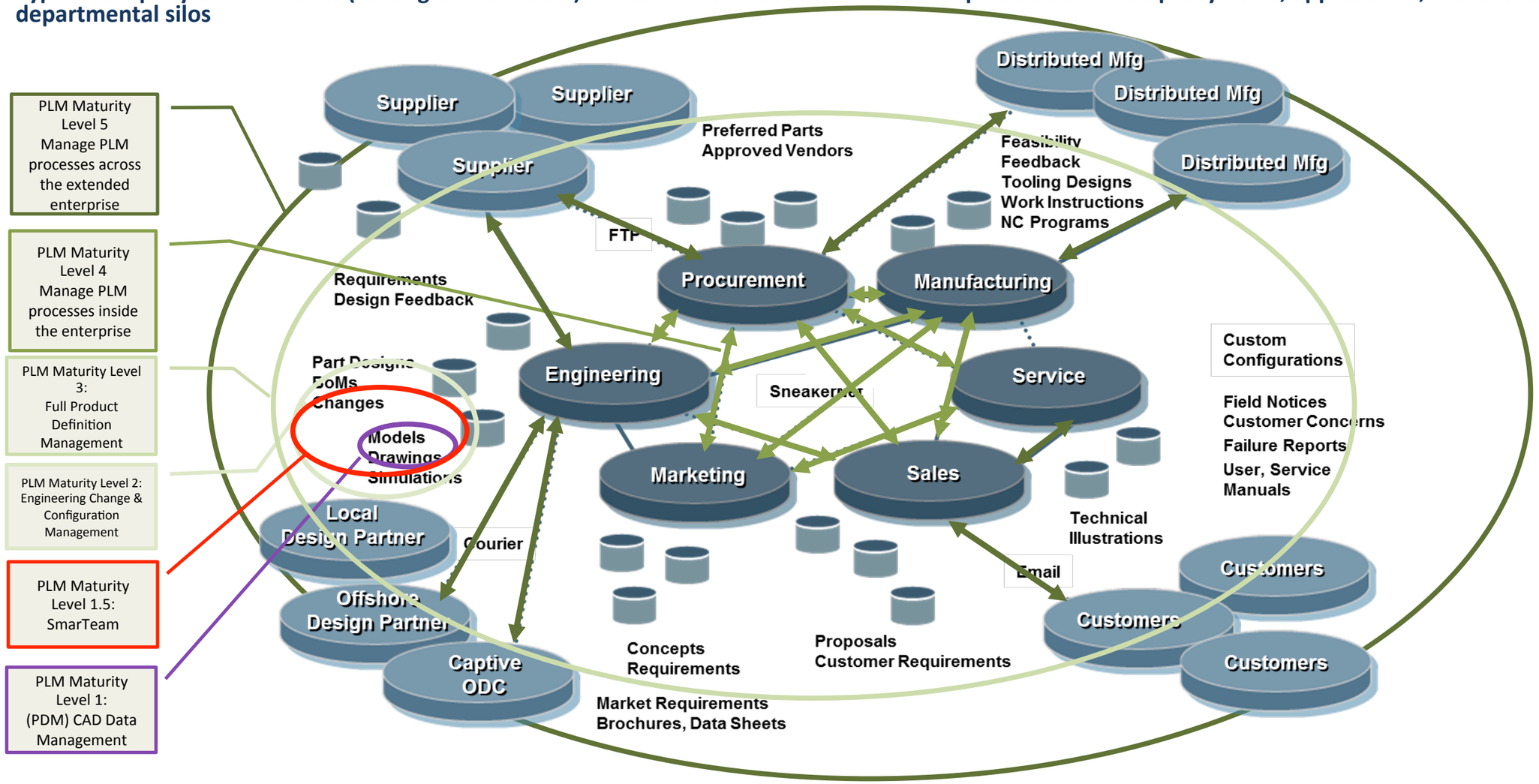
Figure 1. Examples of Roles Governing Product Master Data



Source: Gartner (August 2009)

PLM Maturity Levels

Typical company environments (no single data model) – Product Definition Information is spread across multiple systems, applications, and databases –isolated in departmental silos



PLM Strategy

PLM is More About Discipline, Process, and Culture Than Software

PLM is a discipline for guiding products and product portfolios from ideas through retirement to create the most value for businesses, their partners and their customers

Gartner

- **PLM Strategy should be about deploying Capabilities in the context of…**
  - Business Objectives
  - Departmental Objectives
  - Organizational Change
  - Prioritization
- **It's not what you have that's most important, it's how you use it**

CURRENT TRENDS

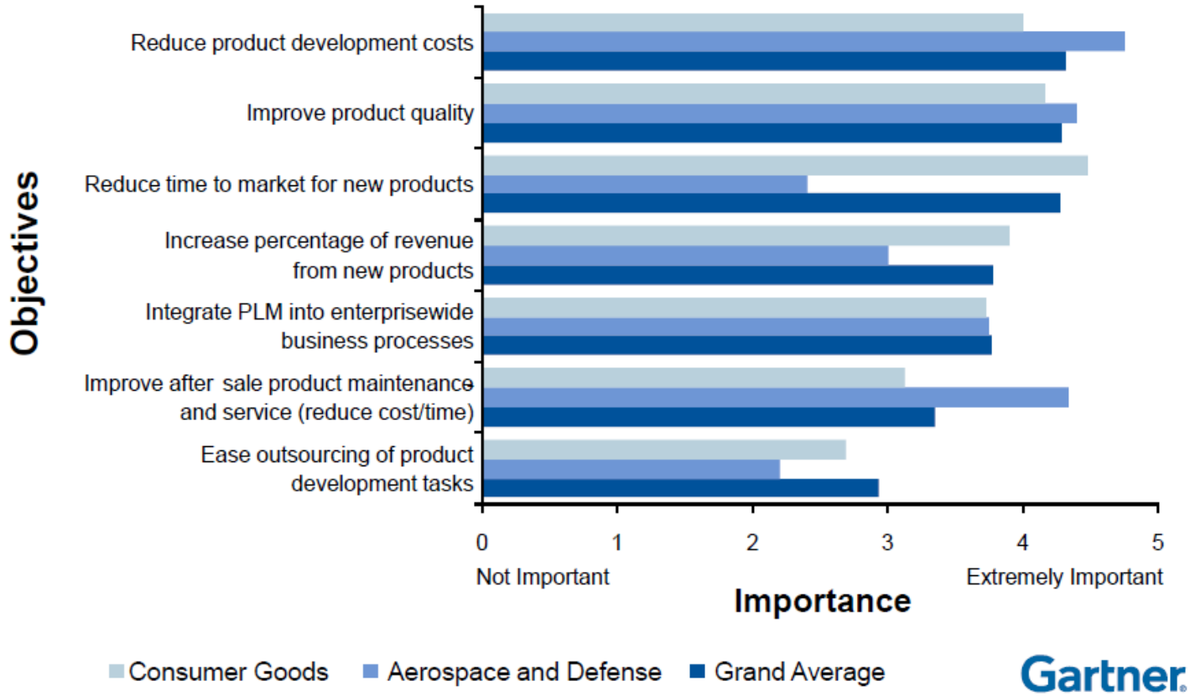
Current Objectives for PLM Systems

Aerospace and Defense Objectives (from highest to lowest importance)

1. Reduce product development costs
2. Improve after-sale product maintenance and service (reduce cost/time)
3. Improve product quality
4. Integrate PLM into enterprise-wide business processes
5. Increase percentage of revenue from new products
6. Reduce time to market for new products
7. Ease outsourcing of product development tasks

