

# The Digital Thread: The Industrial Perspective

2023 Market & Industry Forum—4 April 2023

**CIMdata**

**The Digital Thread:  
The Industrial User Perspective  
PLM Market & Industry Forum  
A CIMdata Leadership Event**

**4 April 2023—Frankfurt, GERMANY**

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# The Digital Thread: The Industrial Perspective

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### Presenter's Profile



James Roche  
Aerospace & Defense  
Practice Director

- 35+ years of experience in transformation and IT enablement of product development and manufacturing processes.
- Strategic advisor and program manager for PLM programs across the Americas, Europe, and Asia.
- PLM Practice Manager at CSC Consulting and at A.T. Kearney.
- Previously with EDS, served as chief architect for General Motors' worldwide engineering systems.
- Areas of Focus
  - Facilitating cooperation within the aerospace and defense industry
  - Strategically expanding PLM within aerospace and defense companies
  - Extending PLM from airframe and propulsion OEMs to their external value chains

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### Key Takeaways



*What you should understand at the end of this session*

- Perspectives of industry leaders regarding the nature of the digital thread and drivers for investment
- Where and how industry leaders have successfully implemented portions of their digital thread vision
- Where and how industry leaders are planning to invest in future expansion of their digital thread vision
- The most significant barriers that have been faced and mitigation methods employed by industry leaders in pursuit of their digital thread vision
- How industry leaders view the current state of digital thread enabling technologies and the degree of alignment with their solution providers

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### Agenda

- Introduction
- Digital Thread Status & Trends in Industry – Research Findings
  - The What & Why of the Digital Thread
  - The Current Reality of Digital Thread in Industry
  - Planning Investment for Digital Thread Expansion in Industry
  - Solution Capability and Provider Alignment
- Concluding Remarks

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### Aerospace & Defense PLM Action Group


#### Mission

An association of aerospace & defense companies within CIMdata's globally recognized PLM Community Program, which functions as a **PLM advocacy group** to:

- Set the direction for the aerospace & defense industry on PLM-related topics that matter to members
- Promote common industry PLM processes and practices
- Define requirements for common interest PLM-related capabilities
- Communicate with a unified voice to PLM solution providers
- Sponsor collaborative PLM research on member-prioritized industry and technology topics

*Founded in February 2014 – Website: [www.ad-pag.com](http://www.ad-pag.com)*

#### Members



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## Collaborative Research Program



*Study Digital Thread current state and future trends*



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### Objective

*The A&D PLM Action Group members and the PLM solution provider sponsors share a common objective for this research – To gain understanding of needs and opportunities within industry that will inform Digital Thread solution strategy and roadmap*

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## Information Gathering



*Subject matter (domain) expert interviews & an online survey of committed professionals*

### Interviews

- Interviews were conducted by CIMdata with three communities:
  - 5 participating PLM solution providers,
  - 5 key A&D customers nominated by the participating solution providers, and
  - 5 AD PAG member companies
- The 10 A&D companies interviewed included
  - 9 of the Top 40 (23%),
  - 7 of the Top 20 (35%), and
  - 5 of the Top 10 (50%)
- The learnings from the interviews were applied to develop the line of inquiry in the web-based survey

