

Realization of Digital Thread in an Enterprise

Enabled by DXP Services' Industry Solutions, Templates, Tools, Accelerators, and Strategic Partnerships

Key Takeaways

Today's complex industrial products combine mechanical, electrical, and software components. Effective development of these complex products necessitates a robust, multi-domain systems engineering framework integrating requirements, design, testing, and production activities.

Establishing seamless, end-to-end connections among requirements management, PLM, ERP, and other enterprise systems is essential for achieving traceability throughout the entire lifecycle.

Transforming the engineering Bill of Materials (EBOM) into manufacturing (MBOM) and service (SBOM) bills requires thorough mapping and alignment across multiple phases of the lifecycle—a complex yet essential process for operational success.

The digital thread provides a single source of truth connecting disparate systems and improves cross-functional collaboration—from engineering to manufacturing and service—leading to faster, better decision-making and streamlined processes.

Successfully implementing a digital thread involves both technical integration and significant organizational change, supported by robust change management practices and strong partnerships with solution providers, such as ITC Infotech, DXP Services and PTC.

Industry Challenges and Importance of Digital Thread

The evolution of smart, connected products is one of the most dominant industrial trends that CIMdata has been observing for the last several years. This means product development often involves co-development of mechanical, electrical, and electronics systems and components along with the necessary embedded software. Business models such as product-as-a-service, software-as-a-service, and subscription-based licensing are making product development even more complex, particularly in the automotive, aerospace, and industrial sectors.

Traditional methods often lead to siloed processes among engineering, manufacturing, and service, complicating Bill of Materials (BOM) transitions—hindering effective data integration and traceability. These issues frequently resulted in delays, cost overruns, and quality problems. An effective digital thread enhances collaboration, improves requirement traceability, streamlines BOM transformations, facilitates

robust data exchanges with ERP and MES systems, and accelerates innovation and decision-making throughout the product lifecycle. Figure 1 illustrates key challenges facing manufacturers.¹

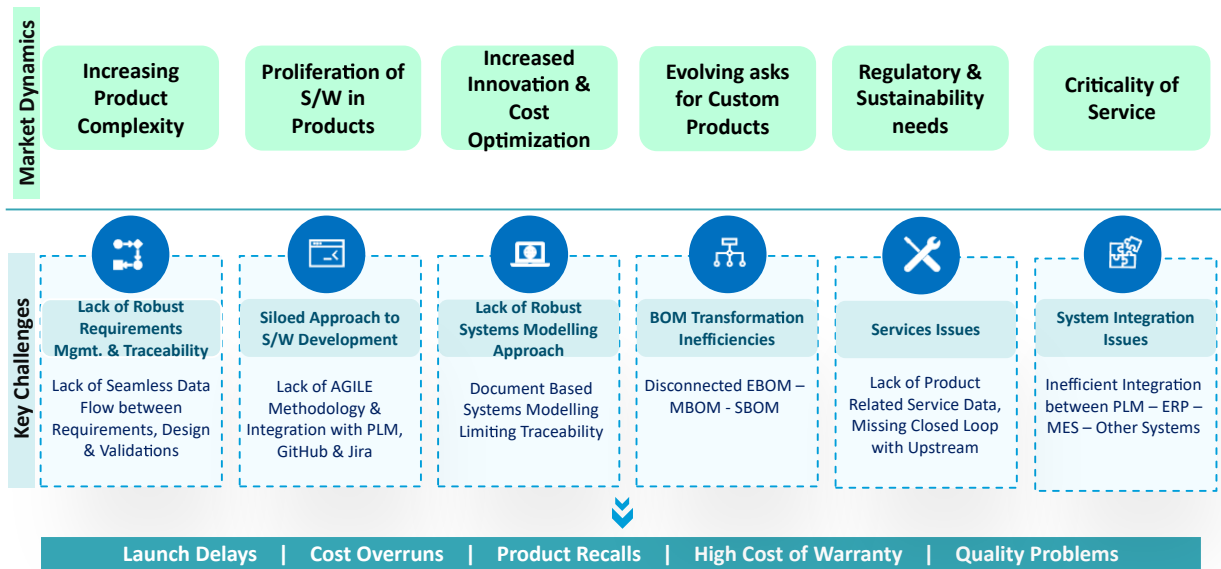


Figure 1—Market Dynamics, Challenges, and Impacts
 (Image Courtesy ITC Infotech, DxD Services)