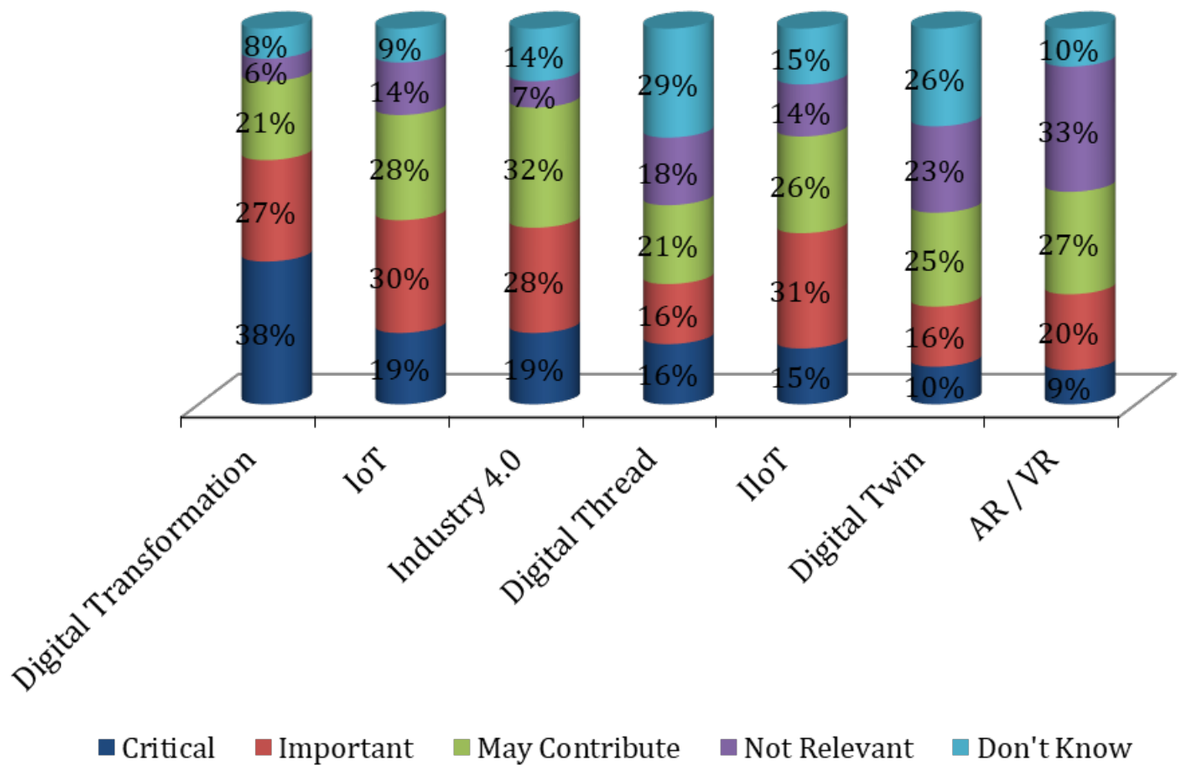
Improving Cost and Quality Dominate PLM Objectives While Others Vary By Industry

Question: Rate the importance of these business objectives in motivating the initiation of the PLM project in your company.

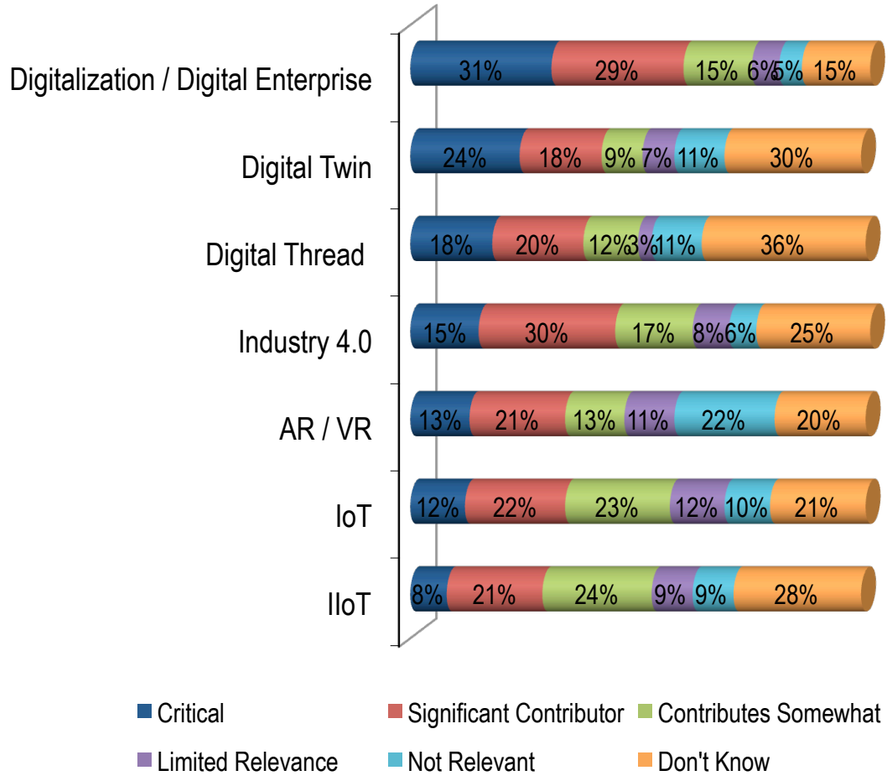


Top Corporate Initiatives and PLM's Impact

Initiatives' Importance to Business Strategy



PLM's Role in Enabling Strategic Initiatives



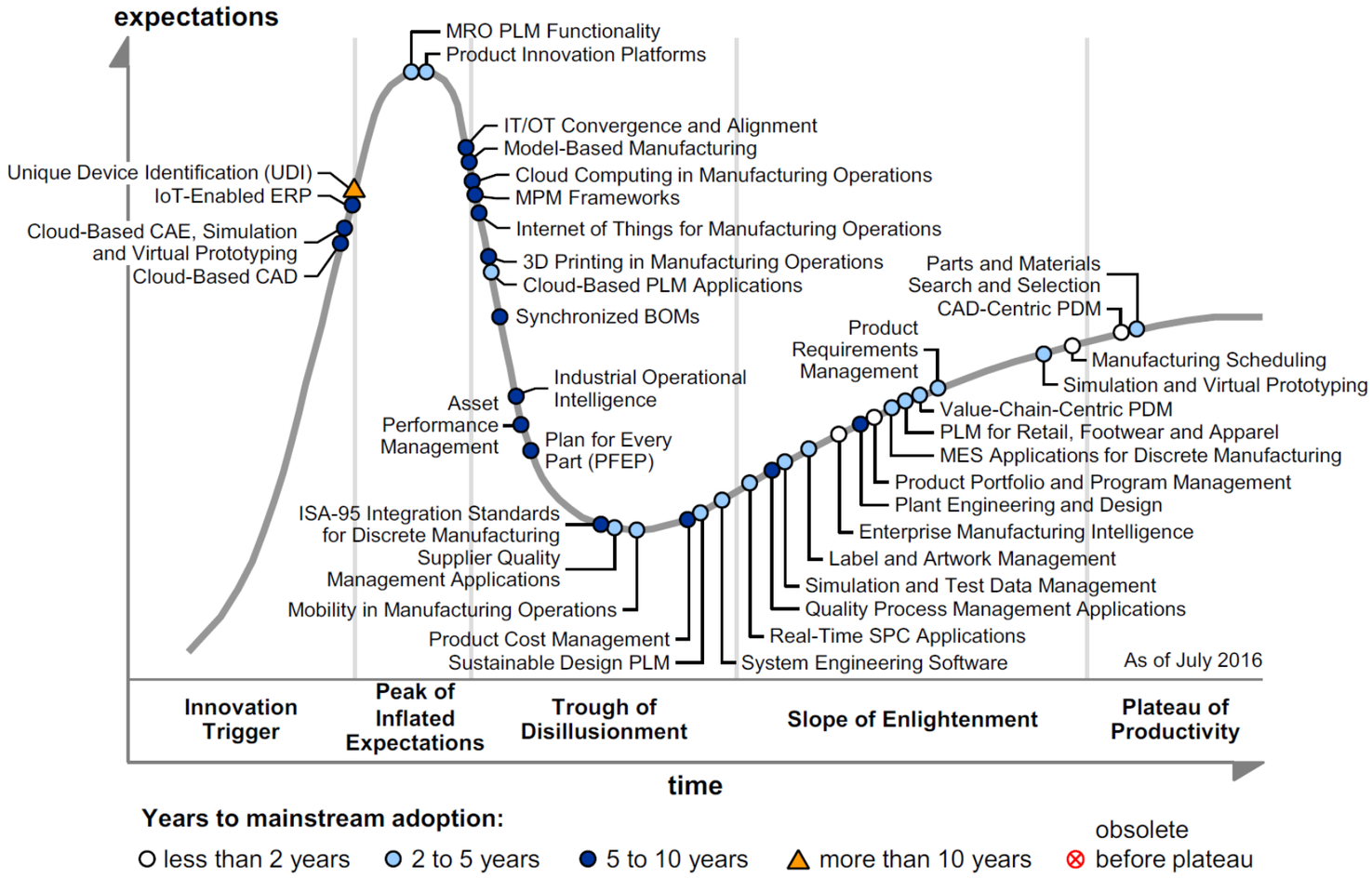
Source: © 2018 ArcherGrey w/Tech-Clarity Survey
To be published Q32018

