

Digital Fabric for the Extended Enterprise

Key Takeaways

A digital thread provides greater end-to-end visibility and connectivity across the product lifecycle enabling seamless data flow across processes, systems, and stakeholders. This enhances visibility, traceability, and context of data, which in turn improves decision making and improves efficiency by ensuring real-time access to accurate, up-to-date information throughout design, manufacturing and operations.

Organizations aiming for a digital thread should have a holistic vision but pursue an incremental approach focusing on areas that deliver the most value and then scaling over time, which reduces risk and improves their ability to continually transform.

When building digital threads, prioritize streamlining the IT architecture by consolidating to fewer platforms and integrating them well for enhanced data quality and connectivity.

Challenge of Market Demands, Customer Preferences, and Increasing Complexity

The challenges of aligning with evolving market demands, meeting customer preferences, and managing increasing complexity continue to grow for modern businesses. Companies are navigating a landscape marked by sophisticated product requirements, disruptive technologies, and global competition, all while aiming to streamline operations and maintain profitability.¹

The Challenge of Product Complexity and Market Pressures

Products today are a blend of mechanical, electrical, electronic, and software components. Managing the associated data in silos creates inefficiencies, leads to defects, and delays time-to-market—ultimately impacting both revenue and profitability. The rise of smart, connected products has not only expanded across disciplines, but across the entire product lifecycle from inception through life, including supporting multiple geographies and the extended value chain. Products now feature technologies like IoT, advanced sensors, and AI, adding another layer of complexity. Companies must connect these physical products to their digital twins to enable continuous monitoring and optimization. Without a robust digital thread, these digital twins risk becoming isolated and ineffective.

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Customization further complicates matters. Personalized products require numerous configurations and variants, making it challenging to manage product lifecycle processes efficiently. Coupled with shorter product lifecycles driven by competitive pressures, companies face a delicate balancing act: delivering high-quality products at speed while managing costs.

Adding to these technical challenges are regulatory and sustainability requirements. Organizations must comply with environmental regulations, adopt circular economy strategies, and reduce waste across the product lifecycle. From remanufacturing to recycling, sustainability demands integrated systems capable of tracking and optimizing processes. Additionally, businesses must protect intellectual property (IP) as they expand digital operations. The growing reliance on connected tools and platforms increases vulnerability to cyber threats, requiring enhanced security measures.

Challenges of Business Complexity

Business complexity has grown exponentially due to factors such as globalization, mergers and acquisitions, and geopolitical uncertainties. Companies must efficiently design, manufacture, and distribute products worldwide while catering to varying market demands and regulations. Simultaneously, they must balance local services with global operations, an effort that requires resilience and flexibility across supply chains.

Disruptive competition from digital-native companies adds another dimension. These agile competitors leverage modern tools and technologies to innovate faster, forcing traditional companies to adopt transformative strategies. Servitization is one such strategy, where businesses shift from selling products to offering outcomes or value-added services like maintenance, performance monitoring, and upgrades. This model not only addresses changing customer preferences but also creates long-term relationships.

A significant barrier to transformation is the reliance on legacy systems that don't integrate easily with modern tools. Over the years, companies have developed disconnected systems, processes, and data storage practices, resulting in fragmented information. Migrating these systems or connecting them through a unified digital thread can be expensive, time-consuming, and fraught with technical challenges.

In many organizations, data silos are not just technological but also organizational, separated by department, function, and geography. Breaking these silos requires significant investments in data standardization and cleansing, as well as fostering cross-functional collaboration. Resistance to change among employees, coupled with skill gaps, adds further complexity to the equation.

Fibers to Fabric: Understanding the Digital Thread

While the term "digital thread" often evokes the idea of a linear, end-to-end connection across the product lifecycle, the reality is far more intricate. A truly effective digital thread is more akin to a digital fabric, comprising interwoven digital fibers that connect systems, processes, and teams in a multi-dimensional web.