Enterprise Realization of the Digital Thread

CIMdata defines the digital thread as a communication framework that connects data flows, which can produce an integrated, holistic views of an asset’s data from physical and virtual systems (i.e., its digital twin) throughout its lifecycle across traditionally siloed functional perspectives. A key factor of a digital thread is that it connects multiple representations of a product across its lifecycle, each tailored to different stakeholders. While the term “thread” suggests a linear structure, a web-based model more accurately represents the complex relationships between these representations, providing a valuable framework for defining scope and planning implementation. Systems engineering, program management, and the Bill of Information (BOI) play key roles in shaping the structure of this web, influencing how information is configured and connected. Successful digital thread implementations require a strategic approach that begins with comprehensive planning to ensure all components align. This is followed by an incremental build-out of data models, system integrations, and process workflows that connect engineering, manufacturing, and service functions (and others) leveraging the PLM backbone. Within this framework, use cases serve as foundational elements, defining the scope and purpose of digital threads and clarifying the business value of their realization.

In late 2022 and early 2023, CIMdata’s Aerospace and Defense PLM Action Group (AD PAG) conducted industrial research on the promise and reality of the digital thread. The most prominent characteristics of what a digital thread is and what it does relate to “establishing traceability of product information.”

Implementing an enterprise-wide digital thread requires integrating technology, processes, and people, supported by strategic partnerships. Central to this is establishing a robust Product Lifecycle Management (PLM) backbone to manage product data, ensuring seamless integration across ERP, MES, ALM, CRM, and legacy platforms. Effective requirements management and traceability from design to production, along with transforming EBOM into MBOM and SBOM versions are crucial. Incorporating systems modeling, simulation, and embedded software development into PLM enhances product innovation. Additionally,

¹ Research for this paper was partially supported by ITC Infotech.

extending the digital thread into Service Lifecycle Management (SLM) improves aftermarket operations and closed-loop feedback to R&D for further product enhancements. Successful implementation relies on structured methodologies, comprehensive data migration strategies, organizational change management, and strong vendor partnerships, enabling organizations to leverage lifecycle data effectively, streamline operations, and drive sustainable business value.

DxP Services' Solutions and Partnership with PTC

DxP Services maintains a strong and strategic partnership with PTC, holding the status of a "Platinum Partner" and being a "Cloud First Partner for Windchill+." This represents a deep level of collaboration where DxP Services not only implements and supports PTC solutions but also actively works with PTC R&D to develop and enhance their products.

This partnership significantly benefits all parties. PTC gains valuable insights into customer needs through DxP Services' implementation experience, helping refine its product roadmap. DxP Services benefits from early access to PTC's latest technologies, particularly through their Cloud First partnership for Windchill+, enhancing their expertise and market position. Customers gain knowledge from DxP Services industry expertise and PTC's platform solutions, leveraging best practices and accelerators for faster, cost-effective deployments with reduced risk. Close collaboration between DxP Services, PTC, and their customers results in efficient issue resolution, enabling faster, smoother digital thread implementations.

PTC and DxP Services work together to implement digital thread solutions, blending technology and deployment expertise. PTC delivers the core platform, which includes Windchill for PLM, Codebeamer, and RV&S for ALM, Creo for CAD, ThingWorx and Kepware for connectivity, as well as a service lifecycle management portfolio. DxP Services adds industry-specific knowledge across sectors such as automotive, aerospace and defense, industrial manufacturing, medtech, and retail, ensuring alignment with industry needs.

