

Next Generation Manufacturing Enterprise: Powered by Generative AI



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Key takeaways

- There is tremendous potential for GenAI opportunities in the manufacturing sector – from copilots for plant operators and product design to supply chain optimization and net zero goals.
- For manufacturers to fully exploit the potential of AI, it is essential to have access to a multitier architecture optimized for cost, quality, security and privacy.
- Built on the principles of an industry-led, data-fueled, and ecosystem-enabled foundation, we offer an “enterprise-wise” AI approach designed to make GenAI consumable for an enterprise-grade transformation.

The transformative potential of GenAI

The excitement of generative artificial intelligence (GenAI) going mainstream has prompted a sense of urgency to tap into its immense potential. The opportunities for the manufacturing sector are abundant – from copilots for product design and maintenance to supply chain optimization and achieving net zero goals.

But while many discussions start and end with enhanced productivity, an even greater value lies in the ability to unlock and democratize knowledge. Reimagining ways of working and augmenting humans with advanced knowledge capabilities can transform tacit knowledge into elite decision making and high-performing innovation superstructures.



AI: From then to now

Initially, AI focused on recognition tasks, like identifying objects in images. Its next iteration involved reasoning, analyzing what is happening, why it is happening, what the likely outcomes are, what we should do about it, and decision-making based on that understanding.

The most transformative shift happened with the advent of generative or operative capabilities, exemplified by Large Language Models (LLMs) like GPT, LaMBDA and LLaMA. These models leverage predictions made during the reasoning stage and can make decisions and propose actions.

GenAI and large language models have the potential to extract insights from such unstructured content. Foundational models, such as GPT, LLaMA and open-source alternatives, are ‘world-wise,’ able to integrate common knowledge that may exist offline, such as in books or paintings. By combining such models with ‘enterprise-wise’ ones and traditional AI/ML techniques, manufacturers can create a knowledge superstructure.

Generative AI for manufacturing value chains

Many manufacturers are already experimenting with AI technologies, to a greater or a lesser degree. In the TCS Global Cloud Study, nearly three-fourths (73%) of manufacturing respondents said they increased investments in artificial intelligence / machine learning (AI/ML) in the past 1 to 2 years and more than three-fourths (76%) said they planned to invest in AI/ML in the next 1 to 2 years.*

Among other use cases for GenAI, manufacturers are currently exploring:

- **Product design and development:** GenAI can accelerate product development and time to market by generating requirements and concepts based on market analysis and customer buying patterns. In the design stage, engineers can model and test prototypes, sifting through parameters such as weight, costs, and durability to reach the best possible outcomes.
- **Supply chain management:** Production planners and supply chain analysts can create comprehensive models and simulations of demand and supply, creating and re-creating endless inventory scenarios to optimize carrying costs and availability. Visual layouts can help determine efficient storage, and provide alternate inventory storage designs.
- **Plant operations:** Orchestrating the processes and workflows contained within a single plant is challenging, let alone synchronizing multiple facilities across the globe. GenAI lets operators and planners identify more efficient processes, layouts and schedules, and allocate resources, such as machines, labor, and materials to minimize bottlenecks and reduce waste. Alerts and sensors can help detect potential errors and failures in real time to improve quality control.
- **Sales and marketing:** From cold calls to close, GenAI can help elevate employee performance across the sales cycle. Dynamic pricing and offers, hyper-personalization and more accurate lead qualification can accelerate timely, cost-effective sales and marketing processes. Contract generation and intelligent copilots can efficiently guide sales teams through closing processes.
- **Distribution:** Even the simplest fulfillment process can contain dozens of logistical details around transportation routes and schedules. GenAI can help sift through dynamic factors like weather, fuel prices, river capacity and traffic conditions to minimize costs and carbon emissions, automatically adjusting based on demand forecast and unexpected delays.
- **Aftersales service:** GenAI can augment those in customer-facing positions by arming them with intelligent troubleshooting support and contextual knowledge repositories. Natural language models can guide customers through self-help processes that offer accurate customized responses, enabling staff to focus on more complex inquiries.

Figure 1 lists these six focus areas, along with relevant use cases and target personas, and the potential benefits GenAI can bring to each. It is important to note that in all these examples, intelligent technologies are a copilot for humans, not a replacement. GenAI will augment humans in their day-to-day work, empowering them to make consistently better decisions and truly innovate in a way that transforms the entire organization.

* Tata Consultancy Services (TCS) conducted a global cloud study from 6 January to 14 February 2023 on the theme of cloud-enabled innovation. TCS surveyed 972 C-suite and IT senior executives and decision makers from companies with +\$1 billion in annual revenue, across UK & Ireland, Continental Europe, North America, and APAC (India, Japan, Australia, NZ). The C-suite and IT senior executives and decision makers included 106 respondents in manufacturing.







