

# The State of PLM: Deep Dive on Leading Trends

2021 CIMdata PLM Market & Industry Forum—June 2021

## State of PLM: Deep Dive on Leading Trends

PLM Market & Industry Forum

A CIMdata PLM Leadership Event

June 2021

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Global Leaders in PLM Consulting  
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#plm4um

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## 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.**

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# The State of PLM: Deep Dive on Leading Trends

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### Key Takeaways

*State of PLM: Deep Dive on Leading Trends*

- The sheer volume of PLM trends and potential technological & non-technological disruptors is staggering
  - Keeping track of them can be a never-ending task, we, as PLM professionals, must consistently seek to do so
  - We cannot afford to miss the opportunities, or worse, allow our clients to take a path that leads to failure
- We must continually expand the scope of study, rethink strategies and capabilities, as well as embrace the fundamental shifts in need & capabilities
  - Only by doing so will PLM environments return their maximum value
- Finally, we must seek to continually narrow the implementation value gap
  - Defining and implementing new capabilities that allow our clients to stay current and leverage the additional value new capabilities provide

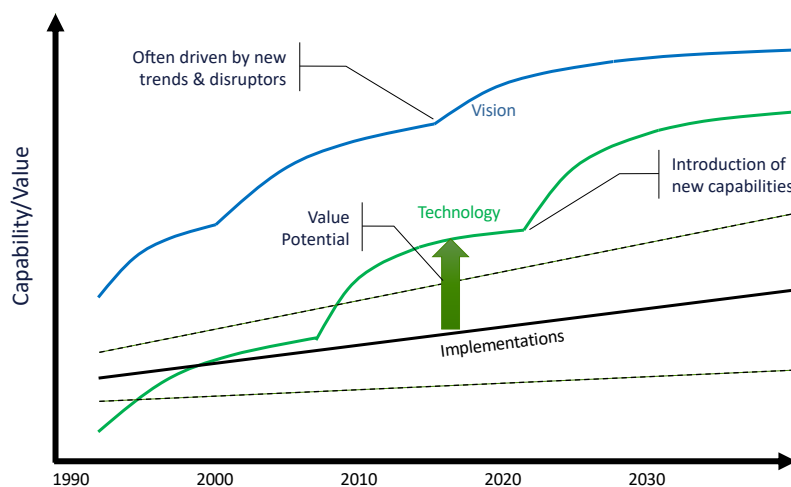
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### Typical Software Delivery & Adoption Cycle

*The delivery of functional capabilities (i.e., technology) typically follows vision, with implementations following*