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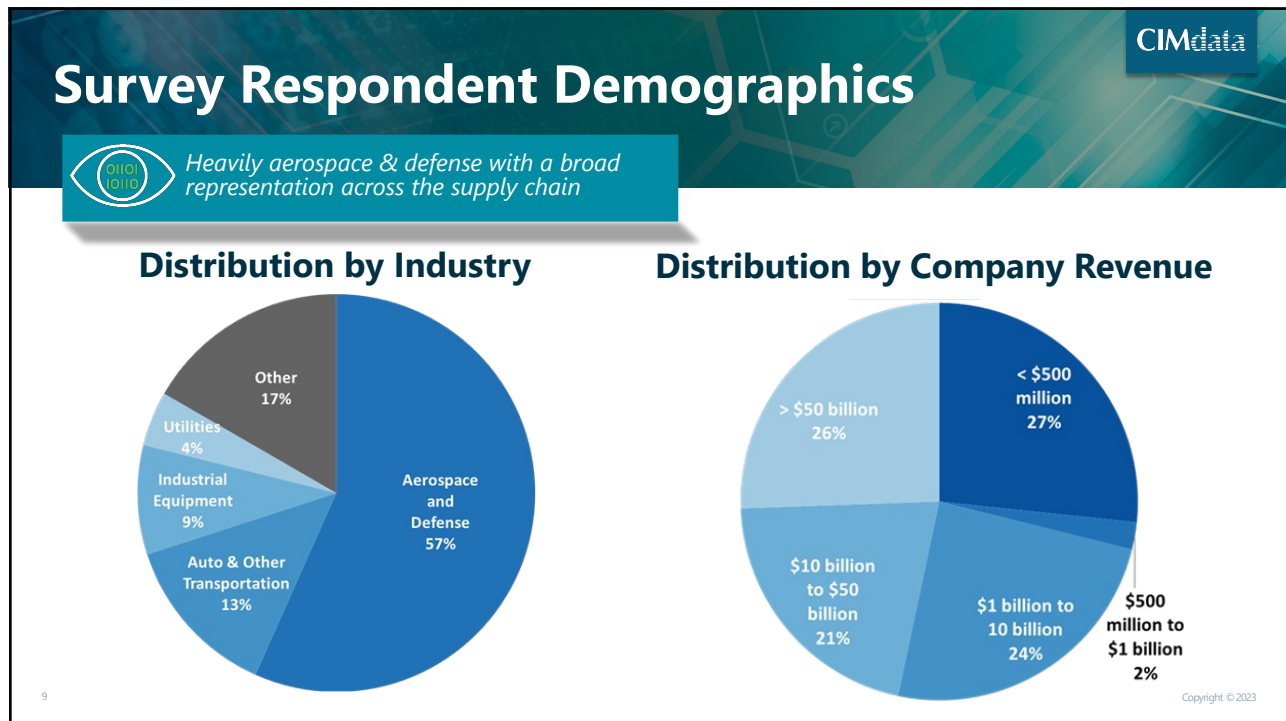
### Survey

- A total of 90 complete and validated online survey responses were received and analyzed
- The survey was intentionally designed to be a challenge for the respondent
  - Answering the questions required a deep understanding of the current status and future plans for digital thread realization within the respondent's company
  - The average time to complete the survey was approximately 30 minutes
- Achieved desired effect
  - Only domain experts on the topic of digital thread invested the time and effort needed to complete the survey