Gartner Hype Cycle for Discrete Manufacturing and PLM

Relevant PLM Capabilities

- **Plateau of Productivity (Mature tech)**
  - Parts & Materials Selection
  - CAD-Centric PDM
- **Slope of Enlightenment (Stable tech)**
  - Simulation & Virtual Prototyping
  - Product Requirements Management
  - Value-Chain-Centric PDM
  - Product Portfolio and Program Management
  - Simulation & Test Data Management
- **Trough of Disillusionment (Reality overtakes Hype)**
  - System Engineering Software
  - Product Cost Management
  - Sustainable Design PLM
  - Synchronized BOMs
  - Mobility in Manufacturing Operations
  - MPM Frameworks

Figure 3. Hype Cycle for Discrete Manufacturing and PLM, 2016



Source: Gartner (July 2016)

Definitions

- **Digital Transformation/Digital Enterprise –** A digital enterprise is an organization that uses technology as a competitive advantage in its internal and external operations (© TechTarget). Digitalization is the us of digital technologies to change a business model and provide new revenue and value-producing opportunities (©2018 CIMdata/Gartner)
- **Digital Twin -** A digital twin is a virtual counterpart of a real object. As its purpose, a digital twin enables other software/systems to interact with it rather than the real object directly to improve maintenance, upgrades, repairs and operation of the actual object. The minimum elements of a digital twin include the model of the object, data from the object, a unique one-to-one correspondence to the object and the ability to monitor the object. (©2017 Gartner, "Hype-Cycle for Discrete Manufacturers")
- **Digital Thread –** the communication framework that allows a connected data flow and integrated view of the asset's data throughout its lifecycle across traditionally siloed functional perspectives (©2016 IndustryWeek)
- **Synchronized bills of materials (BOMs)** - capabilities refer to associating and updating equivalent items from different BOMs such as engineering, manufacturing, sales/marketing and service, where each of the BOMs is structured differently (©2017 Gartner, "Hype-Cycle for Discrete Manufacturers").

Definitions

- **Industry 4.0 -** Industry 4.0, Industrie 4.0, or the fourth industrial revolution, is a collective term embracing a number of contemporary automation, data exchange and manufacturing technologies. It had been defined as 'a collective term for technologies and concepts of value chain organization' which draws together Cyber-Physical Systems, the Internet of Things and the Internet of Services (© Wikipedia 8July2018)
- **AR / VR: Augmented Reality (AR) / Virtual Reality -** Augmented reality and virtual reality are inverse reflections of one in another with what each technology seeks to accomplish and deliver for the user. Virtual reality offers a digital recreation of a real life setting, while augmented reality delivers virtual elements as an overlay to the real world. (© Augment.com 2015)
- **IoT / IIoT -** The Internet of Things (IoT) is the network of dedicated physical objects that contain embedded technology to communicate, sense or interact with their internal states or the external environment. The Industrial Internet of Things (IIoT) is a core building block for smart factories, many national industrial productivity initiatives and digital business. (© Gartner 2017)

BEST PRACTICES

Best Practices

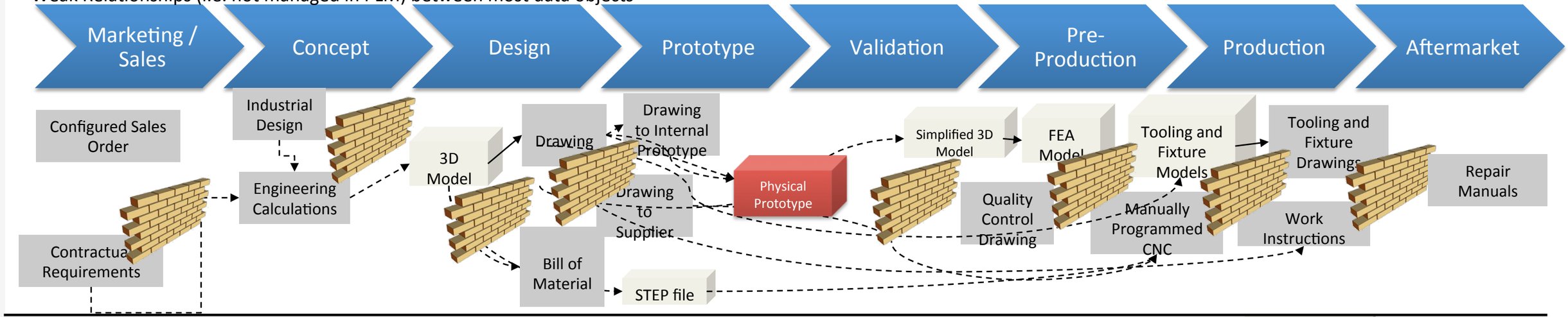
DIGITALIZATION

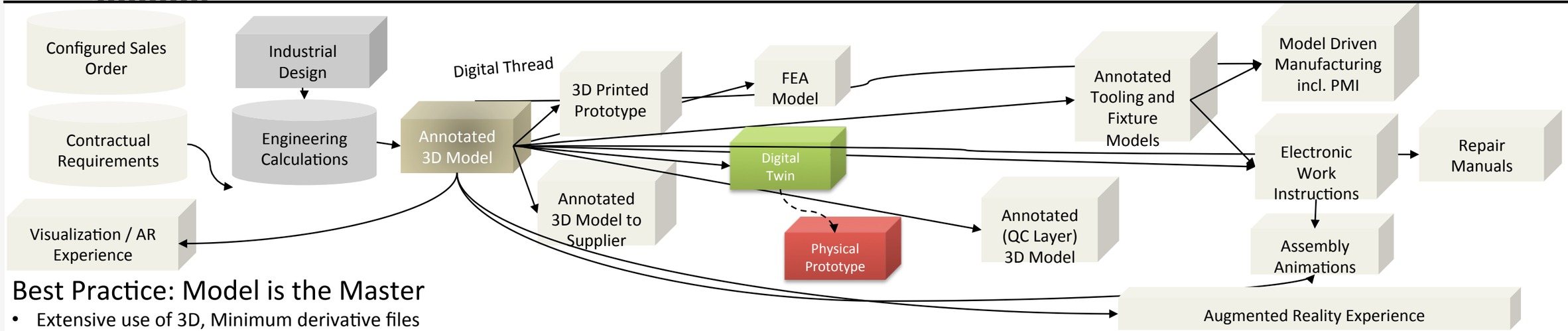
(INCLUDES MBD, DIGITAL THREAD, DIGITAL TWIN, SYNCHRONIZED BOMS)