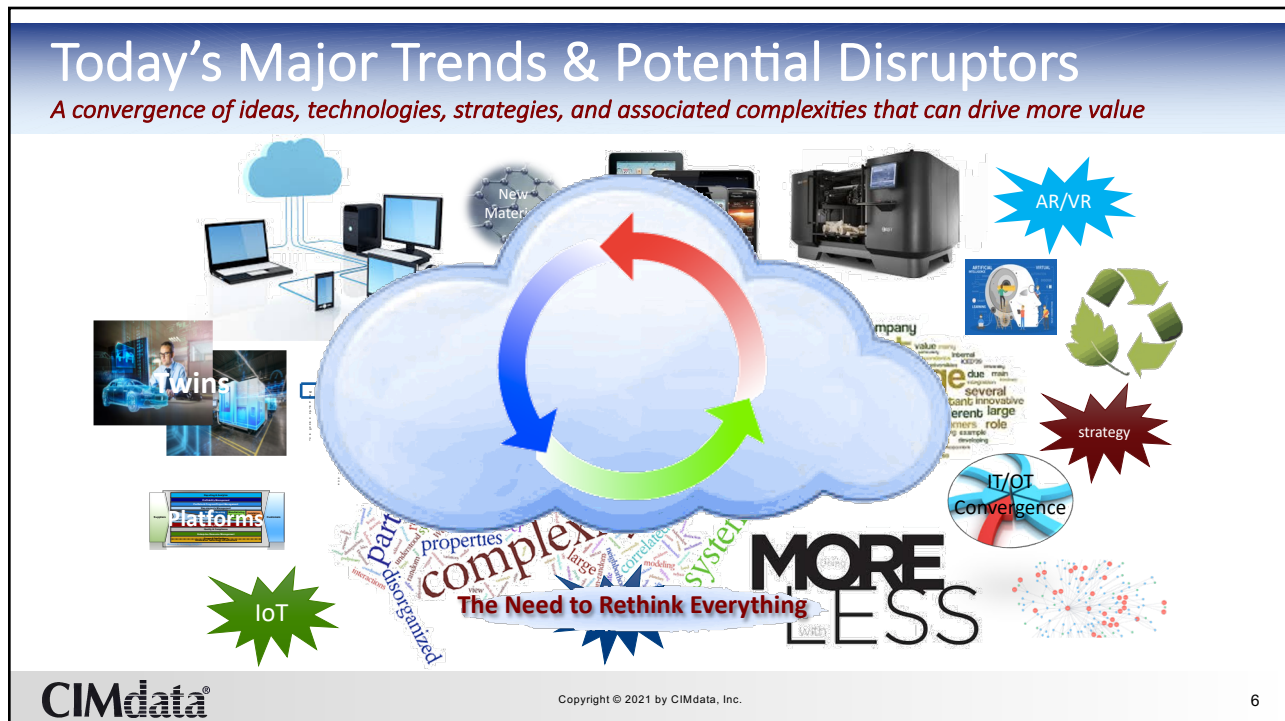
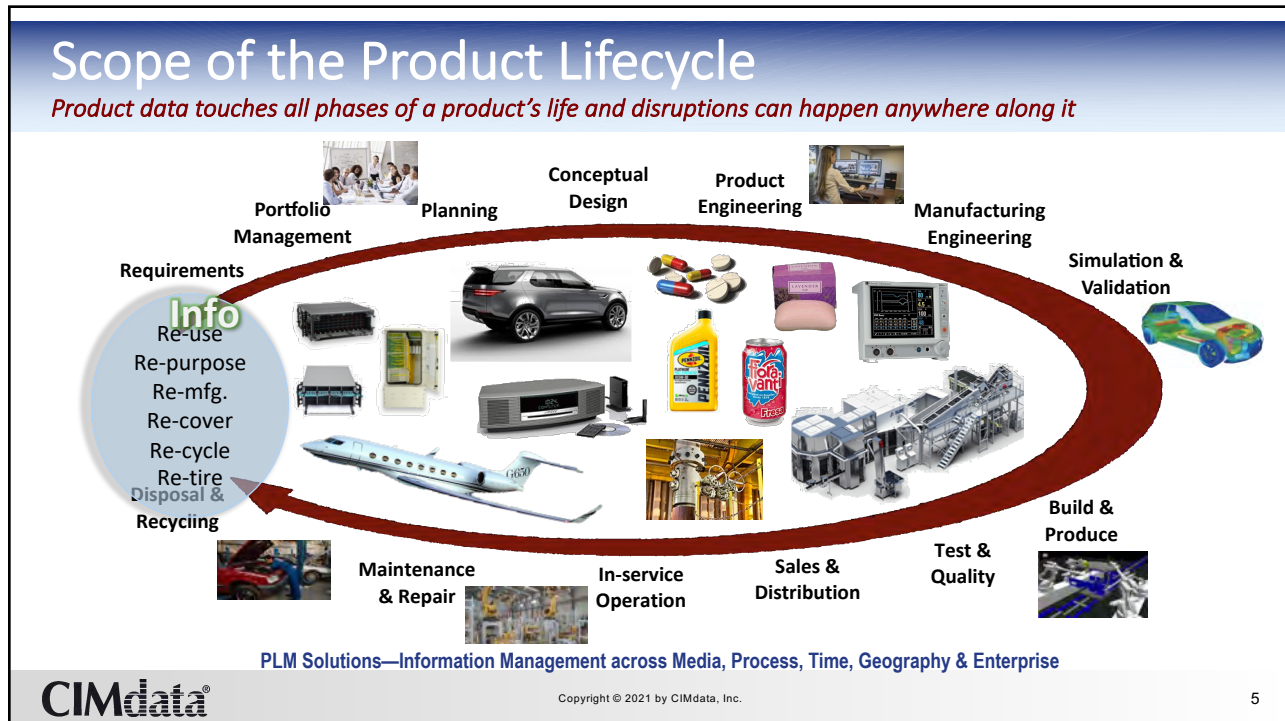
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### Megatrends Affecting Business & Society

*SMAC = Social, Mobile, Analytics, and Cloud plus the Internet of Things—enabling today's digital transformation*

**Social**

**Mobile**

**Cloud**

**Analytics**

**IoT**

<http://www.horizontegro.org/imagenes/logos/20-social-media-icons/20-social-media-icons/social-media-icons-114x144.png>  
<http://ireg.com/apple-repair-news/ipad-repair-for-ipad-air-creativity-seals-the-deal/>  
<http://i2.cdn.turner.com/cnn/dam/assets/130502212037-internet-of-things-graphic-story-top.jp>

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### Death of Product Development as We Know It

*Product development as we have known it is dead and there are many factors as to why*

