COMMENTARY

CIMdata®

# Enhancing R&D with Generative AI in ALM and PLM

## Wipro's Industry DOT solutions lay a foundation for "software-defined" innovation

### Key Takeaways

The potential for unlocking business value using Generative AI and AI/ML across the entire product lifecycle as reported by numerous studies is unquestionable. Product R&D and software engineering are two of the most valuable opportunities to take advantage of this across a broad range of industries.

Established Industry 4.0 technologies such as CAx, ALM, MBD, MBE, MBSE, IoT, and SLM are already creating significant enterprise value. The next opportunity in this domain is using AI and ML technologies to improve the data embedded within the digital threads.

With their focus on "software-defined" innovation, Wipro's Industry DOT (Design to Operation Twin) offerings which span product development, manufacturing processes, and plant operations are laying the foundation for AI use across various digital threads.

While it is too early to discuss well-developed use cases and success stories, having a well-defined and systematic process to assess the potential, define the PoCs and success criteria, and build for scale from the beginning are essential steps for assured success.

## Introduction

Industry 4.0-focused solutions, characterized by the fusion of cyber-physical systems, the Internet of Things (IoT), and advanced analytics (with AI elements), are transforming traditional manufacturing and business operations. These technologies enable smart factories where automation and real-time data collection streamline processes and enhance efficiency. For instance, IoT sensors can help monitor machinery and production lines, providing continuous feedback that enables predictive maintenance, thus reducing unexpected downtime and extending equipment lifespan. Advanced analytics and AI play a pivotal role by analyzing vast amounts of data to uncover patterns and insights to inform proactive decision-making. This leads to improved product quality, optimized resource utilization, and the ability to rapidly adapt to market demands. Furthermore, IoT connectivity facilitates seamless communication between machines, helping synchronize logistics to minimize waste and maximize productivity.[1]

[1] Research for this paper was partially supported by Wipro

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The value proposition of Industry 4.0-focused solutions lies in their ability to drive innovation, enhance operational efficiency, and foster sustainability. By leveraging these technologies, businesses can achieve higher productivity, better quality control, and more flexible production processes. This provides a competitive edge and contributes to sustainable practices by reducing energy consumption and minimizing waste, ultimately leading to long-term cost savings and environmental benefits.

In a study conducted by Mr. Michael Chui, et al, of McKinsey and Company entitled "The economic potential of generative AI: The next productivity frontier" in June 2023, the projected impact of Generative AI in "Software engineering (for product development) and "Product R&D" exceeds US$300B each. See Figures 1 and 2. The impact is spread across multiple industries, such as advanced electronics and semiconductors, advanced manufacturing, energy, high-tech, construction, and consumer goods. This bodes well for Industry 4.0-focused technologies and AI technologies to work together and drive the next wave of industrial innovation.

**Using generative AI in just a few functions could drive most of the technology's impact across potential corporate use cases.**