PLM Digitalization: Model-Based-Definition (MBD)

Common Practice: Drawing is the Master

- Very limited use of 3D, Many derivative files (e.g. .DWG, .STEP, .PDF)
- Weak Relationships (i.e. not managed in PLM) between most data objects

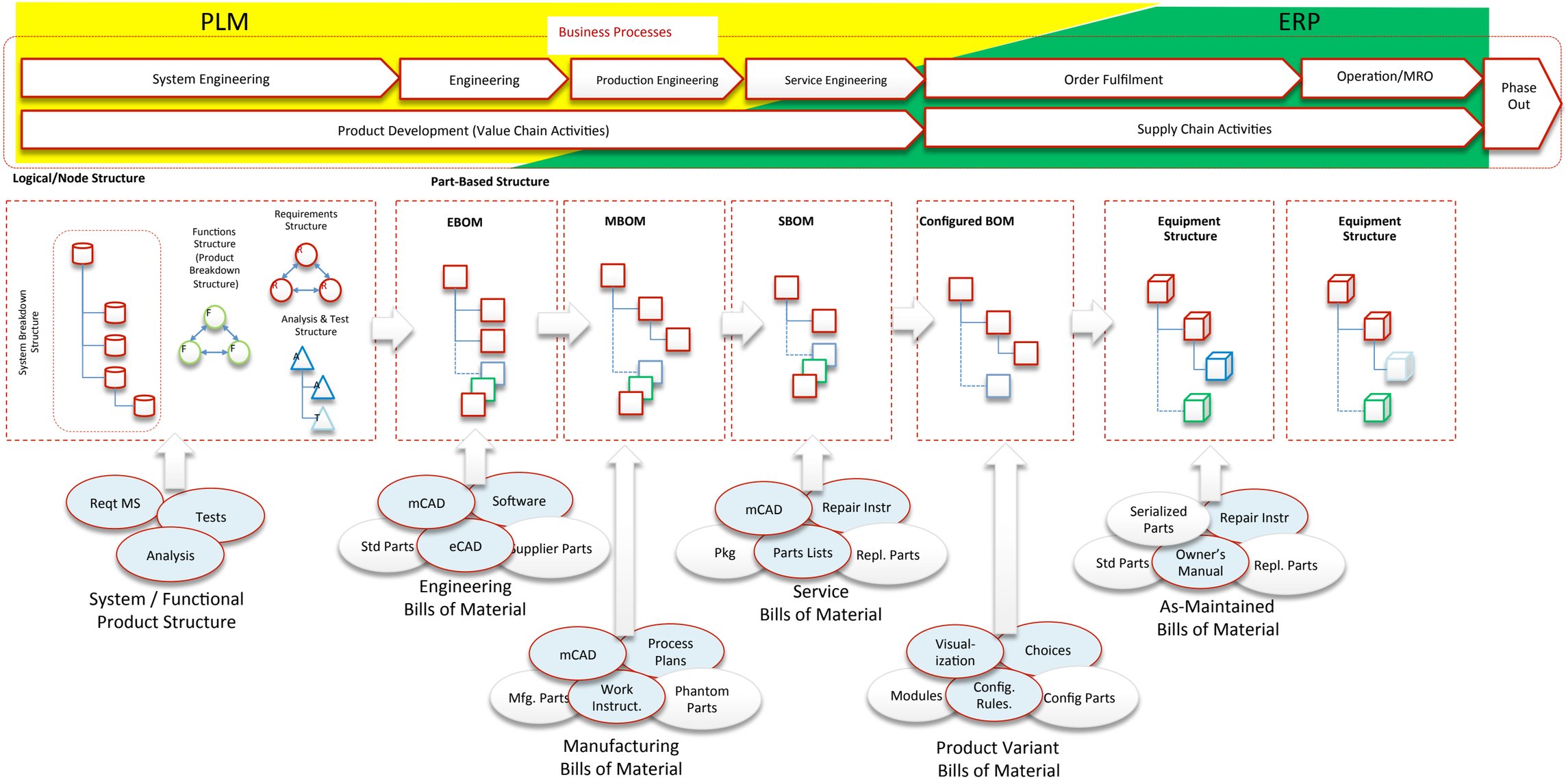




Best Practice: Model is the Master

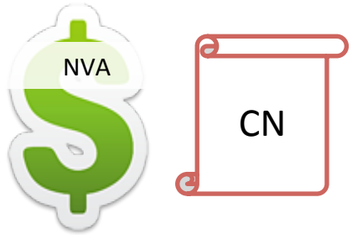
- Extensive use of 3D, Minimum derivative files
- Strong Relationships (i.e. managed in PLM) between most data objects

PLM Digitalization: Synchronized BoMs

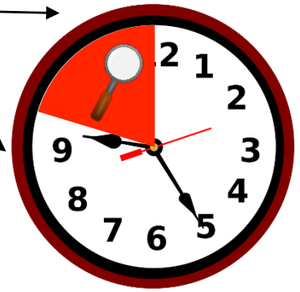


Benefits of Digitalization

- Improve product quality of and reduce errors through design suited for all downstream consumers of the data

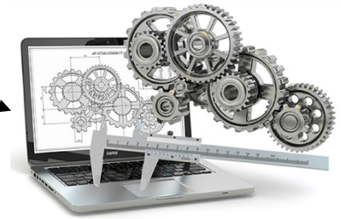


- Increase engineer productivity by search & reuse of data (e.g. Parts Classification, Shape Index Search)



- Rich CAD information can be accessed by non-CAD users in without complex/expensive CAD tools, or spending valuable time generating CAD information in different formats

- Required use of 3D models, annotated with PMI, with suppliers (vs. drawings) improved part quality, engineer/designer know-how, and lowered unit costs



- **20% of engineering costs** are associated with non-value added (NVA) activities. (Coopers and Lybrand)
- **CN creation dropped** dramatically due to improved modeling practices meeting the needs of all downstream users (Anecdote from Solar Turbines)
- It is estimated that **25% of an engineer's time** is spent looking for information. (Benchmark Research)
- The average **knowledge worker spends 2.5 hours per day** searching for information - that is reading emails, searching for information on personal computers, company servers, physical locations and the Internet, and finding information within documents. (IDC)
- **15% of product costs** are related to re-work and re-use issues. (AT Kearney)
- Engineers learned to model within supplier capabilities thus **reducing part cost**, **improving quality**, and allowing Purchasing to **negotiate away supplier remodeling costs** (Anecdote from Cummins)

Benefits of incorporating a Digital Twin

The benefits expected from having a *digital twin* for each product unit include:

- More effective assessment of a system's current and future capabilities during its lifecycle
- Early discovery of system performance deficiencies by simulating results way before physical processes and product are developed
- Optimization of operability, manufacturability, inspectability, and sustainability leveraging models and simulations applied during the entire lifecycle of each tail number
- Continuous refinement of designs and models through data captured and easily crossed referenced to design details