- Closed-door, experts-only approach to defining & engineering products is no longer good enough
- The old ways of working are being flattened by...
  - Unlocking files ► moving to data
  - The new social-savvy workforce
  - Internet-enabled, always-on mobile connectivity—constant collaboration
  - The consumerization of IT (bring your own device, work on cloud, etc.)
  - The “maker” movement, 3D printing, and design-centric thinking
  - Ever-increasing product & process complexity, and relentless global competition

***PLM practitioners must expand their scope, rethink strategies & capabilities, and embrace the fundamental shifts in PLM requirements & their implementations!***

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### Additive Manufacturing (AM) Possibilities

*3D printing materials range has increased substantially—success requires thinking & operating differently*

Traditional  
Assembly

AM Single  
Component

Fabrics

Organics

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### GenDesign, AdvMat & Additive Manufacturing

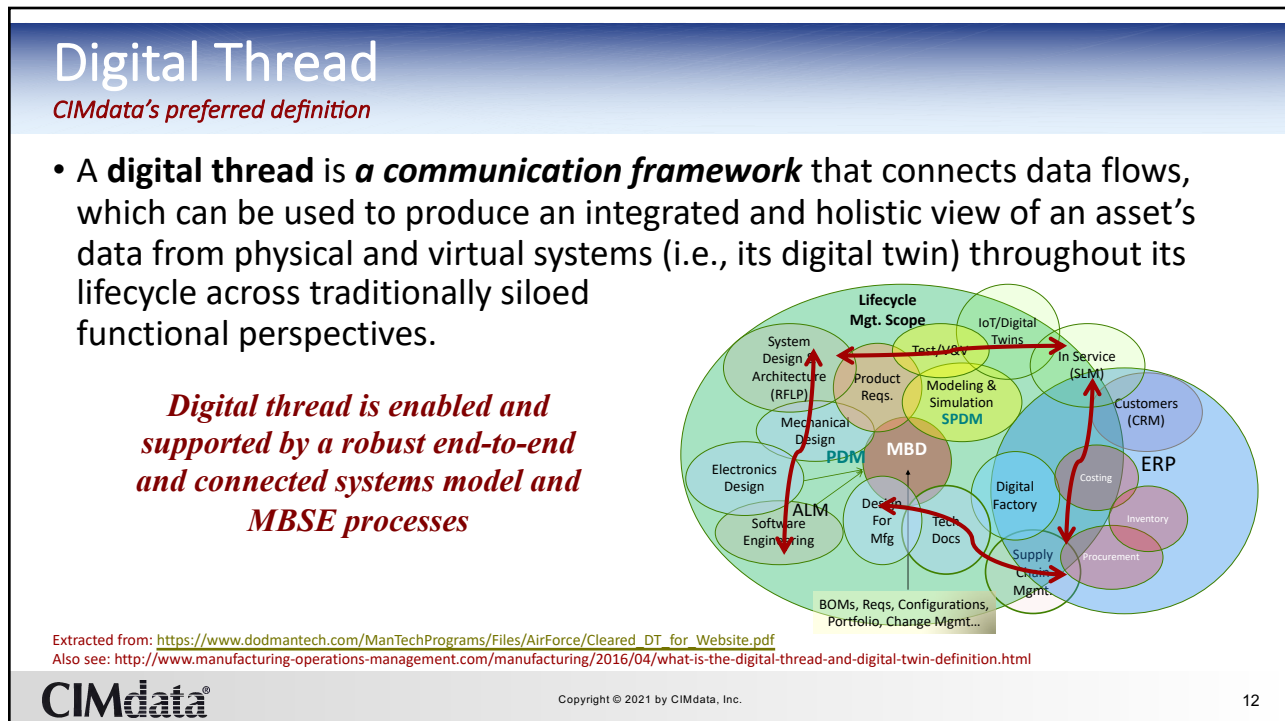
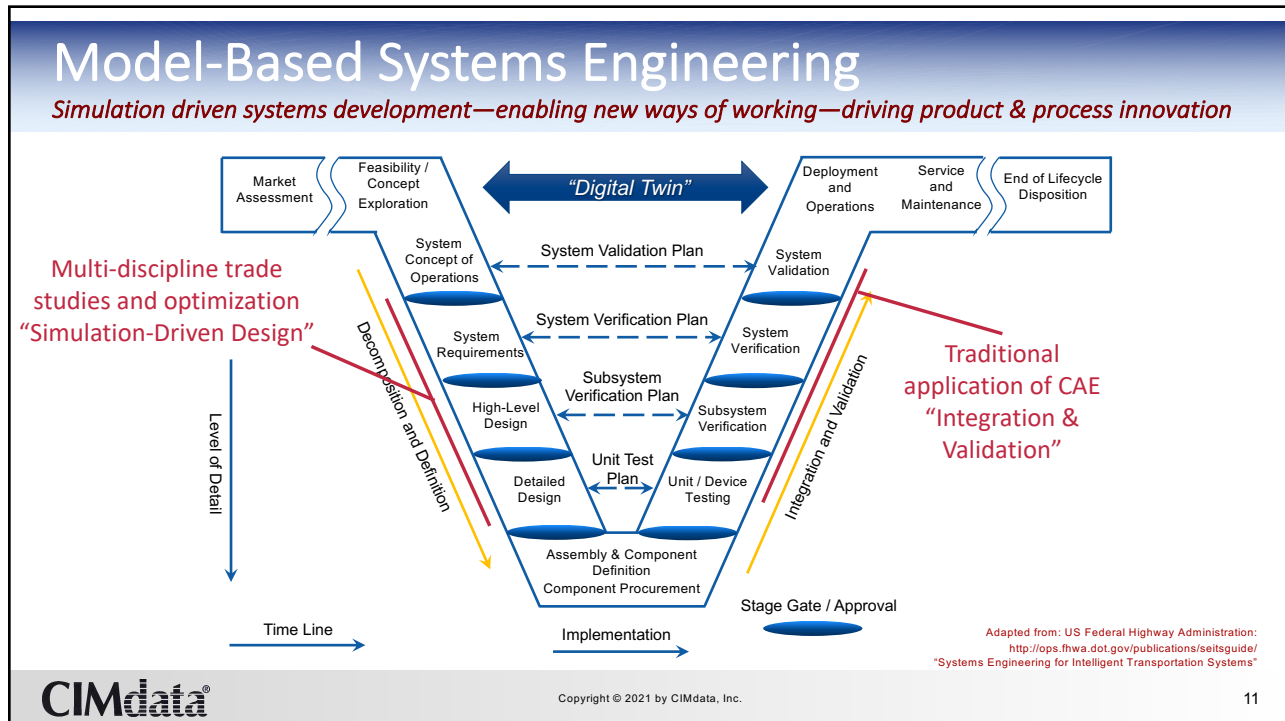
*Convergence of capabilities that can be used to drive significant value*