With experience from numerous global engagements, DxP Services employs a structured PLM consulting and implementation methodology spanning both planning and deployment. Their solutions feature proprietary and PTC-based accelerators for implementation, data migration, integration, and enterprise data access, along with templates tailored to specific industry verticals like automotive, aerospace and defense, industrial, medtech and hi-tech, among others. DxP Services is infusing AI/Gen AI into their solutions to better solve customers' problems both on the business side (e.g., AI enabled BOM creation, AI enabled requirements management, service content creation, etc., with savings of up to 70% of time for business users) and on the technology side (e.g., automatic code generation, automatic standardization for Windchill+, AI enabled data migration with automated data cleaning, transformation, and validation resulting in projected schedule and cost optimization of up to 50%). Additionally, they offer Organizational Change Management (OCM) support and PLM cloud services through partnerships with AWS, Microsoft, and PTC. Together, PTC and DxP Services empower organizations to implement digital threads that integrate product lifecycle data and align with business objectives. Figure 2 presents DxP Services perspective of the Product Development Value Chain.

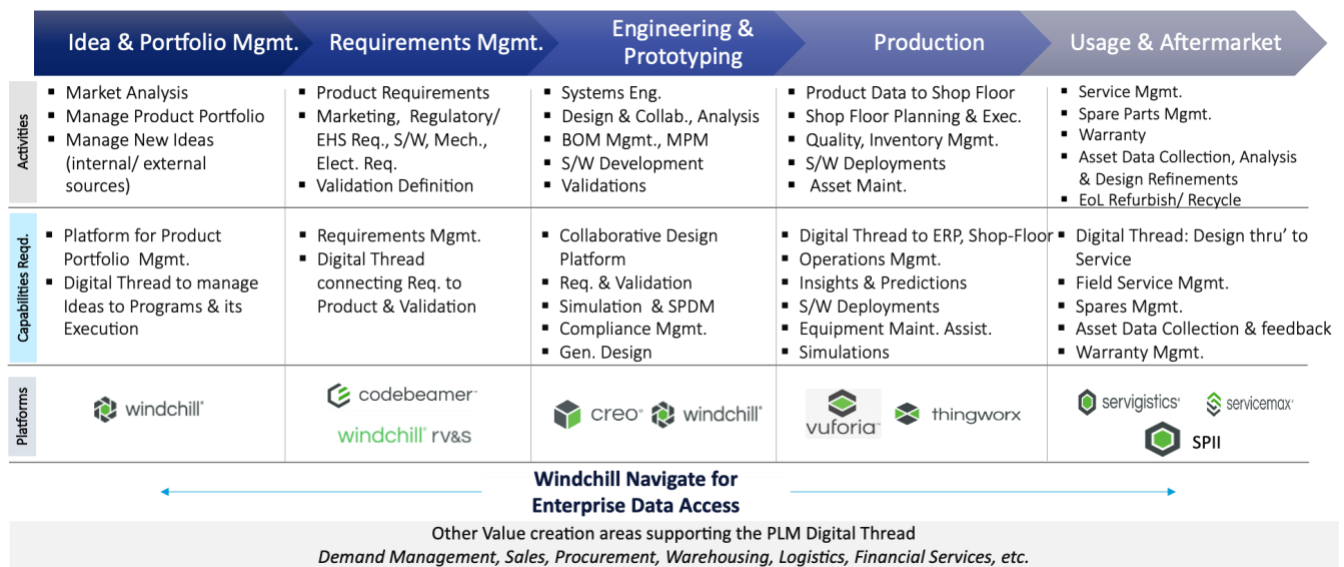


Figure 2—Support of Digital Thread across the Product Development Value Chain
 (Image Courtesy ITC Infotech, DXP Services)

Case Studies

The first case study discusses the successful complex Windchill implementation for a large American industrial equipment manufacturer of irrigation, lighting, solar and transportation equipment with global operations. Their key focus areas included establishing a digital thread from design to manufacturing to service, harmonizing processes across product lines, ensuring zero data loss, and achieving seamless integration with downstream systems. The transition from ETO (Engineer-to-Order) to CTO (Configure-to-Order) was supported by enhanced part classification and reduced search time. The benefits of this implementation resulted in over 1,500 new users of Windchill 11.1 M020 through the migration of millions of parts and CAD data. CAD data management is linked with BOM, change management, and four legacy systems were replaced with Windchill, enabling traceability.