Source: ©2016 IndustryWeek

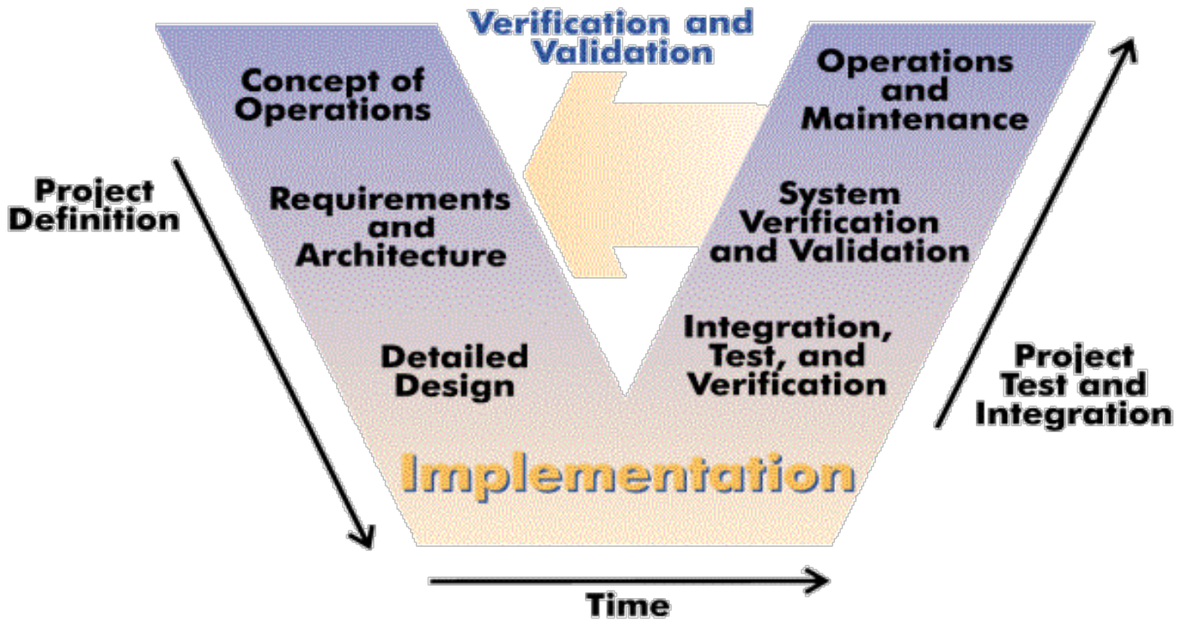
Best Practices

SYSTEMS ENGINEERING

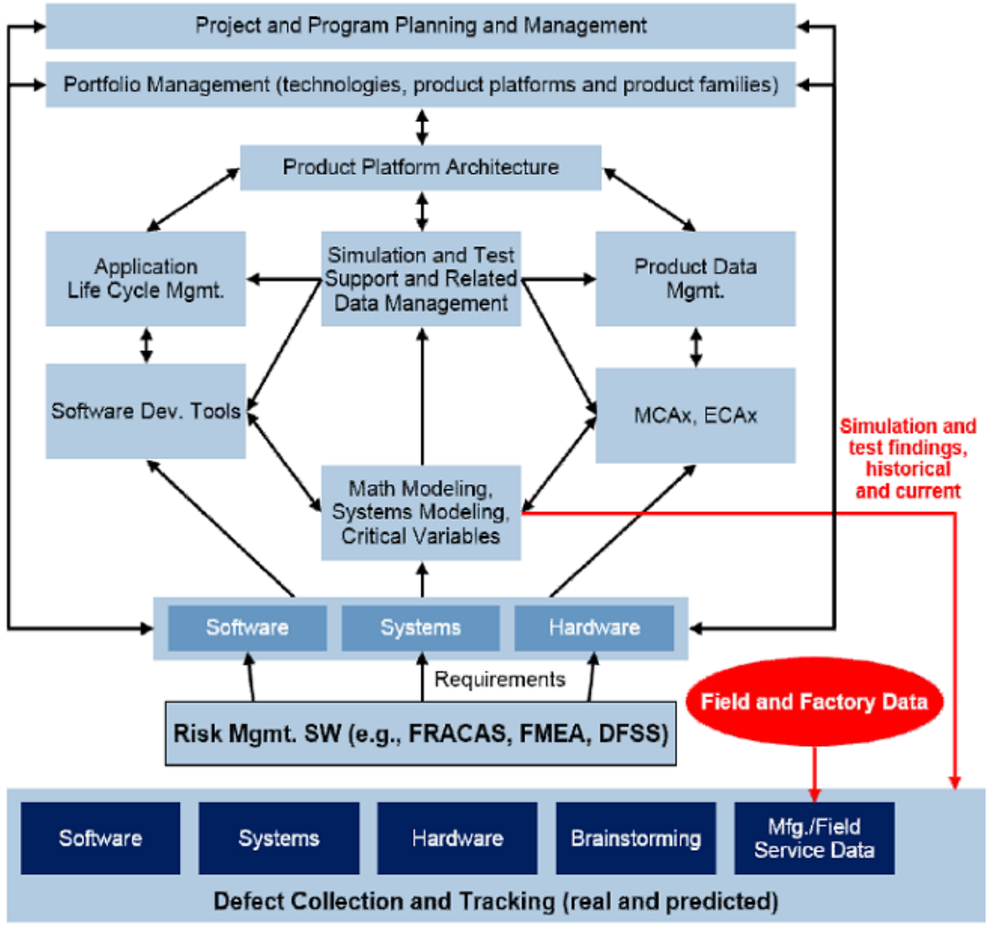
(INCLUDES V-MODEL PROCESS, SYSTEMS ENGINEERING, SIMULATIONS, DIGITAL TWIN)