- Generative Design
- Advanced Materials (AdvMat)
- Additive Manufacturing (AM)
- ...alone or together will enable incredible innovation in years to come
- ...aided by other process and IT technologies

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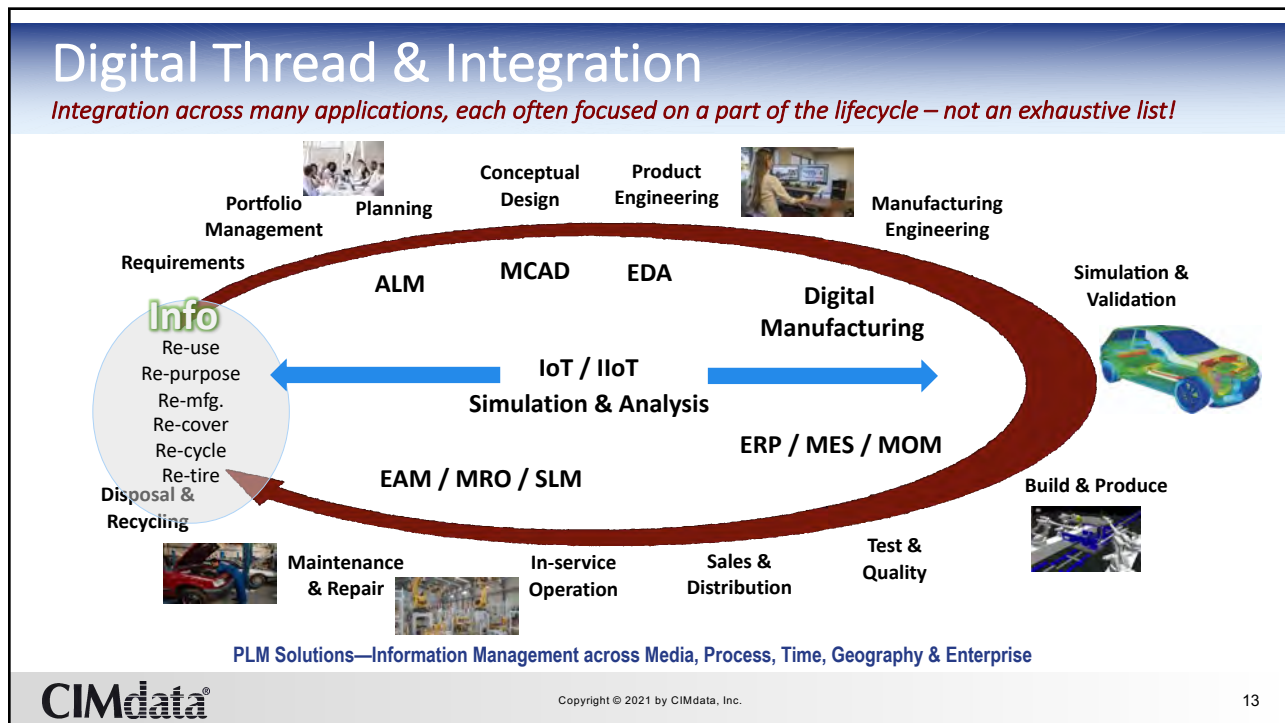
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### Digital Twin

