

AI-Powered Connected Digital Enterprise

Tata Consultancy Services

Takeaways

Since the dawn of the Digital Revolution in the 1970s, organizations have continued to expand their applications of digital technology to the product lifecycle.

To support their digital transformation objectives, industrial companies want to harness this wide-ranging data into a digital thread that spans their value chain, customers, and stakeholders.

There are many applications of artificial intelligence (AI) in value chain applications, but generative AI and Agentic AI offer many new possibilities to leverage digital thread data and corporate knowledge.

The Tata Consultancy Services Digital Thread group is helping their industrial customers build robust digital threads leveraging a value-based consulting methodology, industry best practices, and state-of-the-art AI and cloud technology.

Introduction

Digital technology has powered the product lifecycle since the 1970s.¹ Since product lifecycle management (PLM) emerged around 2000, industrial companies have relied on companies like Tata Consultancy Services (TCS) to help them leverage new technologies and concepts to support their products from idea through life. Generative AI (genAI) and Agentic AI, newcomers on the digital scene, offer exciting new capabilities for a wide range of industries and TCS has invested heavily to be at the forefront of its industrial adoption.

From Data Silos to An AI-Enhanced Digital Thread—The Journey Towards a Connected Digital Enterprise

The concepts of digitization and the impact of technology on businesses emerged as part of Industry 3.0, known as the Digital Revolution. The concept of “product lifecycle management” (PLM) emerged around 2000, with the vision to use digital technology to support the product lifecycle from idea through life.

¹ Research for this commentary was partially supported by Tata Consultancy Services (TCS).

While many existing digital solutions coalesced into PLM—including MCAD, CAM, and product data management (PDM)—industrial organizations built or adopted a wide range of digital technologies that, while not core to PLM, created significant data that could enhance product lifecycle activities.

While genAI is dominating the news cycle, PLM-enabling solutions have used Artificial Intelligence (AI) technologies for years. For example, machine learning (ML) enabled user experience improvements in CAD and other digital solutions in the mid-2000s. AI is central to generative design, an approach first defined in the 1990s that uses product design parameters to virtually test thousands of design alternatives that can satisfy the users requirement. Generative design has been turbocharged in recent years as computing power unit cost continues to decrease.

While the foundations of genAI emerged in 2014, the release of ChatGPT in November 2022 put this powerful technology in the hands of just about everyone. GenAI can create new content in text, images, audio, or other media. By January 2023, ChatGPT was the fastest-growing software application in history.² CIMdata believes engineering is an ideal domain to apply genAI: the engineering discipline rigorously and systematically creates and collaborates on varied information across the product lifecycle from idea through life, creating the raw material, parsed from enterprise and IT-OT systems, that forms the basis of all genAI use cases. As the technology matures, companies are now looking to develop agentic AI systems.³

TCS, a leading global systems integrator firm, is well positioned to leverage their skills, experience, and advanced technology for the benefit of their global customer base.

TCS: The AI-Powered Connected Digital Enterprise

TCS is an Indian multinational IT services, consulting, and business solutions organization. A part of the Tata group, TCS has over 607,000 consultants in 55 countries. In their fiscal year ended March 31, 2025, TCS reported consolidated revenues of nearly US\$30.2 billion, and is listed on the BSE and the NSE in India. Based on CIMdata's market research, TCS is one of the global market leaders in PLM-related services, and partners with PLM market-leading independent software vendors (ISVs) including Dassault Systèmes, PTC, and Siemens Digital Industries Software. TCS' Digital Thread group is part of their IoT & Digital Engineering business unit.

TCS' vision for the "AI Powered Connected Digital Enterprise" will position its customers to thrive in the rapidly evolving digital landscape. Their vision has two foundational pillars: the digital thread and the digital twin.

The digital thread serves as the backbone for seamless information flow across the entire product lifecycle—from initial requirements to the physical product in the field. This continuous flow enables closed-loop feedback from real-world usage back into the organization and ensures that insights and learnings can be systematically captured and leveraged for ongoing improvement.

While the digital thread can help enable transforming the complete product lifecycle across the value chain, it is often complex and time consuming to deliver the entire scope. To address this issue, TCS breaks down the digital thread into multiple manageable threads focused on key problem areas and linked to specific business benefits. This helps TCS deliver a compelling value proposition to their customers.

² <https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/>. It was surpassed by Threads in July 2023.