Systems Engineering and Simulation

Process Perspective



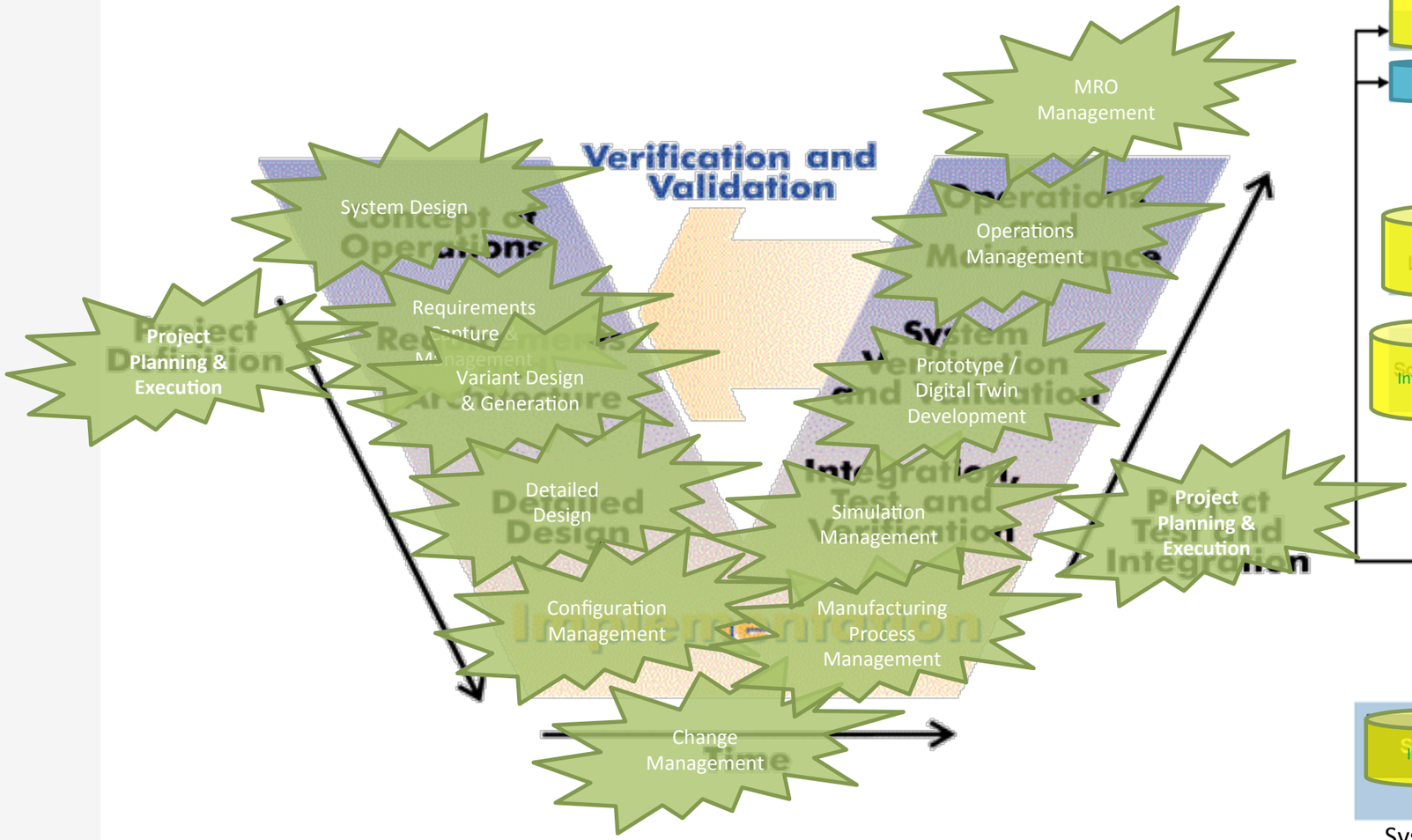
Capabilities Perspective



Systems Engineering and Simulation Diagram: ©2017 Gartner

Systems Engineering and Simulation

Process Perspective



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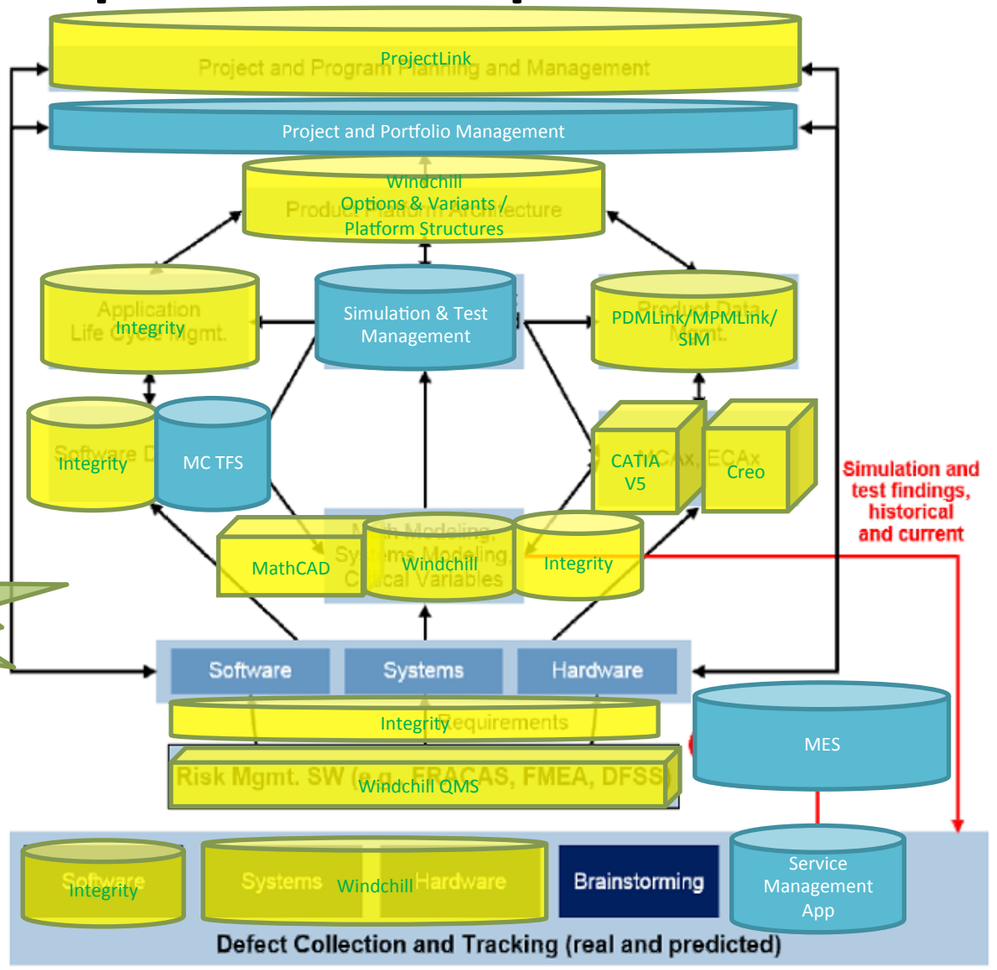