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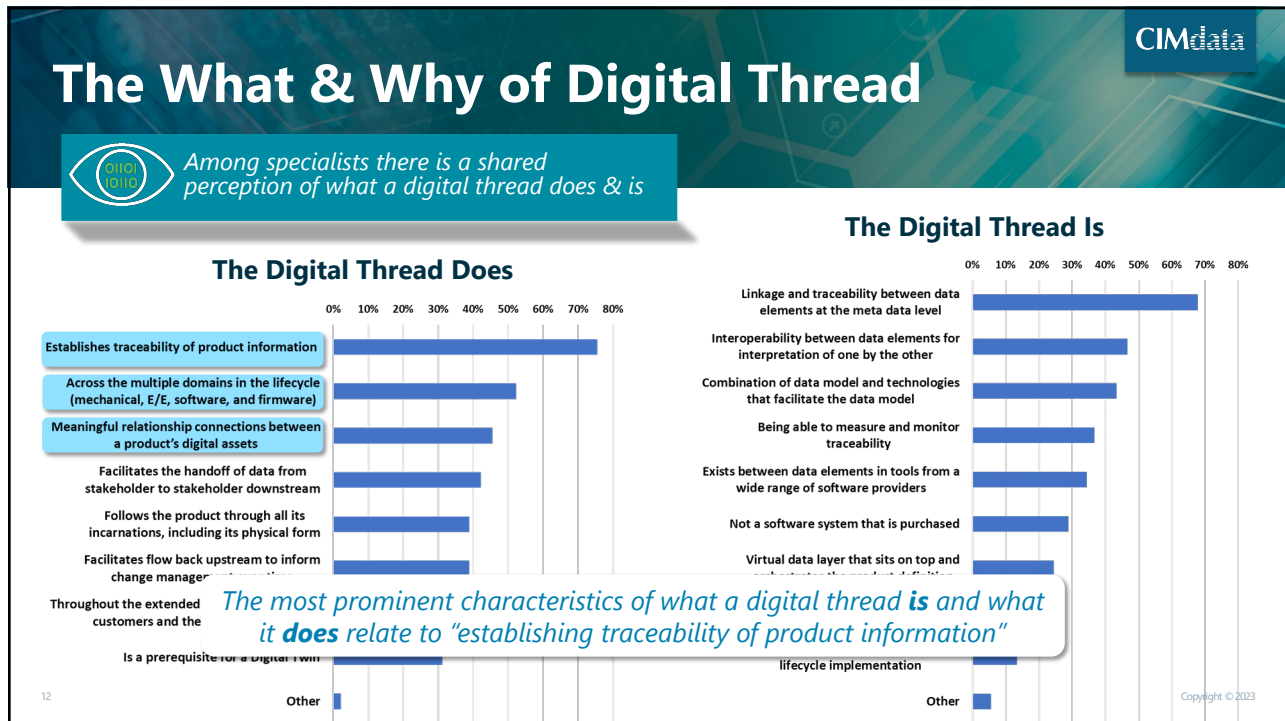
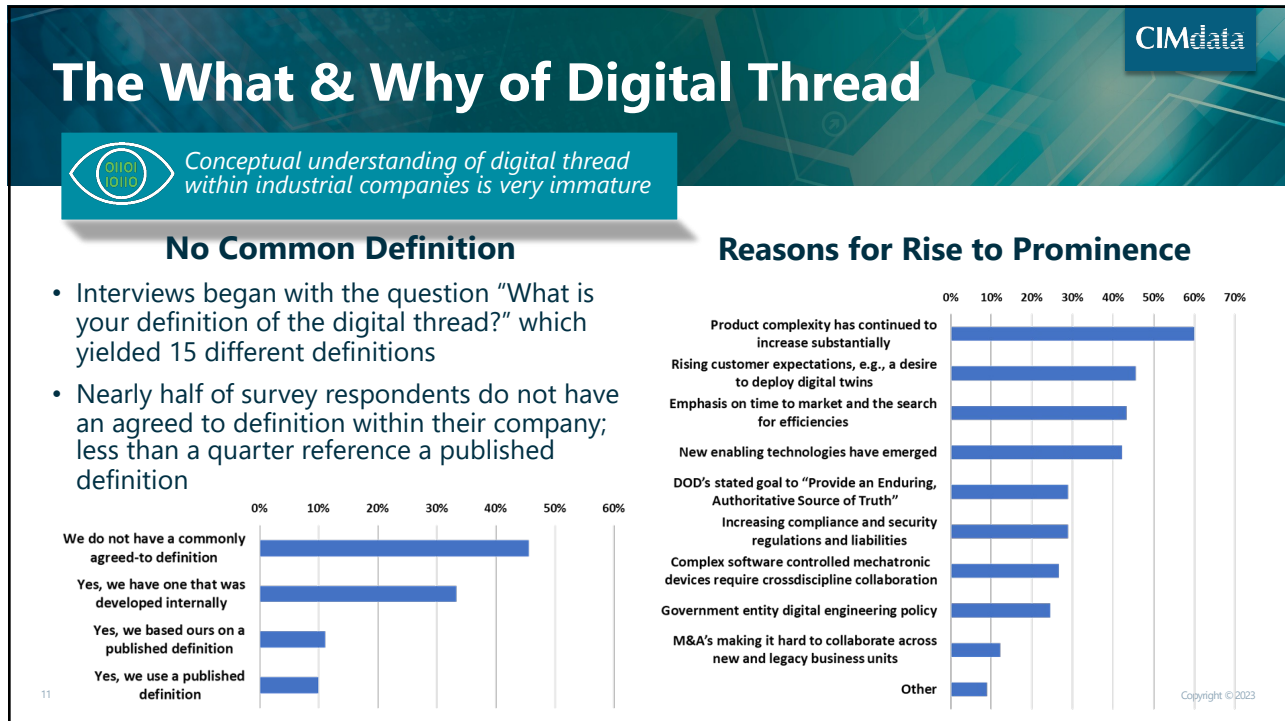
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