³ Agentic AI refers to autonomous AI systems designed to act independently and proactively to achieve pre-defined goals, setting them apart from traditional AI that requires constant human oversight and step-by-step guidance. These systems possess agency, enabling them to plan complex multi-step tasks, adapt to changing conditions, and make decisions without direct human intervention. <https://aws.amazon.com/what-is/agentic-ai/>

The digital twin complements the Digital Thread by generating actionable insights. These insights are fed back into the digital thread, enabling organizations to take timely corrective actions and optimize performance. Together, these capabilities empower enterprises to build context-sensitive, real-time business processes, enhancing agility and responsiveness to dynamic market conditions. TCS' approach is to enable closed-loop digital twins that complement the digital thread to avoid creating data silo's as in the past.

AI will act as a critical catalyst in realizing the Connected Digital Enterprise vision. By embedding AI across the digital thread, TCS will enable organizations to:

- Reimagine how to achieve engineering, manufacturing, and service excellence by continuously consuming the product lifecycle data.
- Continuously assist, augment, and transform human actions by providing the right data in context.
- Automate data collection and analysis from diverse sources, reducing manual effort and accelerating decision-making.
- Uncover hidden patterns and predictive insights from complex product and operational data, driving proactive interventions.
- Enhance model-driven processes with intelligent recommendations, anomaly detection, and scenario simulations.
- Enable real-time monitoring and adaptive responses to changing business environments, making enterprises more resilient and competitive.

TCS' definition of the enterprise digital thread aligns closely with CIMdata's perspective on the product lifecycle, spanning from ideation to end-of-life. TCS' standards-based integration architecture supports a wide range of enterprise applications—including PLM, ERP, ALM, and MES. TCS painstakingly built comprehensive ontologies that incorporate industry standards such as STEP, MoSSEC, and OSLC, to ensure interoperability and data consistency. Their approach also includes using knowledge graphs (e.g., Neo4J) to enable linking and exposing disparate data sources, establishing end-to-end traceability and ultimately driving deeper insights.

Similarly, TCS' approach to digital twin mirrors CIMdata's model-based philosophy, recognizing the critical role of digital twins in realizing the vision of a truly connected digital enterprise. By adopting a model-based approach, organizations can unlock significant advantages in terms of flexibility, scalability, and innovation.

Figure 1 illustrates how product twins, plant twins, and asset twins can act in concert, leveraging information from the digital thread, and enhancing that thread across the entire product lifecycle.

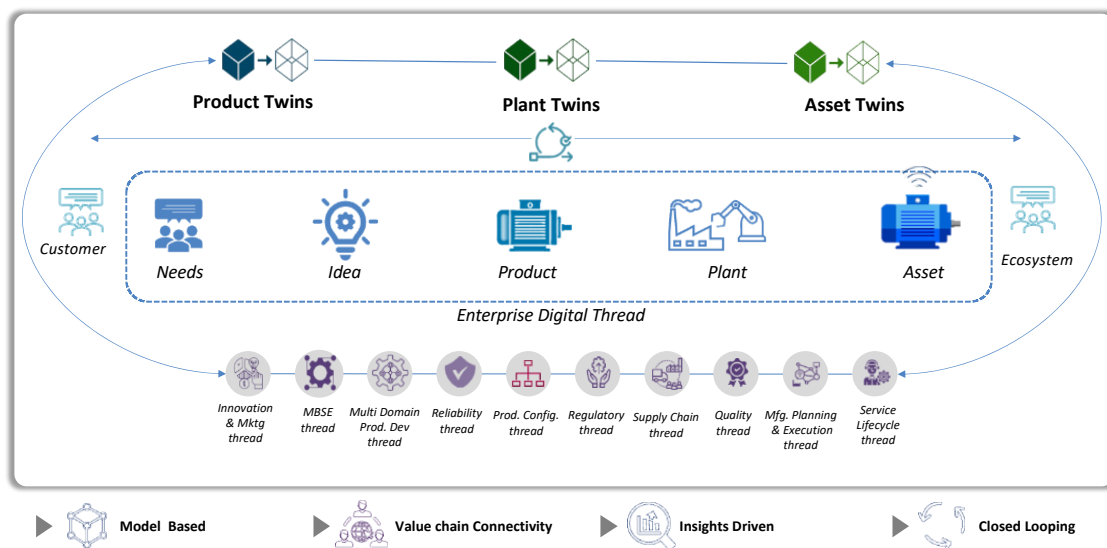


Figure 1—Digital Thread Enabling a Connected Digital Enterprise
(Courtesy of Tata Consultancy Services)

TCS’ goal is to enable an AI-Powered Connected Digital Enterprise. How does TCS engage with their customers to achieve this goal? The TCS “PLM Vision to Value (V2V) Framework” is a consulting methodology and framework to define program vision, a transformation roadmap, and to implement the roadmap to deliver business value using TCS-proprietary tools and best practices.