*CIMdata's preferred definition\**

- 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 of the Product

Digital Twin of Production

Digital Twin of Service

*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](http://www.assessinitiative.com))

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### Augmented/Virtual Reality

*Closing the gap between the digital and the physical worlds—all driven by product data*

- Virtual reality: artificial, computer-generated simulation or re-creation of a real-life environment or situation
- Augmented reality: technology that layers computer-generated enhancements atop an existing reality to make it more meaningful through the ability to interact with it

- Superimpose digital info on the real world

AR in Mercedes-Benz's Rescue Assist app gives first responders an inside look



[techcrunch.com/2016/07/27/ar-in-mercedes-benz-rescue-assist-app-gives-first-responders-an-inside-look/](https://techcrunch.com/2016/07/27/ar-in-mercedes-benz-rescue-assist-app-gives-first-responders-an-inside-look/)

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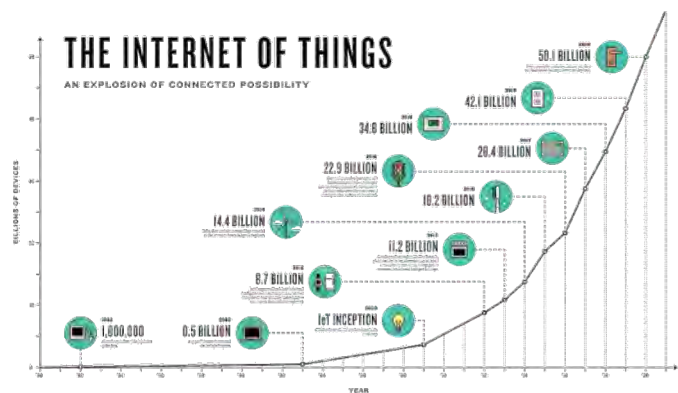
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### The Era of IoT & Smart-Connected-Devices

*The numbers are staggering—key to closing the loops that exist throughout a product's lifecycle*

- The Internet & inexpensive memory has made it economically feasible for almost everything to be smart & connected
  - “Things” with processors, sensors, software, and connectivity that allow data to be exchanged between the “thing” and its environment, manufacturer, operator/user & other products and systems
  - Many of the enabling technologies, like AI/ML, are early in their adoption lifecycle so there is still a lot of experimentation driving learning



<https://www.reddit.com>

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### Data Debris: Finding the Gold

*Finding insights, trends, and correlations in Big Data Debris*



- Big Data provides opportunities—with a huge challenge—how to sift it using the evolving data analytics tools & techniques (e.g., AI/ML)
  - Companies are overwhelmed & drowning in the data lake
- Knowledge and insights are built up from countless data points, we must find the right points
- Industrial companies need to understand...
  - What data are needed to design more competitive products?
  - What are the best ways to retrieve this information?
  - How can measurements—data in the raw—be placed in their proper informational contexts, e.g., trends and correlations?
  - What predictive analyses can be applied in support of closing the loops?

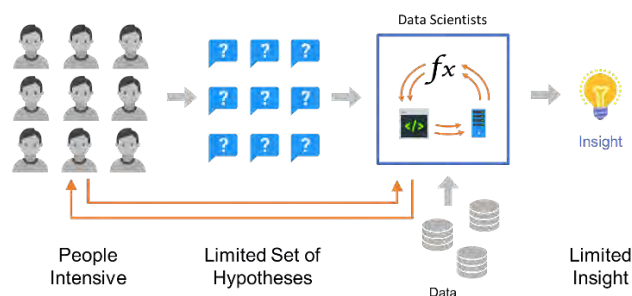
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### Traditional Analytics Problem Statement

*Traditional analytics are highly dependent on specialists & are saddled with constraints—new methods are needed*



- Slow, iterative process**
- Incomplete & missing insights**
- Supports Analysts**
- Limited to intuition or traditional ML**

*New methods and advanced analytics software tools are needed to quickly unlock actionable insight*

Courtesy of SIAI, a SymphonyAI Group company

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### A Proven TDA Approach

*SIAI, a SymphonyAI Group company, focuses on defining & delivering AI-driven solutions that provide high value*