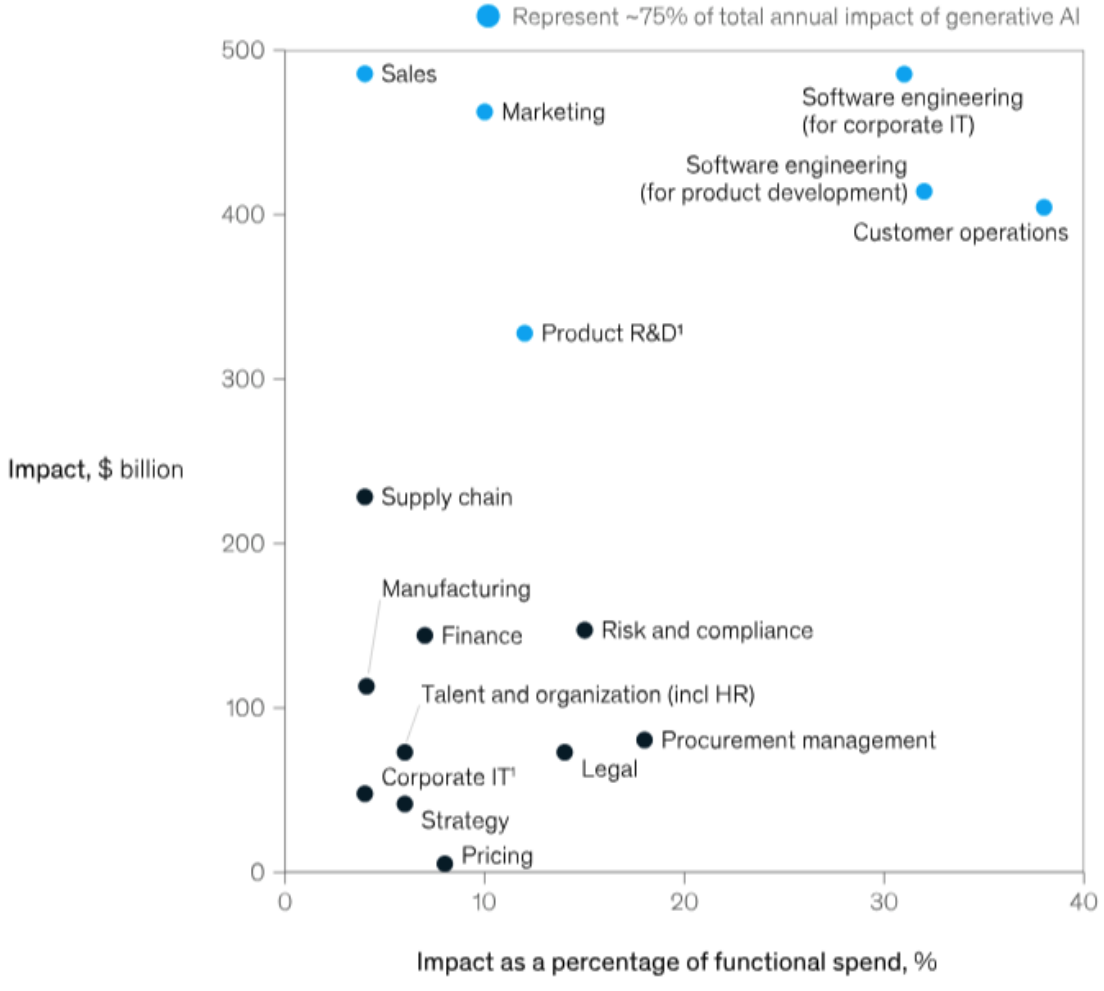


**Figure 1—Generative AI impact Across Business Functions**

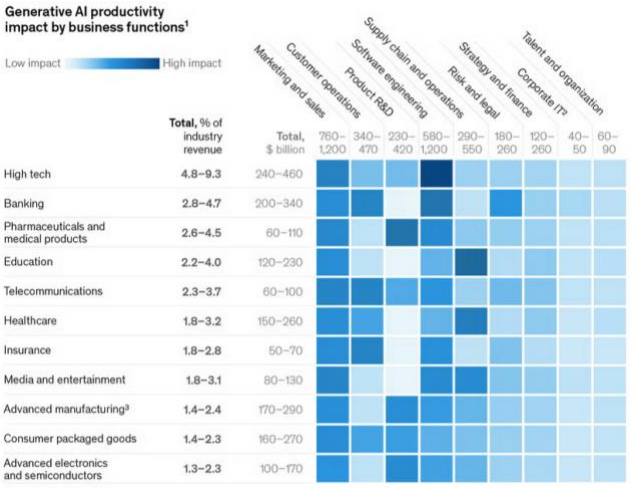


**Figure 2—Generative AI impact Across Industries[2]**

## Laying the Foundation for AI

There are numerous AI applications and use cases supported by Industry 4.0-focused solutions. However, the identification, definition, and successful execution of Proofs of Concept (PoC) and their eventual scale-up needs a thought-out and systematic process. This is the first step in the time-tested process consisting of define and assess, decide and strategize, develop a pilot, and finally, enterprise scale-up.

One key element of success with this process is having active digital threads across the enterprise. Wipro's views on the digital thread are shown in Figure 3. The digital threads connect digital definition, simulation-driven validation, connected and automated realization, and closed-loop and continuous optimization into a unified framework. This brings product engineering, manufacturing processes, asset management, and various enterprise business functions close together and creates significant enterprise value by driving faster decisions, creating sustainable products, and reducing overall waste.