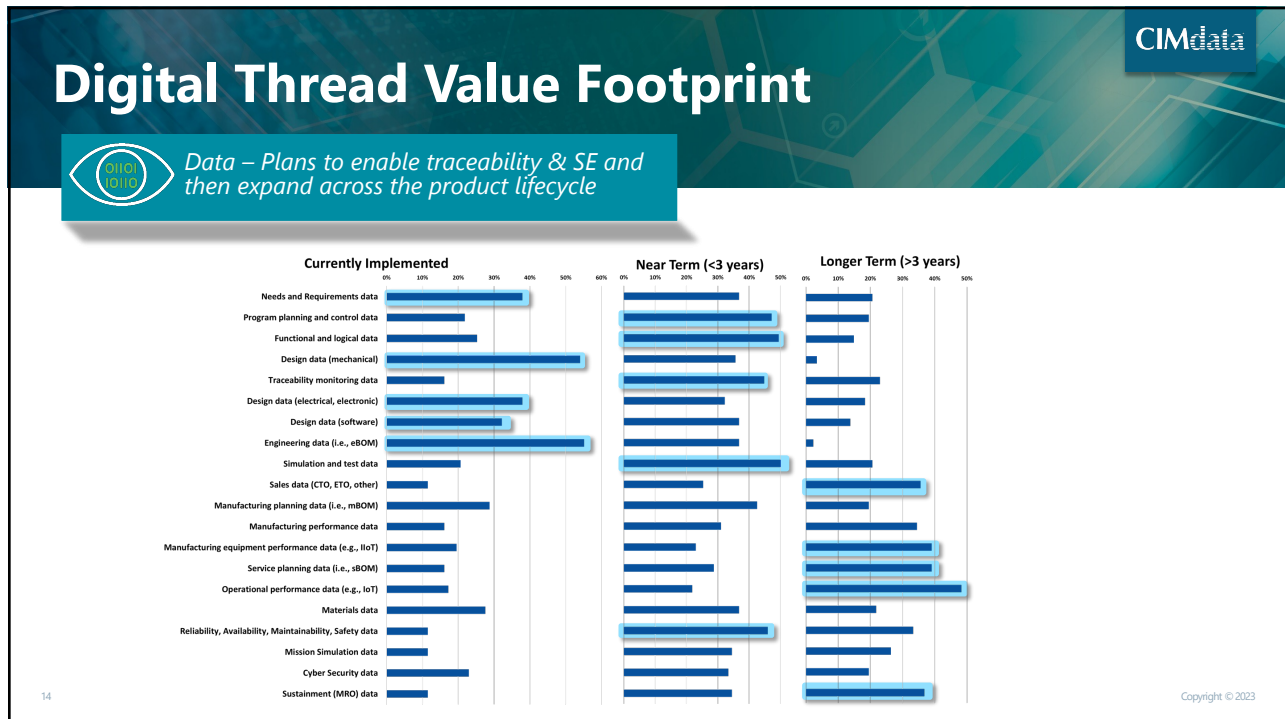
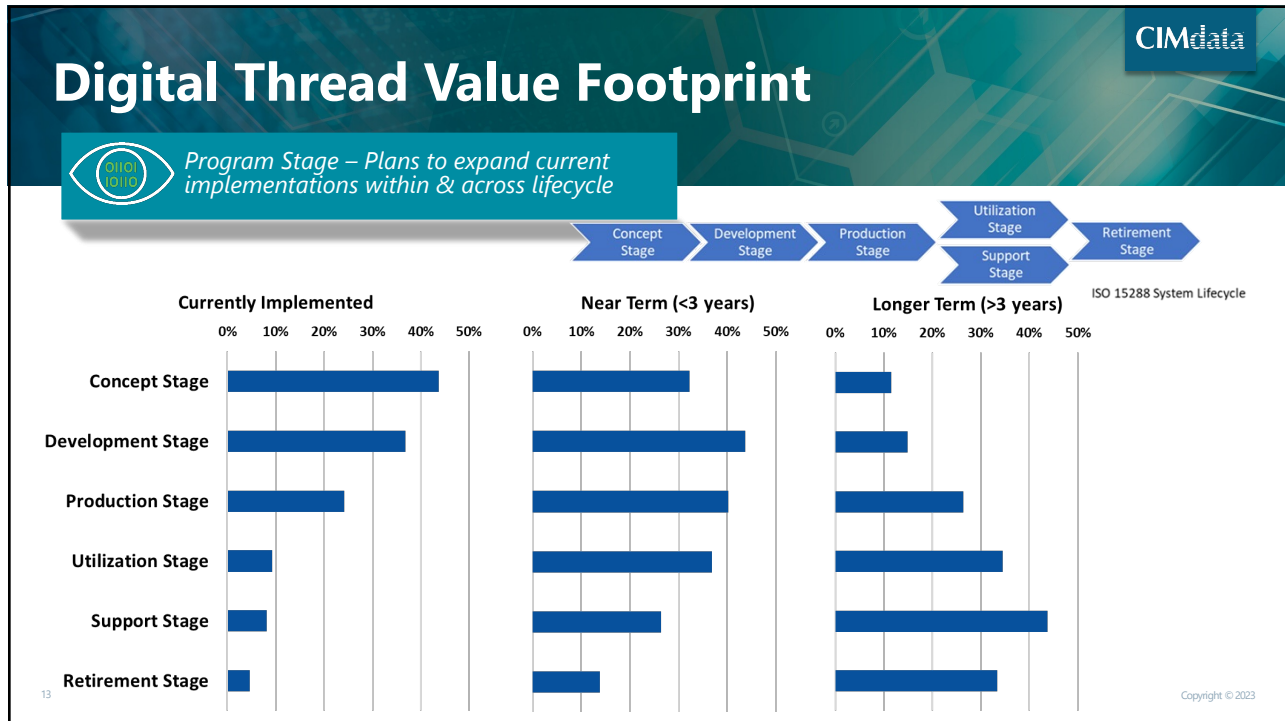
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