Extremely Fast and Accurate      Transparent and Documented      Updated Continuously

**Fast, data-first approach**  
**Comprehensive & deep insights**  
**Supports Domain Experts**  
**TDA-enabled Explainable Machine Intelligence**

*A proven approach that accelerates the investigation of known-unknowns, and inherently probes the sea of data for patterns that reveal predictive insights from unknown-unknowns*

Courtesy of SIAI, a SymphonyAI Group company

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### The Emergence of the Graph Database

*The what and the why...*

- In a **graph database**, the relationships are stored at the individual record level, while in a **relational database**, the structure is defined by tables
  - If the *relationships between data*, not the data itself, are your main concern, then a graph database is in order
  - Graph databases are best suited for exploring highly connected data
- Graph databases are inherently more flexible than relational databases because it is possible to treat the metadata about the database as data itself
  - Until comparatively recently, this flexibility came at the expense of performance, but with the shift to GPUs, that performance disadvantage has largely disappeared
  - It turns out that a graph database is not that much different (in fact they are near identical) to the meshes used in graphics processing

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## Application Containerization

*A rapidly developing technology that is changing the way developers test & run application instances in the cloud*

- An OS-level virtualization method used to deploy and run distributed applications without launching an entire virtual machine (VM) for each app
- Here, multiple isolated applications or services run on a single host and access the same OS kernel
- In general, containers work on cloud instances and virtual machines, across Linux and select Windows and Mac OS's
- Pros: efficiency for memory, CPU and storage; portability; and producibility
- Cons: lack of isolation from the core OS—some experts warn that security threats have easier access to the entire system
- Remember: Containerization is a relatively new and rapidly developing enterprise-level IT methodology

<https://searchitoperations.techtarget.com/definition/application-containerization-app-containerization>

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## Low-Code/No-Code Development Platforms

*The basics as they pertain to PLM*

- A development environment used to create application software through a graphical user interface instead of traditional hand-coded programming
- Such a platform may produce entirely operational applications or require additional coding for specific situations
- These platforms reduce the amount of traditional hand coding, enabling accelerated delivery of business applications
- These platforms trace their roots back to 4th-generation programming languages & rapid application development tools of the 1990s & early 2000s
  - Often based on the principles of model-driven design, automatic code generation, and visual programming

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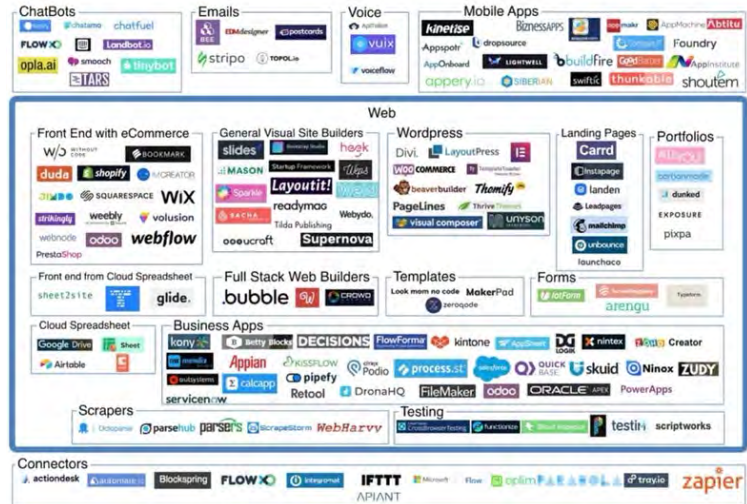
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### Will the Low-Code/No-Code Movement Kill Code?

*High degree of possibility when considering system configuration and extension*

- *No-code solutions* are built to help those who might not have any technical skills to build something
- *Low-code development* is more focused around developers to help design applications quickly and with minimum hand-coding



<https://marionoioso.com/2019/09/09/low-code/>

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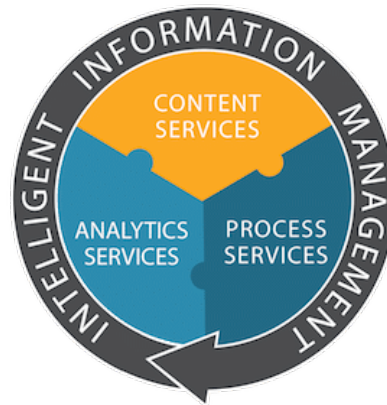
### Intelligent Information Management (IIM)

*IIM building blocks—sounds a lot like the PLM strategy we have been talking about for decades*

- A practice that integrates people, processes, information, and technology to achieve digital transformation

