The Digital Thread: The Industrial Perspective

PLM Road Map & PDT Europe 2023

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Presenter's Profile

CIMdata

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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Digital Thread Status and Trends in Industry

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Key Research Findings Review

- Introduction
- Research Findings
  - The What and 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

Members

AIRBUS, BOEING, GE Aerospace, Gulfstream A General Dynamics Company, Pratt & Whitney Dependable Engines, Rolls-Royce, SAFRAN

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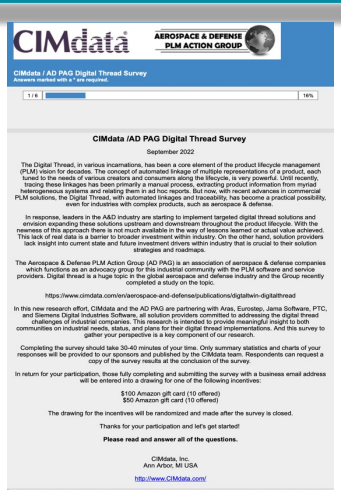
Collaborative Research Program

Study Digital Thread current state and future trends



CIMdata / AD PAG Digital Thread Survey

Answers marked with a * are required.

1 / 6 16%

CIMdata /AD PAG Digital Thread Survey

September 2022

The Digital Thread, in various incarnations, has been a core element of the product lifecycle management (PLM) vision for decades. The concept of automated linkage of multiple representations of a product, each tuned to the needs of various creators and consumers along the lifecycle, is very powerful. Until recently, tracing these linkages has been primarily a manual process, extracting product information from myriad heterogeneous systems and relating them in ad hoc reports. But now, with recent advances in commercial PLM solutions, the Digital Thread, with automated linkages and traceability, has become a practical possibility, even for industries with complex products, such as aerospace & defense.

In response, leaders in the A&D industry are starting to implement targeted digital thread solutions and envision expanding these solutions upstream and downstream throughout the product lifecycle. With the newness of this approach there is not much available in the way of lessons learned or actual value achieved. This lack of real data is a barrier to broader investment within industry. On the other hand, solution providers lack insight into current state and future investment drivers within industry that is crucial to their solution strategies and roadmaps.

The Aerospace & Defense PLM Action Group (AD PAG) is an association of aerospace & defense companies which functions as an advocacy group for this industrial community with the PLM software and service providers. Digital thread is a huge topic in the global aerospace and defense industry and the Group recently completed a study on the topic.

https://www.cimdata.com/en/aerospace-and-defense/publications/digitaltwin-digitalthread

In this new research effort, CIMdata and the AD PAG are partnering with Aras, Eurostep, Jama Software, PTC, and Siemens Digital Industries Software, the solution providers committed to addressing the digital thread challenges of industrial companies. The survey is designed to provide meaningful insight to both communities on industrial needs, status, and plans for their digital thread implementations. And this survey to gather your perspective is a key component of our research.

Completing the survey should take 30-40 minutes of your time. Only summary statistics and charts of your responses will be provided to our sponsors and published by the CIMdata team. Respondents can request a copy of the survey results at the conclusion of the survey.

In return for your participation, those fully completing and submitting the survey with a business email address will be entered into a drawing for one of the following incentives:

$100 Amazon gift card (10 offered)
$50 Amazon gift card (10 offered)

The drawing for the incentives will be randomized and made after the survey is closed.

Thanks for your participation and let's get started!

Please read and answer all of the questions.

CIMdata, Inc.
Ann Arbor, MI USA
http://www.CIMdata.com/

Sponsors

AEROSPACE & DEFENSE PLM ACTION GROUP, aras, eurostep, Jama Software, ptc, SIEMENS

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

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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

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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Survey Respondent Demographics