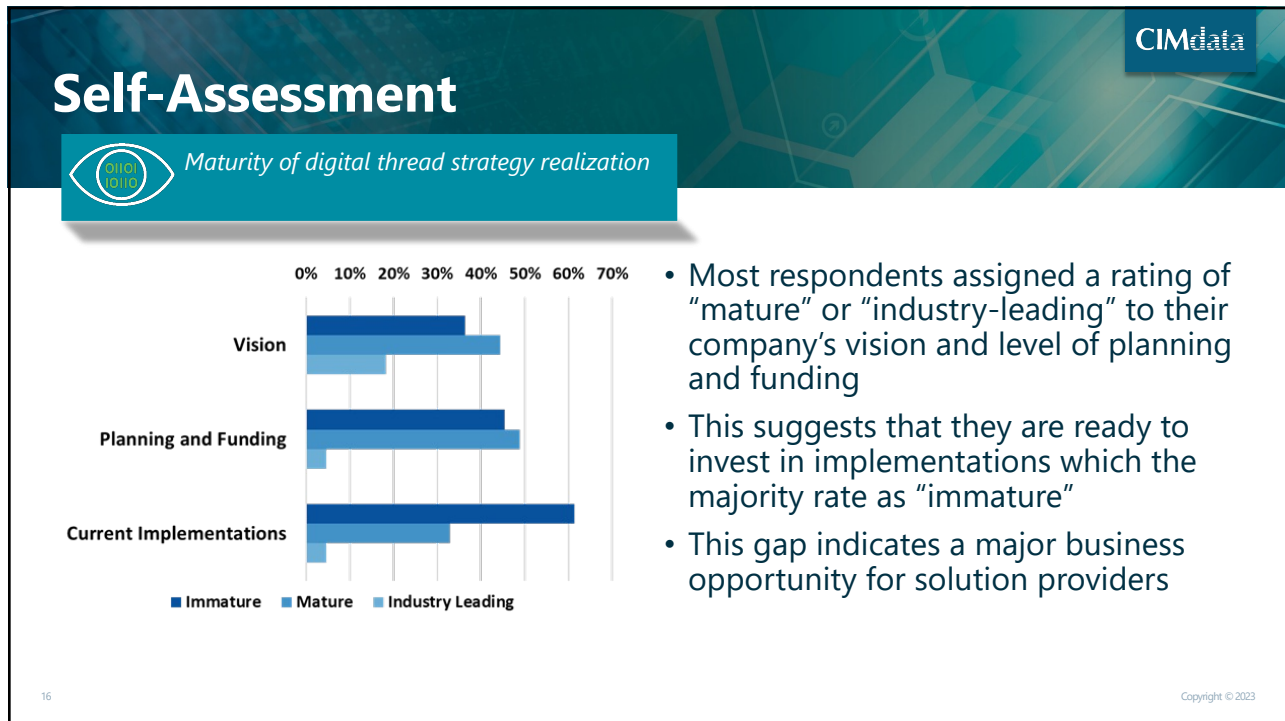
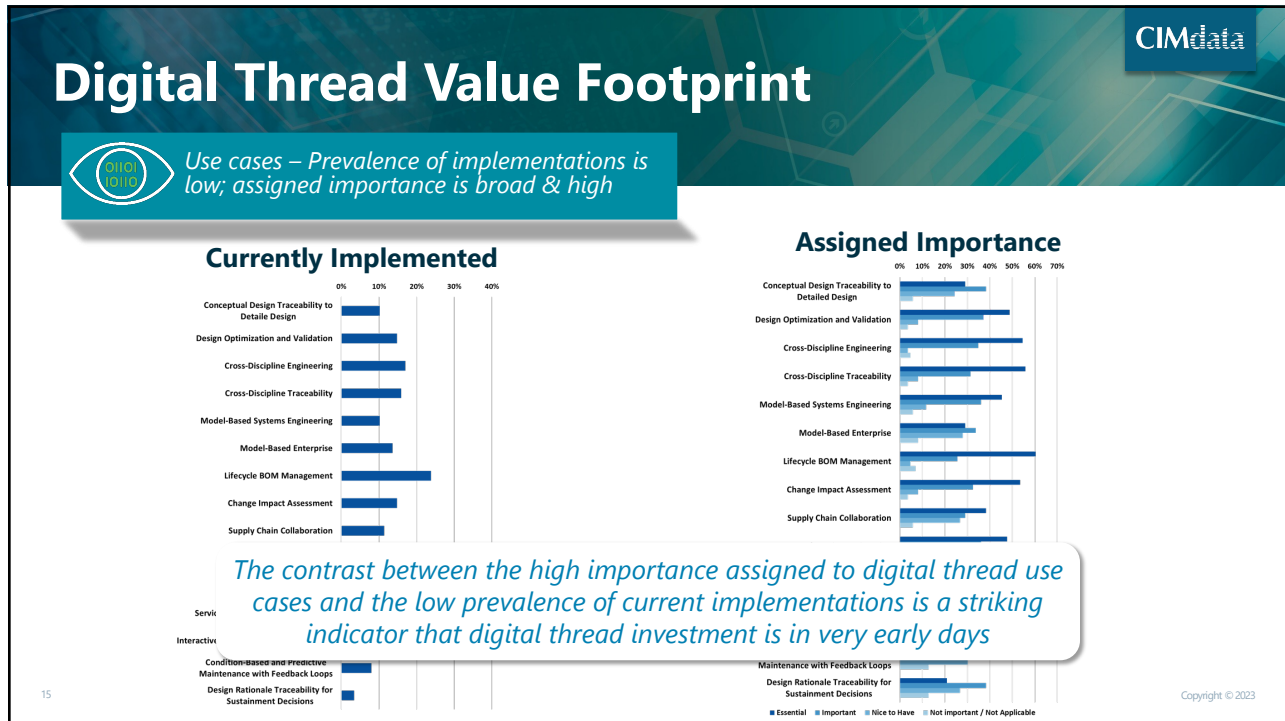
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### Looking to the Future