#### A modern enterprise requires:

- ...a flexible and modular approach that utilizes content and information wherever and whenever it is needed — **CONTENT SERVICES**
- ...process tools that can be delivered with the simplicity of an app, but within a framework that allows the business to remain in control — **PROCESS SERVICES**
- ... automated tools to prepare ALL of its information — both data and content — for the era of machine learning — **ANALYTICS SERVICES**



<https://info.aiim.org/aiim-blog/defining-intelligent-information-management>

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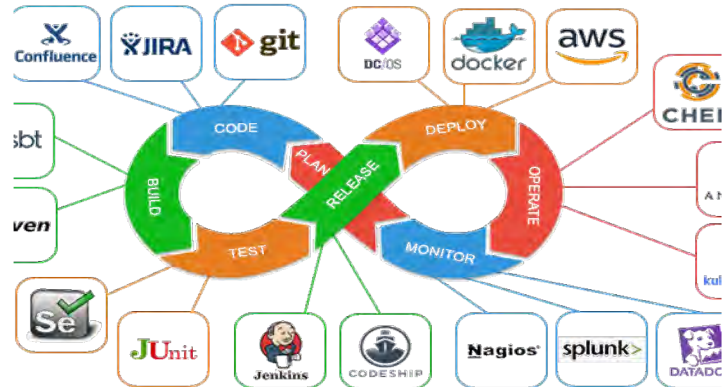
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### DevOps

*As PLM is delivered as a service, the need for DevOps skills & capabilities will increase*

- A set of practices that combines software development (Dev) and IT operations (Ops)
- It aims to shorten the systems development lifecycle and provide continuous delivery with high software quality
- It is complementary with Agile software development
  - Several DevOps aspects came from the Agile methodology



<https://www.pentalog.com/blog/the-devops-engineer-job-explained>

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### Agile Software Development

*The most common application of Agile*

- Historically, Agile is a group of software development methodologies based on a definition that crystalized with the release of *The Agile Manifesto*<sup>1</sup> in 2001

#### Agile Core Values

- **Individuals & interactions** over Processes & Tools
- **Working software** over Comprehensive documentation
- **Customer collaboration** over Contract negotiation
- **Responding to change** over Following a plan

*It's about doing the right thing, not doing things completely right*

<sup>1</sup><http://agilemanifesto.org/>

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### Agile Methodology in Product Development

*It is important to deal with the misperceptions related to Agile*

- There is this perception that Agile applies only in software development
- Times are changing, and we are seeing more and more applications of Agile in broader product development and even in sales and marketing departments
- The core principles of Agile translate very well beyond software development, to mechanical and electrical product development as well other enterprise disciplines

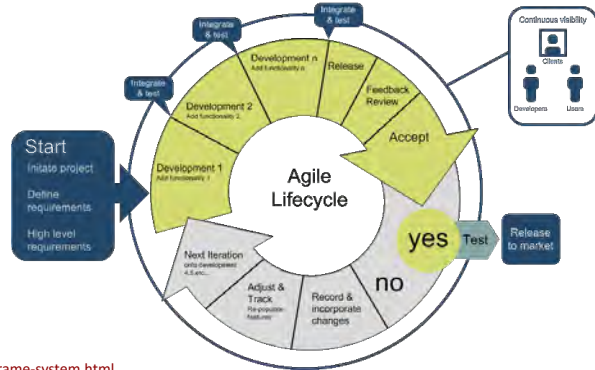


Image: <https://www.mphasis.com/home/thought-leadership/blog/agile-framework-on-mainframe-system.html>



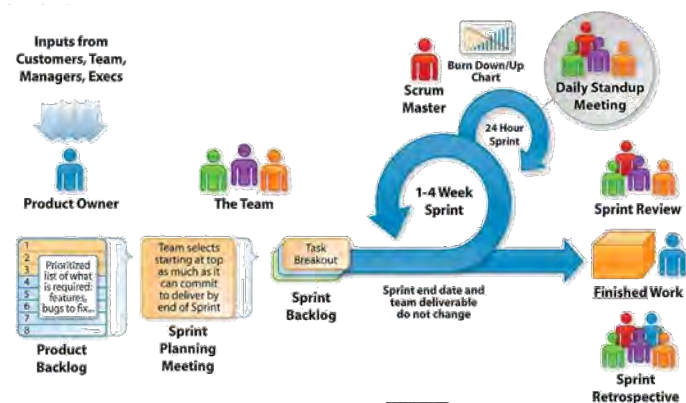
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### Main Features of Agile Product Development

*Agile requires the assessment of the project all throughout the product development lifecycle*

- Iterative
- Incremental
- Reduces costs of development
- Reduces time-to-market
- Responsive to change



<https://www.performatix.com/agile-project-management-product-engineering-services/>



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## Agile Encourages Collaboration & Interaction