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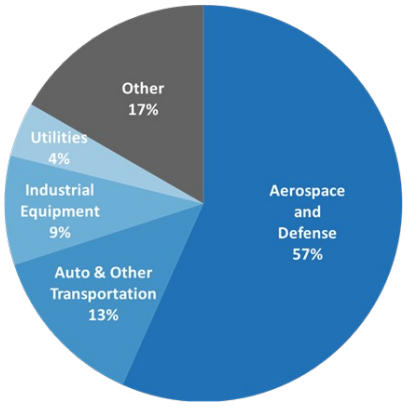
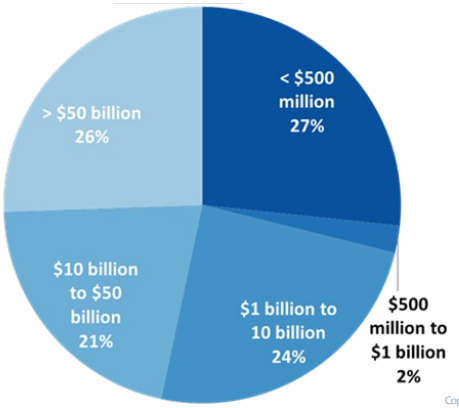
Heavily aerospace & defense with a broad representation across the supply chain

Distribution by Industry



Distribution by Company Revenue



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Digital Thread Status and Trends in Industry

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Bottom Line Up Front ("BLUF")

The most significant findings – and the most surprising

1. Digital thread investment is in early days
2. New influences are driving the rise of digital thread investment
3. The next phase of investment will be more transformative and higher risk
4. Industry leaders diverge in the focus of their implementations
5. There is a clear call for openness and standards
6. Systems engineering is emerging as a prime driver for digital thread
7. Technology is advancing rapidly; enterprise strategies are keeping pace
8. A third tier of digital thread technologies is on the rise

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Research Findings

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The What and Why of Digital Thread

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1a

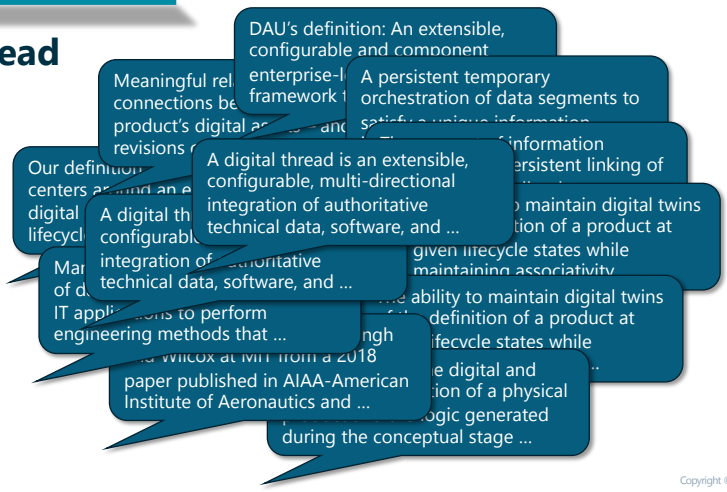
Conceptual understanding of digital thread within industrial companies is very immature

Definition of Digital Thread
(from the interviews)

Q: What is your definition of digital thread?

15 interviews

-> 15 definitions



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The What and Why of Digital Thread

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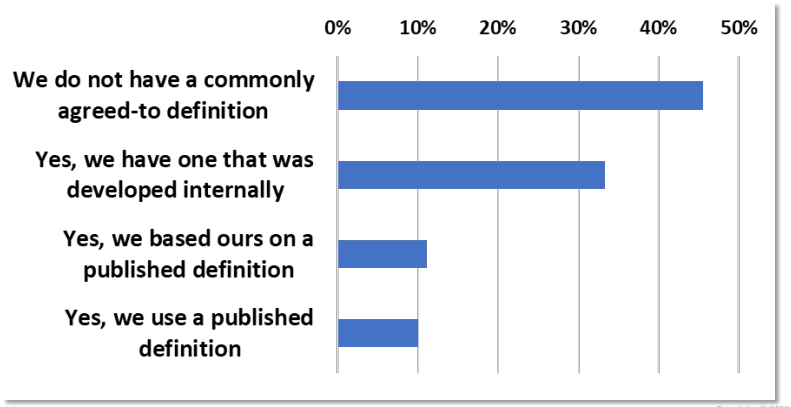
1b

Conceptual understanding of digital thread within industrial companies is very immature

Definition of Digital Thread
(from the survey)

Q: Does your organization have a commonly agreed-to definition of the digital thread?