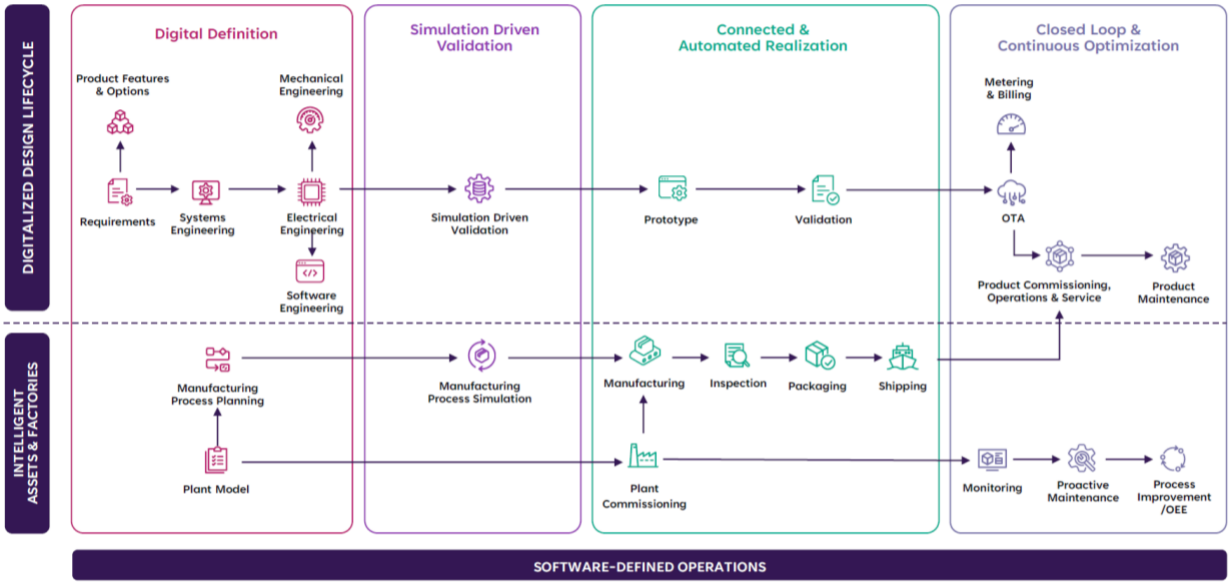


**Figure 3—The Digital Thread Throughout the Enterprise**
*(Courtesy Wipro)*

[2] Source: Chui, Michael, et al. *The economic potential of generative AI: The next productivity frontier*. McKinsey and Company. June 2023.

While the digital threads connect all functions and domains, it is equally important that each function is software-defined and, potentially, model-based. This enables the creation of a digital representation of each step of the product lifecycle. The digital representation can then be used in conjunction with physical reality so that a continuous virtual loop can be put in place to achieve defined objectives. Achieving these needs requires the careful implementation and integration of many technologies, such as CAD, PLM, IoT, digital manufacturing, robotics, additive manufacturing, and digital supply chain solutions. Each step has its own nuances and requires domain expertise to be successful.

## Wipro Industry DOT AI

Wipro's AI offerings are divided into six areas: R&D process optimization, manufacturing process optimization, asset and facility management, AI applied to enterprise, supply chain management, and sustainability.

AI supports a wide range of applications and use cases across these areas. In R&D process optimization, AI can help streamline ideation, systems engineering, product development, manufacturing engineering, and service engineering. In manufacturing, AI can help with manufacturing planning, demand forecasting, inventory optimization, and predictive asset maintenance. AI can assist with trends-based asset monitoring and facility maintenance for asset and facility management. AI has the potential to help with business processes related to asset acquisition and maintenance. When applied at an enterprise scale, AI can potentially create significant value by connecting the engineering and business functions. AI can help optimize logistics, improve demand forecasting, and enhance inventory management and supply chain management. Lastly, regarding sustainability, AI can help companies reduce their environmental impact by optimizing resource usage, improving energy efficiency, and helping design more sustainable products and services.

With its strength in a process-oriented and consultative approach, Wipro is geared up to assess the potential of AI integration in all these areas and implement methods and an architecture for scalable AI deployment. Figure 4 highlights how Wipro is differentiating their Industry DOT offerings. In CIMdata's experience, this figure hits many of the hot-button issues facing potential adopters.