The second case study describes the digital transformation of a leading digital printing solutions provider. The company sells printing presses, proprietary consumables, and workflow solutions. The project emphasized a consulting-led implementation to maximize the out-of-the-box (OOTB) solution and a structured migration approach using the DMF 2.0 framework. It maintained data integrity with zero data loss. The successful implementation led to an integrated enterprise PLM with a global ERP platform connecting product development teams. Tangible results included a 20% improvement in data efficiency through consolidation and a unified business process; a 12% reduction in maintenance, service, and hardware costs using a single Windchill system; and a 10% direct cost benefit from decommissioning another enterprise PLM system.

In the third case study, DXP Services assisted an oil and gas services company whose portfolio includes systems and services for onshore and offshore drilling, subsea and onshore mining, and construction applications. The primary challenge involved harmonization, standardization, and application rationalization across multiple PLM and ERP systems to an enterprise Windchill PLM. The implementation was agile and included a thorough analysis of CAD, Non-CAD, and ERP data. Reusable templates and frameworks (e.g., DFM 2.0), along with frequent rehearsals employed to ensure success. As a result of timely implementation, OpEx costs were optimized, and an on-time US rollout helped avoid potential negative consequences. More than 300 million records from 7 different source systems were successfully migrated during the project.

Figure 3 provides examples of the value provided by DXP services.

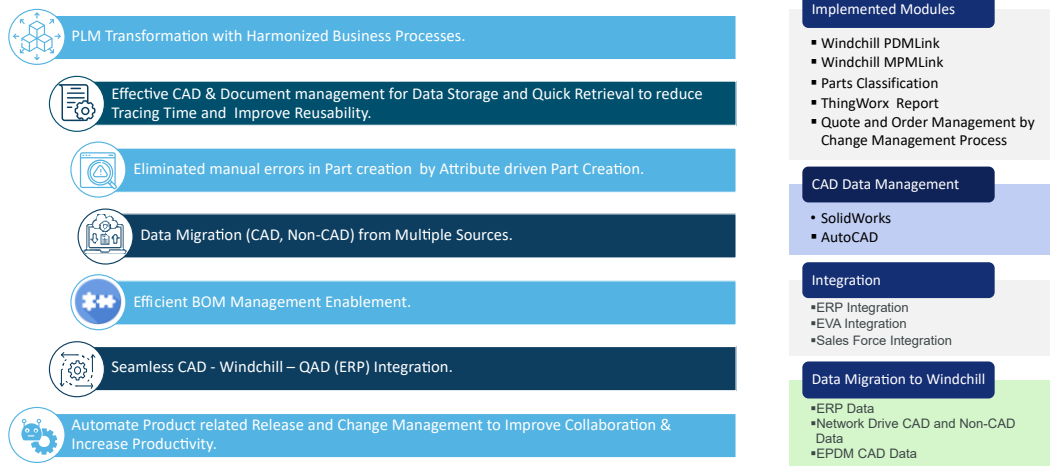


Figure 3—The value provided by DxP Services
(Image Courtesy ITC Infotech, DxP Services)

Summary

The manufacturing industry faces many challenges. Modern industrial products are a highly complex integration of mechanical, electrical, and software components and functionality, which necessitates a robust, multi-domain systems engineering framework. Establishing seamless, end-to-end connections among requirements management, PLM, ERP, and other enterprise systems is crucial for achieving optimization and traceability throughout the entire lifecycle. A digital thread is key to establishing cross-functional collaboration, decision-making, and streamlining of processes. Successfully implementing a digital thread involves technical integration and substantial organizational change, supported by effective change management practices and strong partnerships with solution providers.

DxP Services maintains a strong, strategic partnership with PTC. This in-depth partnership better enables both DxP Services and PTC to help their manufacturing clients define and deploy effective digital thread environments. PTC provides the enabling technology and DxP Services provides the industry and deployment expertise needed for implementation and operation.

CIMdata recommends that companies looking to deploy digital threads across their business and value chain include DxP Services and PTC in their evaluation and selection process.

About CIMdata

CIMdata, a global strategic management consulting firm, provides services designed to maximize an enterprise's ability to design, deliver, and support innovative products and services. For more than forty years, CIMdata has provided industrial organizations, providers of digital technologies and services, and investment firms with world-class insight, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) topics and the digital transformation they enable. CIMdata also offers research, subscription services, publications, and education through certificate programs and international conferences. To learn more, visit www.CIMdata.com or email info@CIMdata.com.