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The What and Why of Digital Thread

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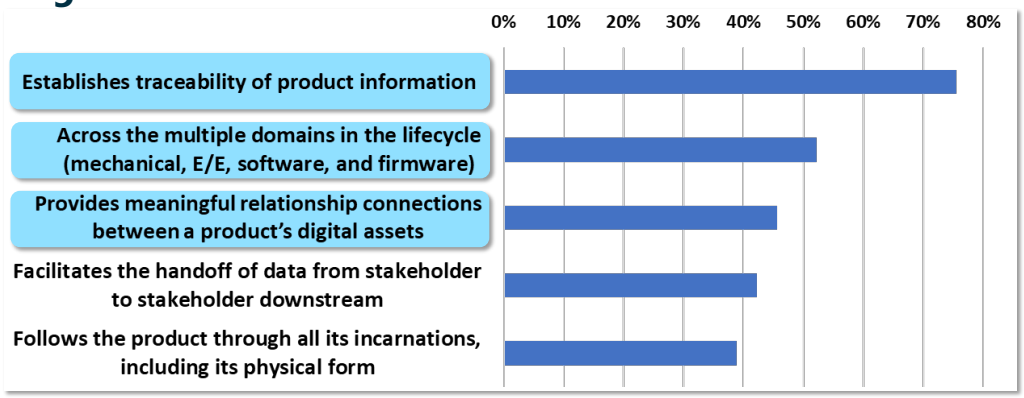
Among specialists there is a shared perception of what a digital thread is & does

What the Digital Thread Does*



* Top 5 selections

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Digital Thread Value Footprint

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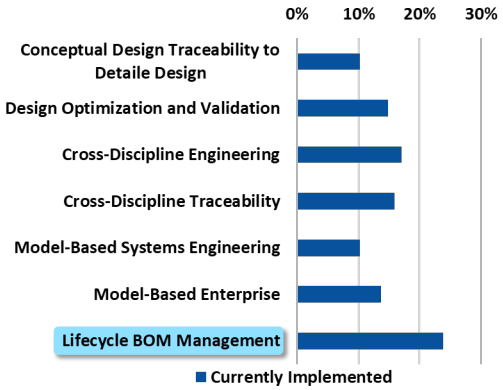
1c

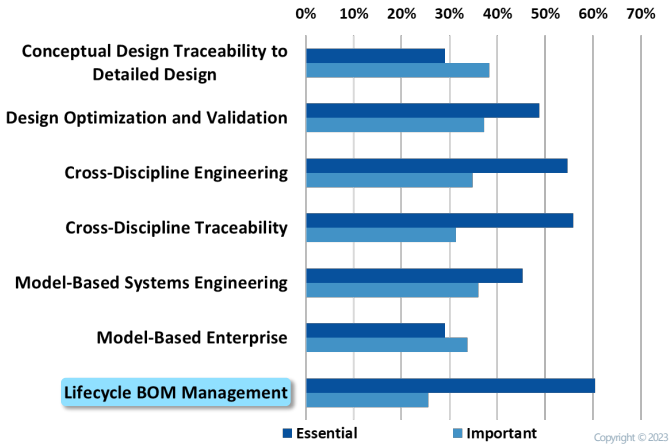
Use cases – Prevalence of implementations is low; assigned importance is broad & high

Currently Implemented*



* Top 7 selections

Assigned Importance*



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Self-Assessment

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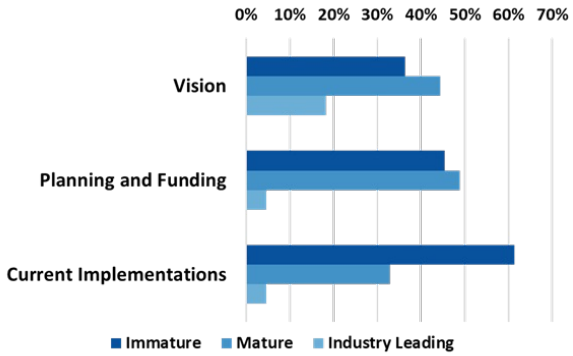
1d

Maturity of digital thread strategy realization

Digital Thread Maturity (self-assessment)