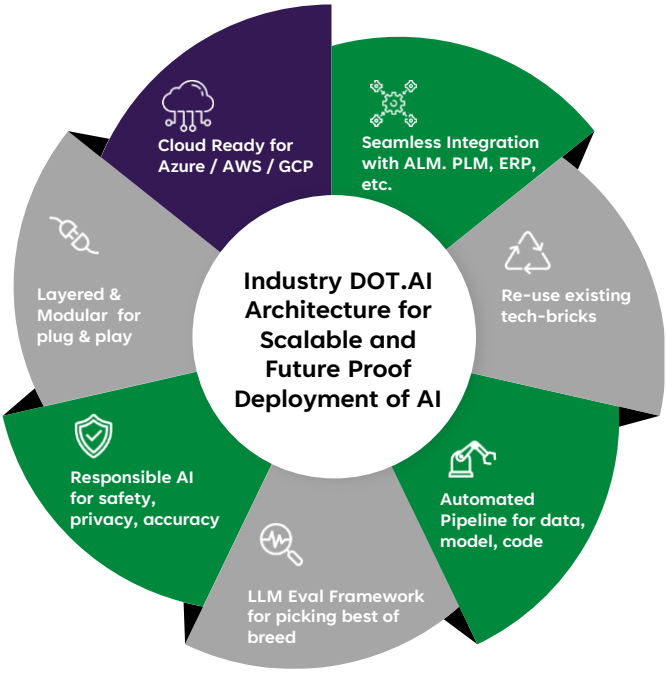


**Figure 4—Deployment of AI**
*(Courtesy Wipro)*

## R&D Optimization with AI: A Use Case in Systems Engineering

Multiple challenges exist in turning product requirements from varied stakeholders into a consistent requirements definition. Using text-based requirements to create a systems architecture model and connecting them with verification and validation plans can generate significant value for organizations during the early stages of the product lifecycle.

The Wipro team uses a novel approach, creating a customized small model to demonstrate early wins enabled by AI. A small model, when used as it is, cannot achieve an acceptable performance in this regard. To achieve this, an open-source foundation large language model (LLM) is used to create synthetic data to provide contextual and annotated data to train the small model. This improves the small model's performance, and successfully creates an initial architecture of specifications. This use case indicates the potential of using an open-source LLM model to create the context for in-house small models, which can then be fed proprietary data to significantly improve outcomes. See Figure 5.