Industry leaders are taking a broader view as they enter a more complex phase

- There will be more investment in production and service
- There will be increased emphasis on extending the digital thread community to include customers, partners, and suppliers more fully
- MBSE will be a fundamental driver of future investment
- The next stage will be more complex and transformative
  - There are examples of established programs that enjoy strong support from a well-informed and motivated senior management
  - But many are struggling to build awareness within their leadership and achieve early successes as proof points to motivate executive engagement and funding for execution

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### Future Investment Priorities


Top pain points relate to accessibility and traceability; top opportunities relate to SE

#### Pain Points



Pain Point	Near Term	Longer Term	Not in Plan
Inability to trace requirements throughout product data	65%	15%	15%
Productivity loss finding and validating data	55%	15%	15%
Inability to collect and act upon operational data	50%	15%	15%
Ingesting product data from multiple sources in multiple formats	45%	15%	15%
Accessing key data attributes locked within the models	45%	15%	15%
Lack of data consistency throughout product lifecycle	40%	15%	15%
Compliance and industry regulations	35%	15%	15%
Waste in the form of scrap and rework	35%	15%	15%
Inability to track products in use	35%	15%	15%
Safety / Catastrophic failure avoidance / Liability avoidance	35%	15%	15%
Cross-discipline configuration coordination (mech, E/E, SW)	35%	15%	15%
Compliance with customer contracts or RFP differentiators	30%	15%	15%

#### Opportunities




Opportunity	Near Term	Longer Term	Not in Plan
Systems engineering/MBD/MBE/MBSE	60%	15%	15%
Quality compliance	55%	15%	15%
Readiness analysis by integrating PLM, ERP and logistics data	55%	15%	15%
Closed-loop verification & validation to requirements	50%	15%	15%
Simulation to design revision traceability	45%	15%	15%
Full Digital Thread search	45%	15%	15%
Closed-loop quality	45%	15%	15%
Digital Twin configuration traceability	45%	15%	15%
Model-based service	40%	15%	15%
Measurement of digital thread coverage	35%	15%	15%
Seamless integration of sub-system suppliers with system OEM	35%	15%	15%
Enablement of artificial intelligence and machine learning (AI/ML)	35%	15%	15%
Process enablement with behaviors, events, and semantics	35%	15%	15%