- Most respondents assigned a rating of "mature" or "industry-leading" to their company's vision and level of planning and funding
- This suggests that they are ready to invest in implementations which the majority rate as "immature"
- This gap indicates a major business opportunity for solution providers

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Research Findings

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The most significant findings – and the most surprising

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The What and Why of Digital Thread

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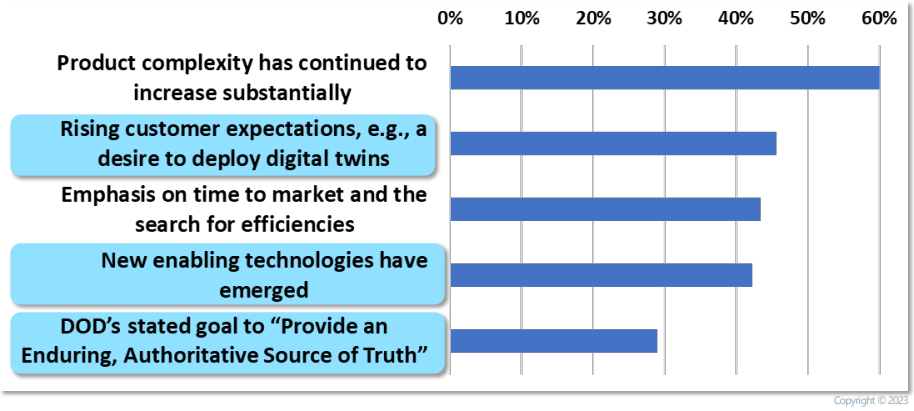
2

New influences are driving the rise of digital thread investment

Reasons for Digital Thread's Rise to Prominence*



* Top 5 selections

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Looking to the Future

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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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Strategies for Success

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Industry leaders diverge in 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

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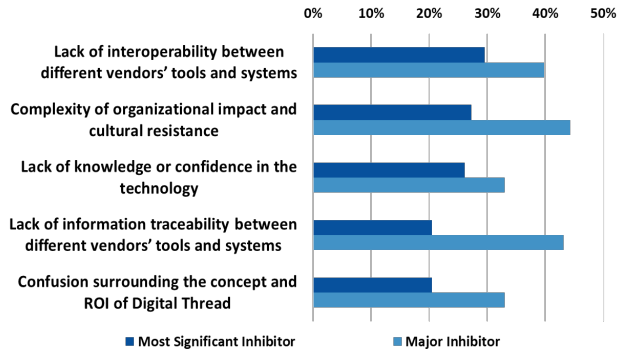
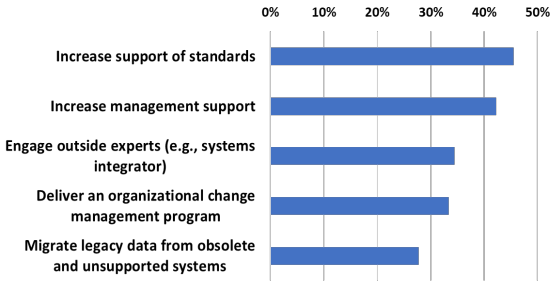
There is a clear call for openness and standards

Principal Inhibitors*



Means for Mitigation*



* Top 5 selections

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Future Investment Priorities

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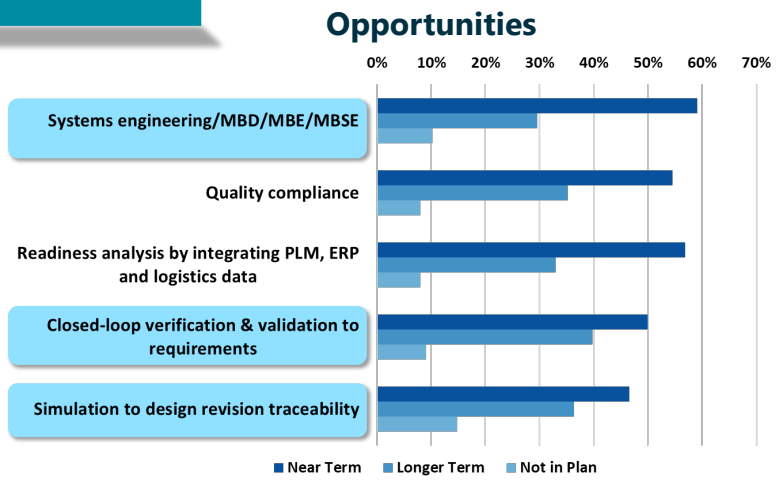
Top opportunities relate to systems engineering

Q: What are the new value opportunities that you are targeting in future Digital Thread implementations within your company?