Mature companies with established processes often start with micro-threads, or digital fibers, connecting specific disciplines such as two engineering disciplines. These fibers link requirements, designs, configurations, and bills of materials (eBOM, mBOM). Expanding these connections to include manufacturing, sourcing, and service creates a more robust digital fabric.

For example, connecting requirements to a digital twin allows real-time updates and testing, ensuring the physical product aligns with the design intent. This "system of systems" approach integrates PLM with ERP and service management systems to enable continuity across the product lifecycle.

The digital twin, a virtual representation of a physical product or process, evolves based on real-time data. However, without a digital thread, this twin can become disconnected from the systems that govern its

lifecycle, limiting its utility. A well-executed digital fabric ensures that digital twins remain connected to their source of truth, enabling up-to-date configurations, informed decision-making, predictive maintenance, and optimized performance.

Best Practices for Implementing Digital Threads

CIMdata advocates for a holistic, end-to-end view of the digital thread while pursuing incremental implementation. Starting with high-value areas allows companies to manage risk, gain early successes, and scale over time. This phased approach is particularly effective in large, complex organizations.

A simplified IT landscape reduces the challenges of interoperability. By consolidating systems, adopting open standards, and leveraging APIs, organizations can enhance connectivity and improve data flow. Additionally, implementing strong data governance practices ensure data quality, consistency, and security throughout the product lifecycle.

Aligning digital thread strategies with business objectives ensures that investments deliver measurable value. By addressing critical pain points, companies can improve efficiency, enhance collaboration, and drive competitiveness. Analytics play a key role in this process, enabling continuous improvement across geographies and functions.

HCLTech Digital Thread Solution

HCLTech provides a robust portfolio of services and solutions to help companies streamline their technology architectures and connect disparate technologies. These offerings simplify application integration, establish digital threads and digital twins across systems, and enable enterprise-wide data federation and search capabilities within a connected digital mesh. By bridging gaps between disparate technologies, HCLTech facilitates seamless data flow across engineering, manufacturing, services, and operations in industries such as automotive, aerospace, medical, and other industrial sectors.