*Rigid rules and lines of authority should be discouraged*

- Agile prioritizes the individuals within the development team & their interaction
  - Putting them above the tools and processes that they use in the process
- With Agile, collaboration is given more emphasis, as members of the product development team put their heads together to solve problems
- Personnel or people empowerment is prioritized
- Members of the team feel more motivated when they feel that they are working *with* other people in the team, instead of *for* a person of authority
- *Self-organization* is greatly encouraged in a product development environment that follows the Agile methodology

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## Agile: A Warning

*When you start you must fully understand where Agile does or does not work*

- Agile is not a panacea...it is most effective and easiest to implement where:
  - The problem to be solved is complex
  - Solutions are initially unknown
  - Product requirements will most likely change
  - The work can be modularized
  - Close collaboration with end users (and rapid feedback from them) is feasible
  - Creative teams will typically outperform command-and-control groups
- These conditions exist for many product development functions, strategic-planning activities, supply-chain challenges, and other business decisions
  - Less common in routine operations such as MRO, purchasing, sales & accounting

<https://hbr.org/2016/05/embracing-agile>

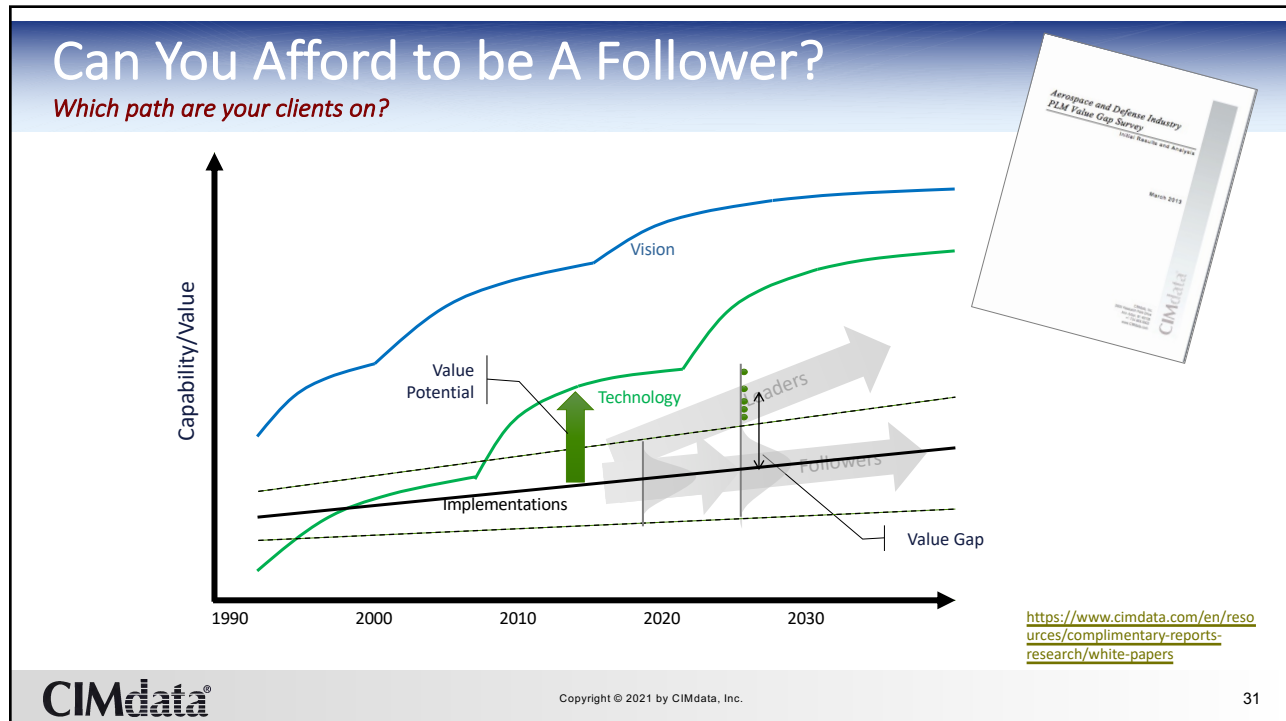
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### Concluding Remarks

*State of PLM: Deep Dive on Leading Trends*

- As PLM professionals, we must continually expand the scope of our study, rethink our strategies and capabilities, as well as embrace the fundamental shifts in business requirements & enabling technologies
  - Only by doing so will the PLM environments we support return their maximum value to our clients
- The sheer volume of PLM trends and potential technological & non-technological disruptors is staggering
  - Keeping track of them can be a never-ending task, we, as PLM professionals, must consistently seek to do so
  - We cannot afford to miss the opportunities, or worse, allow our clients to take a path that leads to failure
- We must seek to continually narrow the value gap & increase PLM's ROI

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