Systems Engineering and Simulation Diagram: ©2017 Gartner

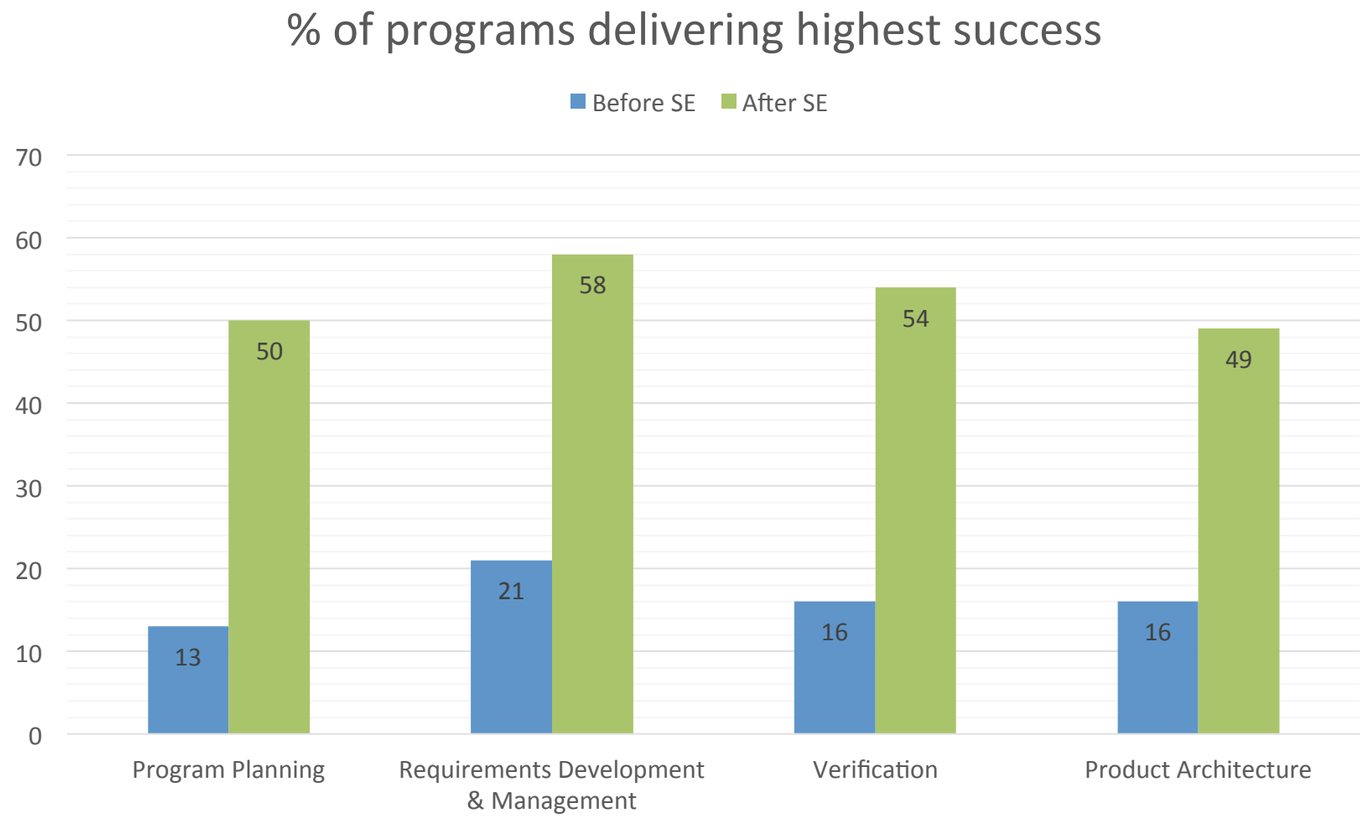
Benefits of Systems Engineering

Reasons for difficulty in quantifying the ROI on Systems Engineering

- Risks that didn't materialize
- Rework that didn't need to be done
- Customer complaints that didn't occur
- Product deficiencies that are circumvented

Key Findings

- Significant positive impact of Systems Engineering on the performance of primarily Industrial Manufacturing and Services businesses(116 of 147)
- Systems Engineering is still no silver bullet



Source: ©2013 Report from Carnegie Mellon University's Software Engineering Institute "The Value of Systems Engineering", SEI Blog

ArcherGREY

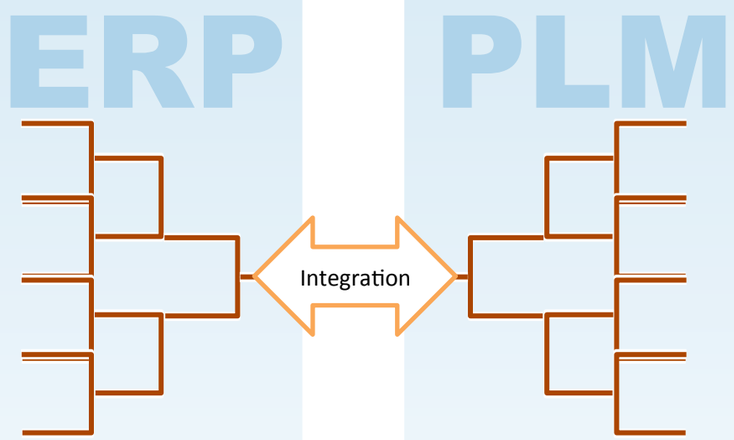
Best Practices

PLM AND ERP

Like ERP Systems, PLM is a Consolidation Strategy

ERP has Consolidated:

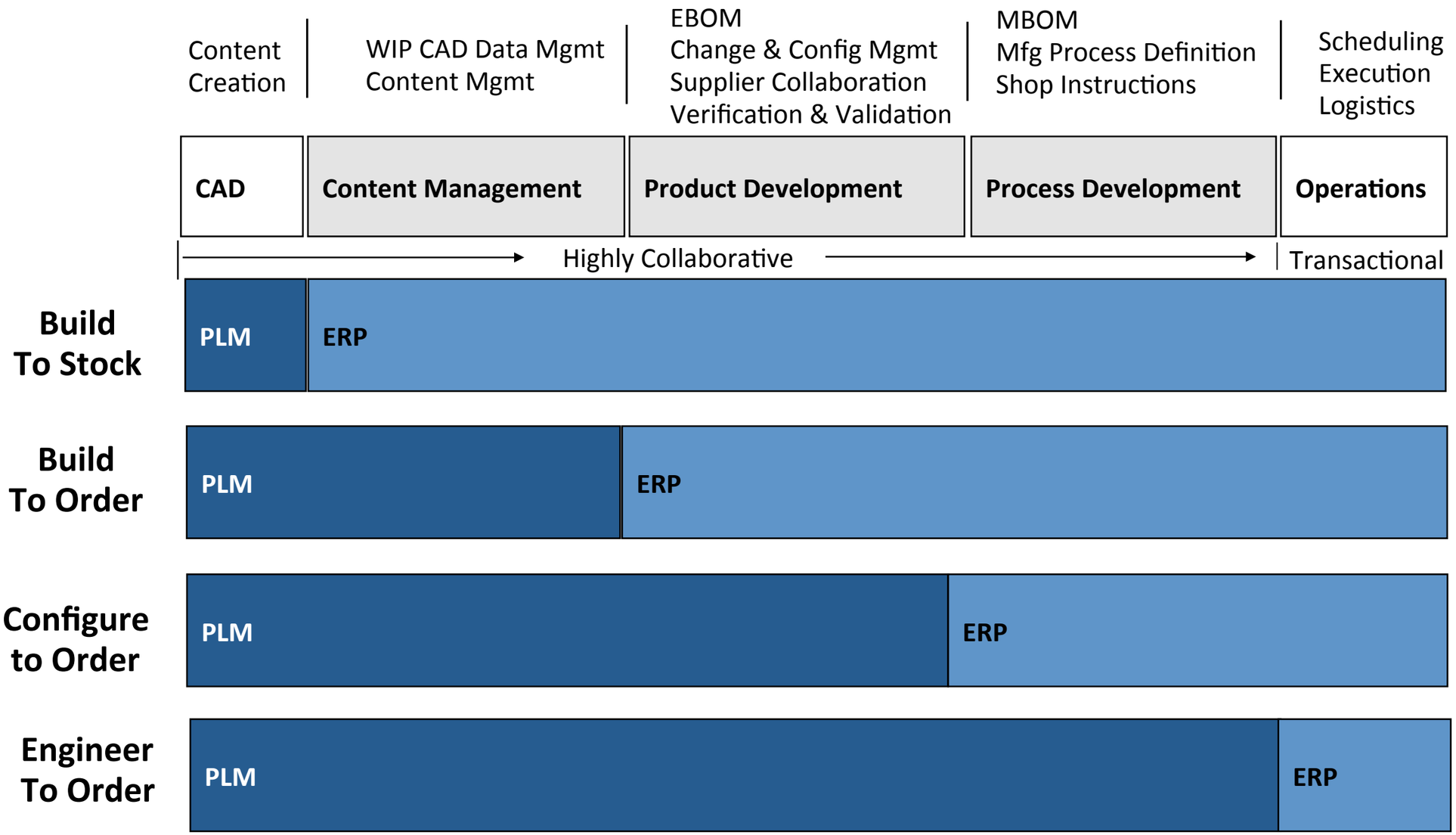
- Financials
- Accounting
- Human resources
- Procurement
- Manufacturing resource planning
- Supply chain management
- Supplier relationship management
- Customer relationship management