Figure 2 highlights the key elements in their AI-Powered Connected Digital Enterprise vision. This framework is ISV-independent, and TCS built demonstrators on different platforms from the leading ISVs. To help jump start a customer’s digital transformation journey TCS developed accelerators including a Process Framework, an Integration Architecture, and Solution Demos that help decrease time-to-value (TTV) for their implementations.

Building such an expansive heterogeneous solution requires partnerships with leaders in several key domains. TCS is collaborating with their PLM ISV partners, like Dassault Systèmes, PTC, and Siemens Digital Industries Software, to enable genAI in their applications. Hyperscaler partners like Amazon Web Services (AWS), Microsoft Azure, and Google Cloud work with TCS to ensure their cloud technology stack can support the genAI aspirations of TCS’ industrial clients. Those clients genAI initiatives will often use multiple AI technology providers and TCS’ many AI partnerships include leading providers like OpenAI.

To determine how best to apply genAI to the product lifecycle, TCS leveraged their significant customer experience to capture their priorities and voices to define and build a robust AI solution framework (as shown in Figure 2) to address customer needs. Key customer requests included: support for digital transformation, next-generation platforms and solutions, sustainable operations, quality, compliance and cost reduction, process optimization, modernization, and cost savings of their IT assets. TCS genAI efforts are focused on productivity, efficiency, value creation, performance, and engineering innovation. Prominent use cases include product design and innovation, intelligent bills of material (BOMs), lifecycle analytics, natural language processing (NLP), collaborative systems, enhanced digital twins, sustainability analytics, product quality control and analytics, automated compliance and regulatory checks, and more.

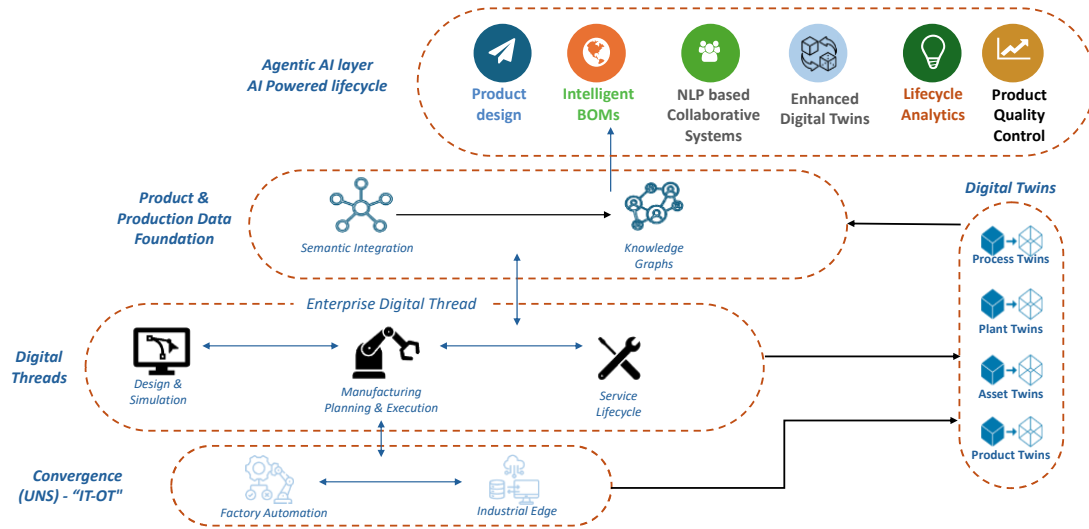


Figure 2—AI-Powered Connected Digital Enterprise
(Courtesy of Tata Consultancy Services)

Their expansive agentic AI framework, shown in Figure 3, illustrates their broad range of agentic AI proofs of concept (POCs), most of which are in progress for various clients.