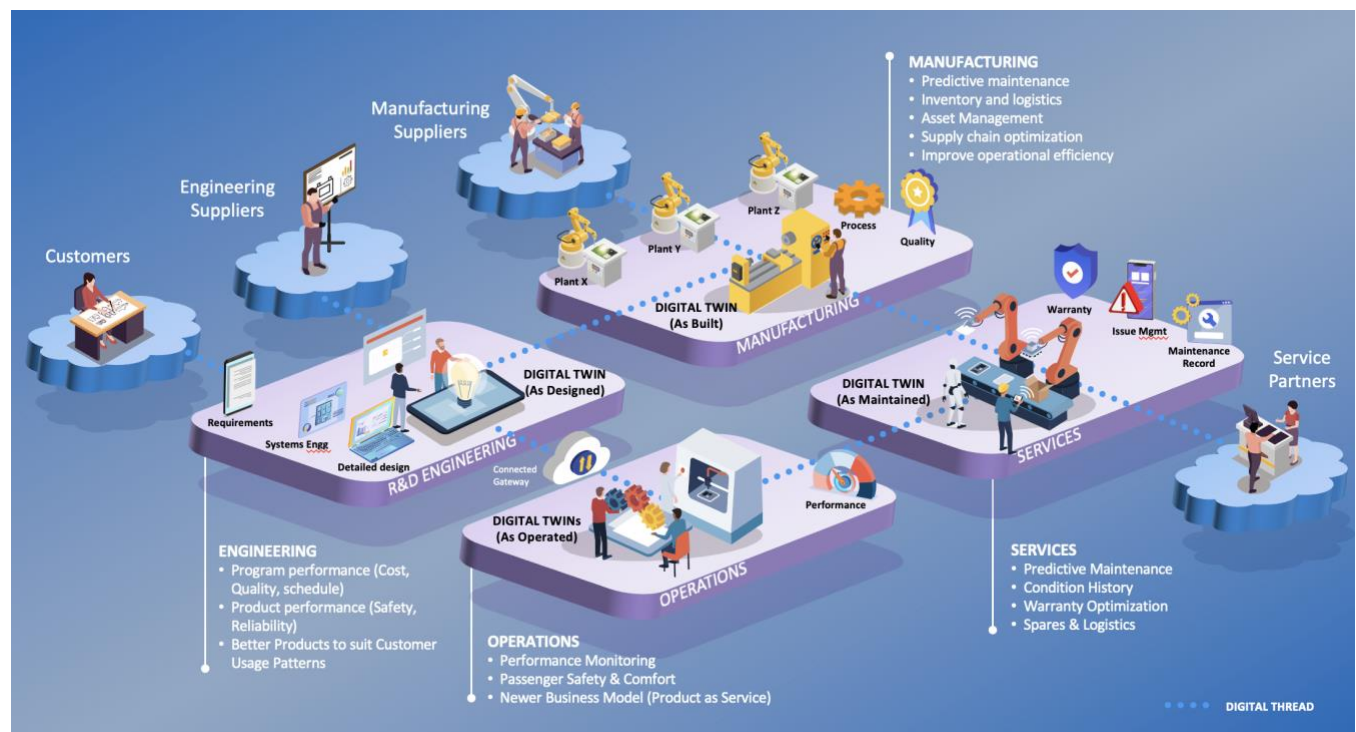


Figure 1—Digital Twins and Threads
(Courtesy of HCLTech)

Methodology and Expertise

HCLTech begins with a comprehensive assessment of an organization's processes, technology touchpoints, data ownership, and system interfaces. This assessment lays the foundation for defining digital thread implementation boundaries, analyzing data quality, and identifying gaps in the proposed thread.

HCLTech designs processes and digital thread models tailored to organizational needs—distributed, federated, or consolidated. The design phase includes creating user interfaces, reports, dashboards, and data transformation strategies, ensuring complete, consistent, and contextualized data flow. HCLTech provides a detailed roadmap with ROI justification, covering process implementation, system integrations, and data enrichment strategies.

HCLTech deploys digital threads across leading PLM platforms, including Siemens Xcelerator, SAP S/4HANA, PTC, Dassault Systèmes 3DEXPERIENCE, and Aras Innovator. Their solutions integrate partner technologies like SBE Vision and PROSTEP alongside proprietary offerings such as MBSE Connectors, EDA Connectors, MPMAccelerate, and ECCO.