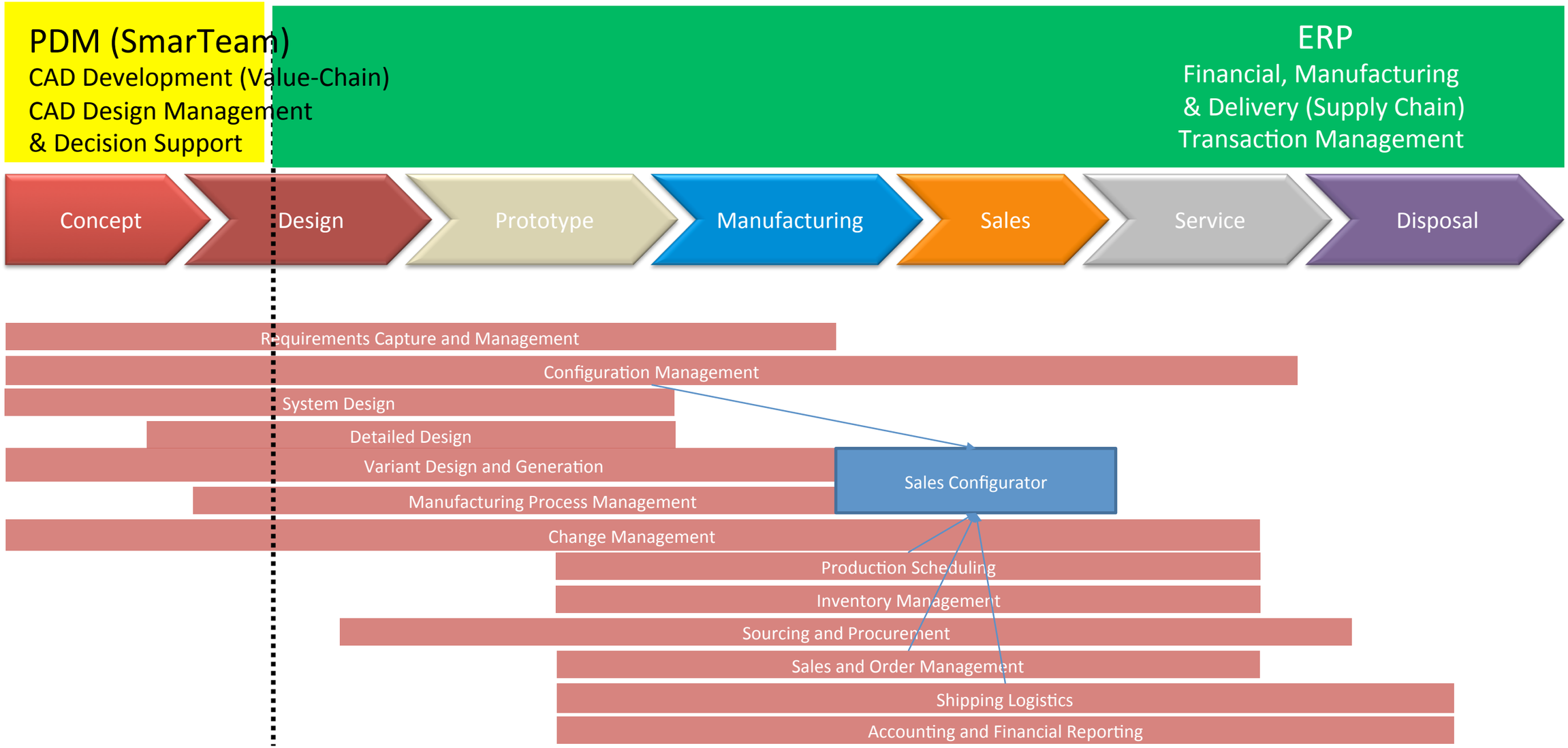
PLM is Consolidating:

- Mechanical CAD
- Simulation
- Manufacturing Process Management
- Digital Mockup
- Technical Publications
- Requirements Management
- Visualization and Markup,
- Project Management
- Portfolio Management
- Component Management
- Supplier Management
- Product Data and Configuration Management
- Content Management & Workflow
- Quality Management

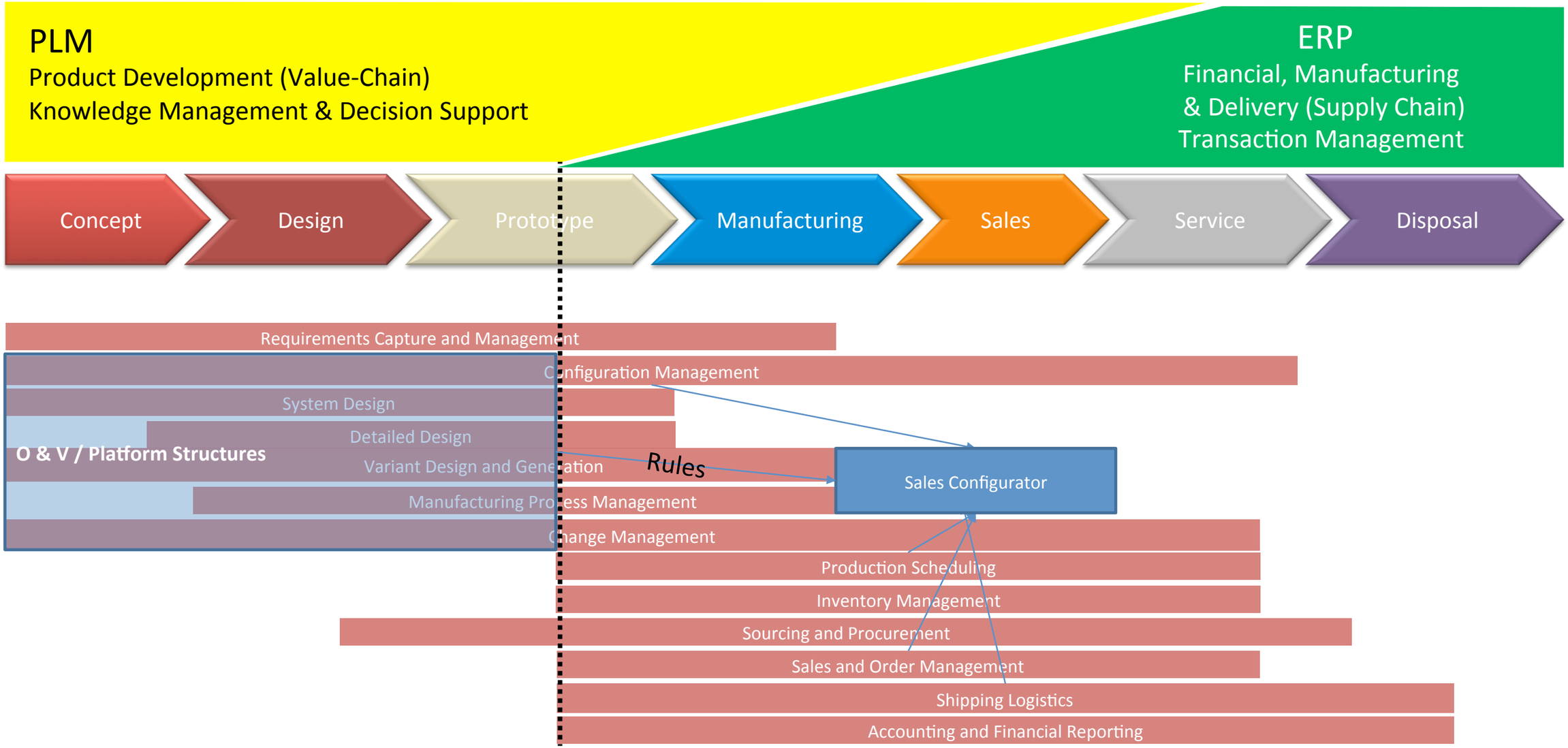
Traditional lines of demarcation between PLM and ERP



Defense: PDM and ERP Concepts & Processes



Best Practice PLM and ERP Concepts & Processes



CONCLUSION

PLM Strategy

PLM is More About Discipline, Process, and Culture Than Software

PLM is a discipline for guiding products and product portfolios from ideas through retirement to create the most value for businesses, their partners and their customers

Gartner

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QUESTIONS?