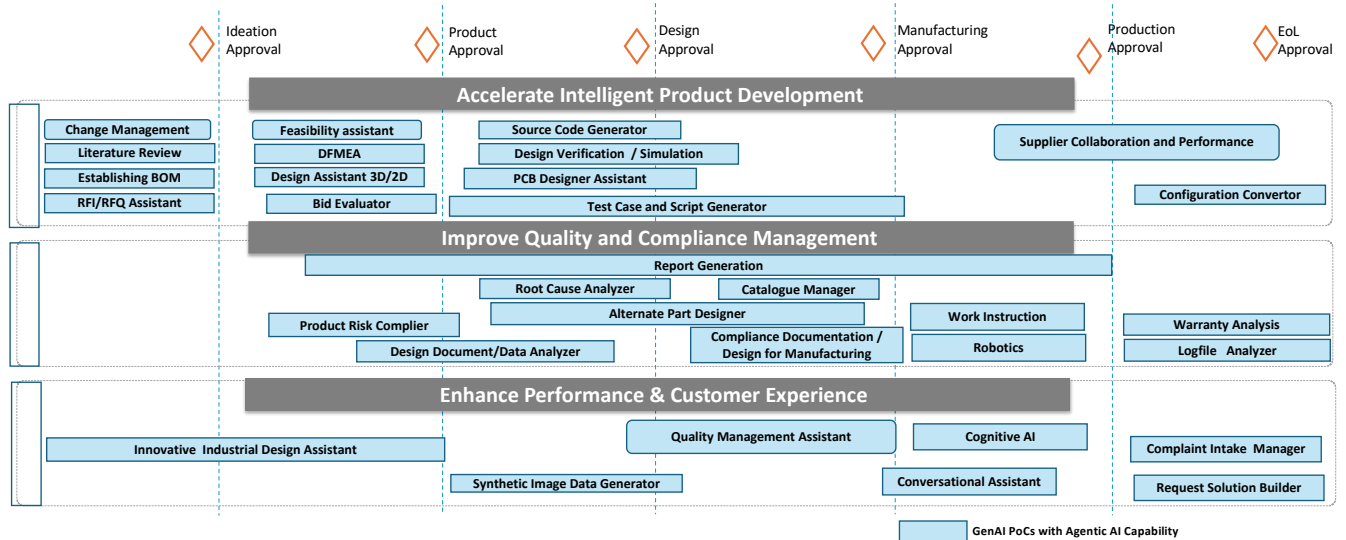


Figure 3—AI Applications Across the Product Development Lifecycle
(Courtesy of Tata Consultancy Services)

To support enterprise adoption, TCS has developed AI WisdomNext™, an innovative platform that aggregates multiple generative AI and cloud services into a unified interface. The platform enables centralized governance with guardrails for all AI applications across diverse multi-modal scenarios, including Retrieval Automated Generation (RAG), GraphRAG, and agentic AI. It includes a set of ready-to-deploy blueprints and solution templates for rapid enterprise adoption of enterprise-grade genAI solutions.

Early TCS AI customers' examples illustrate the breadth of their capabilities. TCS worked with a leading semiconductor equipment manufacturer to develop a comprehensive impact assessment for planning and execution of changes across multi-disciplinary functions using knowledge graphs and AI. At a semiconductor integrated device manufacturer (IDM), TCS helped to establish project-to-product traceability using AI/genAI with knowledge graphs. At a power equipment manufacturer, TCS assessed the impacts of SW requirement changes across package builds, engine calibration, programs, products, and factories' shopfloor lines using ML and knowledge graphs. And finally, TCS worked with an automotive OEM to identify standard vehicle components issues based on customer

complaints/narratives in audio/text form, for regulatory compliance submittal (e.g., NHTSA) using ML and genAI.

CIMdata believes that TCS was smart to attack the genAI challenge head on. These initial efforts illustrate the efficacy of the TCS' approach and bode well for their agentic future. As their POCs are applied and expanded through customer engagements, their capabilities will continue to improve. Of course, those customer engagements will reveal new requirements for TCS to tackle, helping them reach their AI-Powered Digital Connected Enterprise vision.

Conclusion

Companies have applied digital technology to the product lifecycle for decades, creating seas of digital data from a wide range of applications. Since then, companies have worked to harness that data through the digital thread, and to power model-based approaches to development leveraging digital twins and, increasingly AI. The introduction of generative AI empowers companies to increasingly leverage their digital threads and twins. TCS, a leading global IT services, consulting, and business solutions organization, is using their considerable resources to define and help industrial companies realize their vision for an AI-Powered Connected Digital Enterprise. This commentary describes just some of their methods and tools developed to support their customers digital enterprise journey. The early results are in and TCS customers are already reaping the benefits of their efforts to date. CIMdata looks forward to seeing what's next.

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.