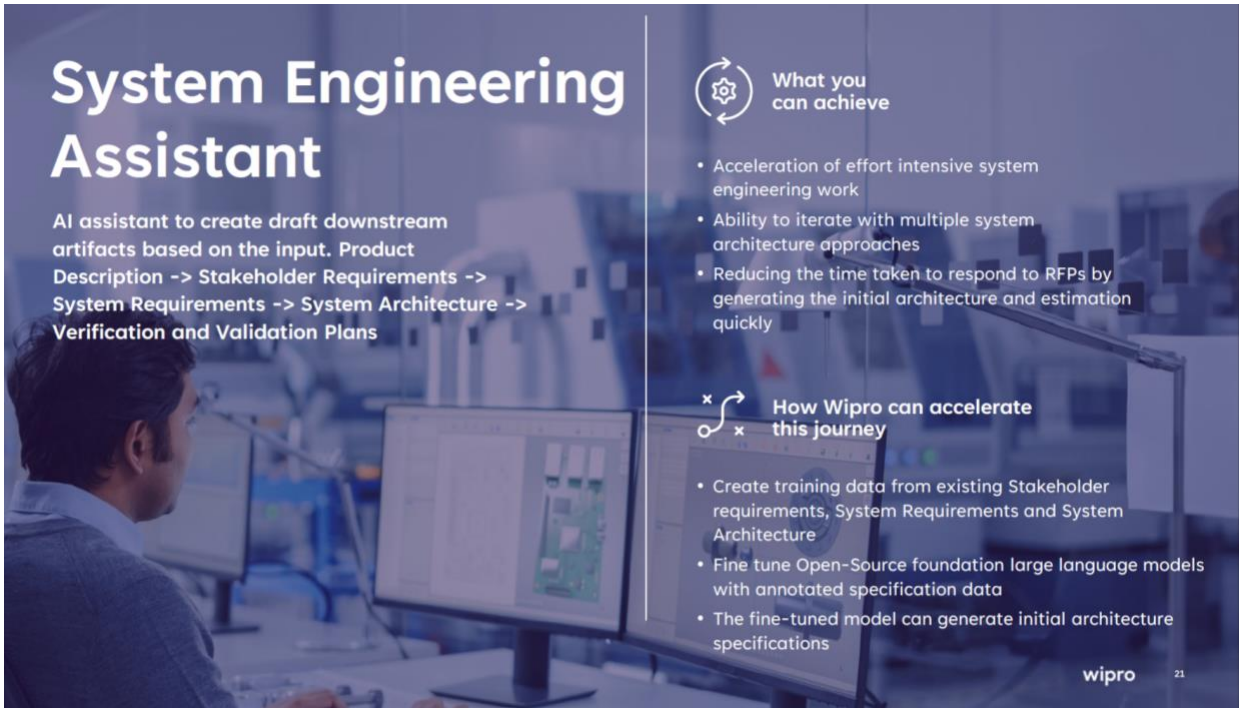


**Figure 5—Deployment of AI**
*(Courtesy Wipro)*

A robust, flexible, and scalable IT architecture is required to develop these use cases. Data security and privacy are significant considerations when designing architectures. Wipro is working with several ecosystem partners to implement such an architecture. Figure 6 illustrates one example.

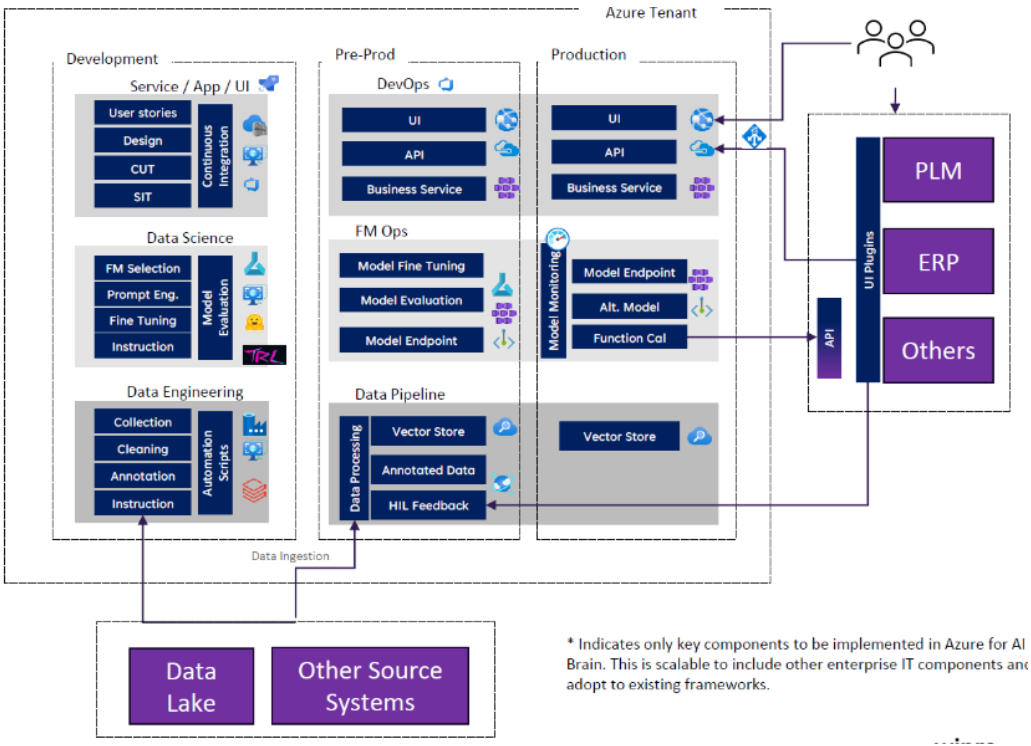


**Figure 6—A Reference Deployment Architecture**
*(Courtesy Wipro)*

## Concluding Remarks

Advanced analytics and AI can play a pivotal role by analyzing vast amounts of data to uncover patterns and insights and inform proactive decision-making. These capabilities can help companies improve product quality, optimize resource utilization, and enable rapid adaptation to market demands.

The potential for unlocking business value using advanced analytics and Generative AI across the entire product lifecycle is unquestionable. However, a process-oriented and systematic approach and domain-specific consulting expertise are necessary to achieve these goals.

Wipro's Industry DOT offerings, focusing on "software-defined" innovation, are laying the foundation for the potential use of AI across various digital threads. CIMdata recommends companies evaluating and selecting AI solutions across Industry 4.0-focused applications should consider Industry DOT AI.

## About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design, deliver, and support innovative products and services by identifying and implementing appropriate digital initiatives. For forty years, CIMdata has provided industrial organizations and providers of technologies and services with world-class knowledge, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) solutions 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.