18
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### Strategies for Success



An area of divergence between industry leaders is the focus of their implementations

- For some, it is providing **interfaces to source applications** to extract and associate product data artifacts and attributes, something like a search engine
- For others, the key is the **association and traceability of dependencies** between artifacts in support of a use case, such as the linkage and traceability of requirements through functional/physical design to simulation and test
- For a few, their current focus is on **data governance**, which they believe is foundational for a richer and more extensive set of product lifecycle use cases

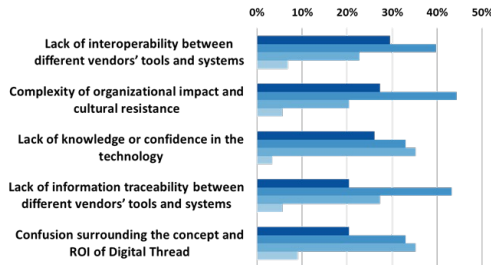
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### Strategies for Success

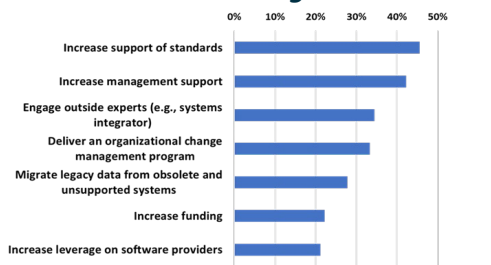

Inhibitors to formulating & executing a digital thread strategy & proposed mitigations

#### Principal Inhibitors



Inhibitor	Percentage
Lack of interoperability between different vendors' tools and systems	~45%
Complexity of organizational impact and cultural resistance	~35%
Lack of knowledge or confidence in the technology	~30%
Lack of information traceability between different vendors' tools and systems	~25%
Confusion surrounding the concept and ROI of Digital Thread	~20%

#### Means for Mitigation



Mitigation Strategy	Percentage
Increase support of standards	~45%
Increase management support	~40%
Engage outside experts (e.g., systems integrator)	~35%
Deliver an organizational change management program	~30%
Migrate legacy data from obsolete and unsupported systems	~25%
Increase funding	~20%
Increase leverage on software providers	~15%


The number 1 inhibitor to formulating and executing a digital thread strategy is "lack of interoperability between different vendors' tools and systems"

The number 1 proposed means for mitigation is to "increase support of standards"


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# The Digital Thread: The Industrial Perspective

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### Solution Technologies



Key technical considerations

- **Core to the value of digital thread is traceability** across source and derivative product-related artifacts along the lifecycle & throughout the extended enterprise
- The **digital thread value landscape is distributed across a heterogeneous value chain** from customer to OEM to partners and multiple tiers of suppliers. This reality drives the need for data interoperability and elevates the importance of standards and openness of enabling solution architectures
- **Proven technical solutions exist for enabling the digital thread**, and leading solution providers are investing heavily in research-guided strategies and roadmaps to further strengthen their offerings
- **Data is the foundation of the digital thread**. This reality elevates the importance of sound data governance and a cleansed repository, especially as use case implementations proliferate and must be interlinked into an extended thread

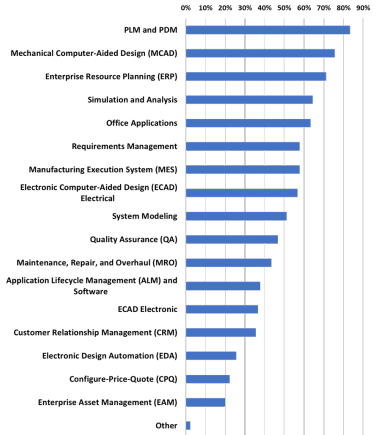
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### Solution Technologies

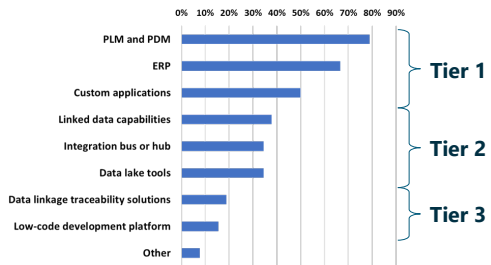

Enabling technologies in use today to create, consume and link product lifecycle data