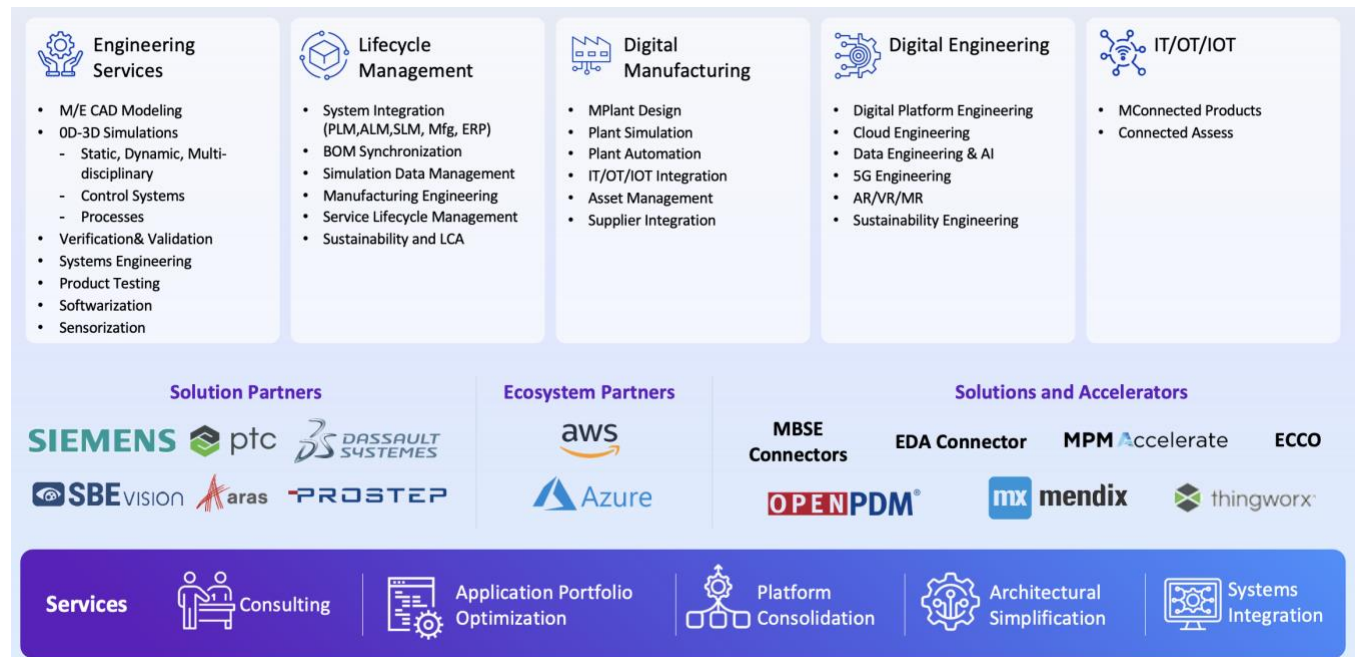


Figure 2—Digital Thread Offerings
(Courtesy of HCLTech)

With expertise spanning Microsoft Azure, AWS, Google Cloud, Oracle, and SAP, HCLTech enables seamless integration of engineering services, lifecycle management, digital manufacturing, and IoT and OT technologies.

HCLTech has developed a virtual lab to incubate and demonstrate digital thread solutions. This facility allows customers to experiment with proof-of-concepts, apply best practices, and gain hands-on experience to refine their strategies.

Industry Applications

HCLTech's digital thread expertise addresses a wide range of use cases:

- Defense Industry: Enabled bi-directional traceability and advanced digital twin capabilities to support virtual product development.

- Global Manufacturers: Transformed disconnected architectures into integrated systems with change management, supplier collaboration, and automated processes.
- Oil & Gas Provider: Streamlined operations by replacing Excel-based tools with a unified web application, enhancing collaboration, reducing duplication, and improving data reuse.

Partnering for Success

HCLTech collaborates with leading PLM platforms and uses proprietary tools like MBSE connectors and analytics solutions to address client needs. Their virtual labs allow companies to experiment with proof-of-concepts, ensuring stakeholder buy-in and alignment before scaling.

Conclusion

The journey to digital transformation is essential, challenging, and continuous. By addressing the complexities of product design, regulatory requirements, and organizational silos, companies can unlock the full potential of digital threads.

Companies that can successfully deploy a digital thread, provide greater end-to-end visibility and connectivity across the product lifecycle enabling seamless data flow across processes, systems, and stakeholders. This enhances visibility, traceability, and context of data, which in turn improves decision making and improves efficiency by ensuring real-time access to accurate, up-to-date information throughout design, manufacturing, and operations. CIMdata believes that organizations striving for a digital thread should have a holistic vision but pursue an incremental approach focusing on areas that deliver the most value and then scaling over time, which reduces risk and improves their ability to continually transform. Companies that can prioritize streamlining their IT architecture along this journey by consolidating to fewer platforms and integrating them to enhance their data quality and connectivity will achieve greater success.

HCLTech's expertise in building robust, scalable solutions positions them as a key partner in helping organizations navigate this dynamic landscape and achieve sustainable, long-term success. CIMdata recommends that companies wishing to enhance their digital thread consider HCLTech 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.