* Top 5 selections

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Solution Technologies

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Commercial solutions continue to advance rapidly, but data governance is only emerging

- ***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

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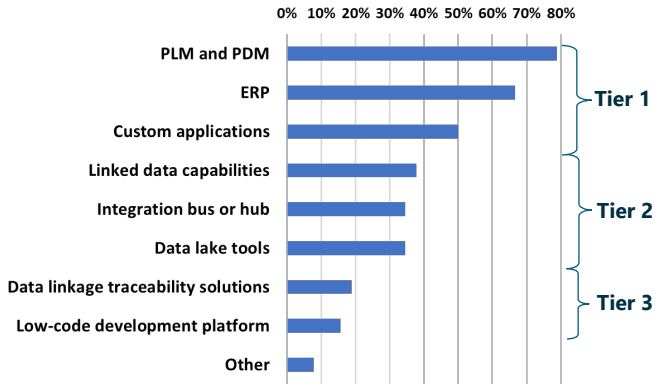
Enabling technologies in use today to link product lifecycle data

Technologies Used to Link Product Lifecycle Data



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 Tier 3 technologies to rise significantly over the next few years

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Solution Technologies

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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

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Digital Thread Research – Audience Poll

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The most significant findings – and the most surprising – according to the audience

		Significant	Surprising
1.	Digital thread investment is in early days	41%	**31**%
2.	New influences are driving the rise of digital thread investment	37	10
3.	The next phase of investment will be more transformative and higher risk	25	29
4.	Industry leaders diverge in the focus of their implementations	33	**35**
5.	There is a clear call for openness and standards	**60**	12
6.	Systems engineering is emerging as a prime driver for digital thread	**58**	14
7.	Technology is advancing rapidly; enterprise strategies are keeping pace	22	27
8.	A third tier of digital thread technologies is on the rise	20	20

Survey submits 48

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Concluding Remarks (1 of 3)

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The most important findings – and the most surprising

1. Digital thread investment is in early days
   - 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
   - Current digital thread implementations are relatively modest in comparison to industrial companies' visions and plans

   Corollary: Digital thread investment within the ecosystem is poised for rapid growth
2. New influences are driving the rise of digital thread investment
   - New realities, such as enablement of digital twins, 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 (2 of 3)

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The most important findings – and the most surprising

3. The next phase of investment will be more transformative and higher risk
   - 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

   Corollary: Over the next few years, we will witness some spectacular successes and failures
4. Industry leaders diverge in the focus of their implementations
   - Progression from accessibility to traceability to full enterprise reflects the range of maturity in digital thread strategy and strategy realization

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Concluding Remarks (3 of 3)

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The most important findings – and the most surprising

5. There is a clear call for openness and standards
   - Lack of interoperability between vendors' tools and systems is rated #1 inhibitor
   - Promotion of standards is rated #1 means for mitigation
   - Distinction between openness and standards is not well understood
6. Systems engineering is emerging as a prime driver for digital thread
7. Technology is advancing rapidly; enterprise data governance is a gap
   - A few companies recognize the need for an enterprise data governance strategy
8. A third tier of digital thread technologies is on the rise
   - Data linkage traceability solutions and low-code development platforms are becoming more prominent in enterprise digital thread architectures

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For contributing their knowledge and for funding this important work

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- Access A&D PLM Action Group resources at www.ad-pag.com
  - Digital Twin/Digital Thread Solution Definition for Aerospace and Defense: Phase 4, position paper, Nov 2023
  - A&D PLM Action Group Digital Thread Collaborative Research Report, Aug 2023
  - 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
  - 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
- Contact for further discussion

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Questions & Answers

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What's on your mind?

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