#### Technologies Used to Create & Consume



Technology	Usage (%)
PLM and PDM	85
Mechanical Computer-Aided Design (MCAD)	75
Enterprise Resource Planning (ERP)	70
Simulation and Analysis	65
Office Applications	60
Requirements Management	55
Manufacturing Execution System (MES)	50
Electronic Computer-Aided Design (ECAD) Electrical	45
System Modeling	40
Quality Assurance (QA)	35
Maintenance, Repair, and Overhaul (MRO)	30
Application Lifecycle Management (ALM) and Software	25
ECAD Electronic	20
Customer Relationship Management (CRM)	15
Electronic Design Automation (EDA)	10
Configure-Price-Quote (CPQ)	5
Enterprise Asset Management (EAM)	2
Other	1

#### Technologies Used to Link



Technology	Usage (%)	Tier
PLM and PDM	85	Tier 1
ERP	70	Tier 1
Custom applications	55	Tier 2
Linked data capabilities	45	Tier 2
Integration bus or hub	40	Tier 2
Data lake tools	35	Tier 2
Data linkage traceability solutions	25	Tier 3
Low-code development platform	15	Tier 3
Other	5	Tier 3

#### Three tiers of linkage technologies

- Tier 1: Traditional solutions with the longest history
- Tier 2: Application and data integration tools
- Tier 3: Newer specialty technologies for combining data from multiple sources and establishing linkages and traceability
  - Expect the ranking of these to rise significantly over the next few years

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## Solution Technologies



Solution capability and provider alignment

- Attitudes on solution capability and provider alignment are mixed
- Some industry leaders are quite critical, especially regarding data model accessibility and flexibility to comply with a corporate data governance strategy
- Others are somewhat neutral or slightly positive. They feel that some providers are moving in the right direction; some are not
- Several feel that solutions have improved significantly in the last 5 to 10 years and, despite some remaining gaps, are now fully capable
- Some express satisfaction that “good partnering” is happening

23

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24

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## Concluding Remarks

Learnings from the research – the current reality (1 of 2)

- Industry investment planning is widely based on use cases and the associated ROI
- Digital thread investment within the ecosystem of industrial users, their customers, suppliers, and solution providers is poised for rapid growth
- New realities, such as rising customer expectations (e.g., DoD's authoritative source of truth) and new enabling technologies, are major drivers of the digital thread's rise to prominence

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## Concluding Remarks

Learnings from the research – the current reality (2 of 2)

- The conceptual understanding of digital thread within industrial companies is immature, but specialists within those companies have a surprisingly consistent view of what the digital thread is and does
- Lack of interoperability between different vendors' tools and systems is rated the number 1 inhibitor to formulating and executing a digital thread strategy
- Promotion of standards is rated the number 1 means for mitigation
- Current digital thread implementations are relatively modest in comparison to industrial companies' visions and plans

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## Concluding Remarks



*Learnings from the research – planning  
future investment*

- The top six pain points all relate to accessibility and traceability across data elements, especially of requirements throughout the lifecycle
- Systems engineering is ranked as the top new value opportunity
- The next stage of digital thread realization will be more complex and transformative
- Most industrial companies seem to be unaware of the complexities and prerequisite foundational elements as they pursue their visions
- A few have sophisticated programmatic approaches with strong support from a well-informed and motivated senior management

27

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## Concluding Remarks



*Learnings from the research – solution  
capability and provider alignment*

- There is a broad sense that solution capabilities have improved significantly in the last 5 to 10 years and that, despite some remaining gaps, these solutions are now fully capable
- The majority feel that their PLM solution providers are moderately or well aligned with their strategies for digital thread investment
- Lack of openness and dependence on 3<sup>rd</sup> parties for connectivity and data interchange with the PLM solutions is a universal concern
- Specialty technologies for combining data from multiple sources and establishing linkages and traceability are emerging to challenge the traditional platforms

28

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  - Digital Twin/Digital Thread Solution Definition for Aerospace and Defense: Phase 3, position paper, Feb 2023
  - Digital Twin/Digital Thread Solution Definition for Aerospace and Defense: Phase 2, position paper, Jul 2022
  - Multiple View Bill of Materials (BOM) Solution Evaluation Benchmarks, report, Jul 2020
  - Multiple View Bill of Materials, position paper, Feb 2019
- Access CIMdata resources at [www.CIMdata.com](http://www.CIMdata.com)
  - Multi-view BOM Value Potential, webinar, Apr 2022
  - The Digital Thread is Really a Web, with the Engineering Bill of Materials at Its Center, webinar, Sep 2021
  - Making Multi-view BOM a Reality, webinar, Mar 2020
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**Questions & Answers** CIMdata

 *What's on your mind?*



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