						
	Product design & development	Supply chain management	Manufacturing & operations	Sales & marketing	Distribution	Aftersales & service
Potential Benefits*	<ul style="list-style-type: none"> • 20%+ reduction in time to market • 5% - 10% R&D expenses 	<ul style="list-style-type: none"> • 10%+ reduction supply chain cost • 10% - 20% productivity improvement 	<ul style="list-style-type: none"> • 10-15% OEE improvement • 2% - 10% asset uptime improvement 	<ul style="list-style-type: none"> • 10% - 25% improved campaign content • 20-25% improved sales conversion 	<ul style="list-style-type: none"> • 10% - 20% improved fulfilment • 5-10% cost reduction with route optimization 	<ul style="list-style-type: none"> • 5% - 10% reduction in warranty cost • 10% - 30% reduction in MTTR/MTBF • 20%+ improved NPS
Use Case Areas	<ul style="list-style-type: none"> • Market research & analysis • Concept design • Design & development • Product validation • Regulatory compliance 	<ul style="list-style-type: none"> • Sourcing contracts, Supplier selection • Logistics optimization • Demand forecasting • Risk Prediction • Scenario planning (inventory, capacity etc) 	<ul style="list-style-type: none"> • Production planning and sequencing • SOPs / Work instructions • Predictive maintenance 	<ul style="list-style-type: none"> • Content design • Lead management • Campaigns • Order management • Personalization • CPO & commerce 	<ul style="list-style-type: none"> • Packaging & shipping • Fleet management • Warehouse management • Third party logistics 	<ul style="list-style-type: none"> • Customer self service • Digital field service • Contact center • Warranty • Parts management
Target Personas	<ul style="list-style-type: none"> • Product design engineer • Product marketing manager • Product validation engineer 	<ul style="list-style-type: none"> • Demand planner • Material planner • Logistics in charge • Supply chain analyst • Supplier (Partner) • Category manager 	<ul style="list-style-type: none"> • Production planner • Manufacturing engineer • Plant operator 	<ul style="list-style-type: none"> • Digital eCommerce manager • Customer care executive • Sales/Market executive 	<ul style="list-style-type: none"> • Logistics and distribution manager • Warehouse manager 	<ul style="list-style-type: none"> • Customer care executive • Chief service officer • Service engineer • Parts manager • End customer

Figure 1: Focus areas for GenAI

*Potential benefits based on TCS' experiential and contextual knowledge, domain expertise and internal model estimates; actual results may vary.



Our GenAI Vision

Transforming the potential of GenAI into sustained performance requires a multidimensional strategy and an enterprise architecture optimized for cost, quality, security and privacy. In short, it requires a tailored fit – not a one-size-fits-all solution.

With extensive experience in working with hundreds of global companies, we take a best practice approach to help manufacturers master the delicate balance of opportunity and risk to ensure successful GenAI outcomes.

Built on the principles of an industry-led, data-fueled and ecosystem-enabled foundation, we offer an “enterprise-wise” AI approach designed to make GenAI consumable for an enterprise-grade transformation.

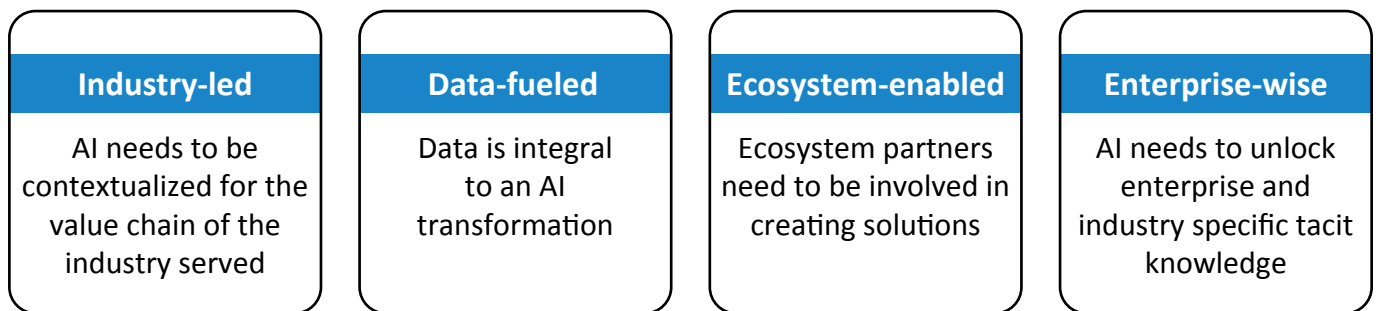


Figure 2: “Enterprise-wise” AI adoption approach

These four principles underlay the TCS path of AI potential to performance, a continuum that builds upon and reinforces each stage: Assist, Augment, Transform (see Figures 3 and 4).

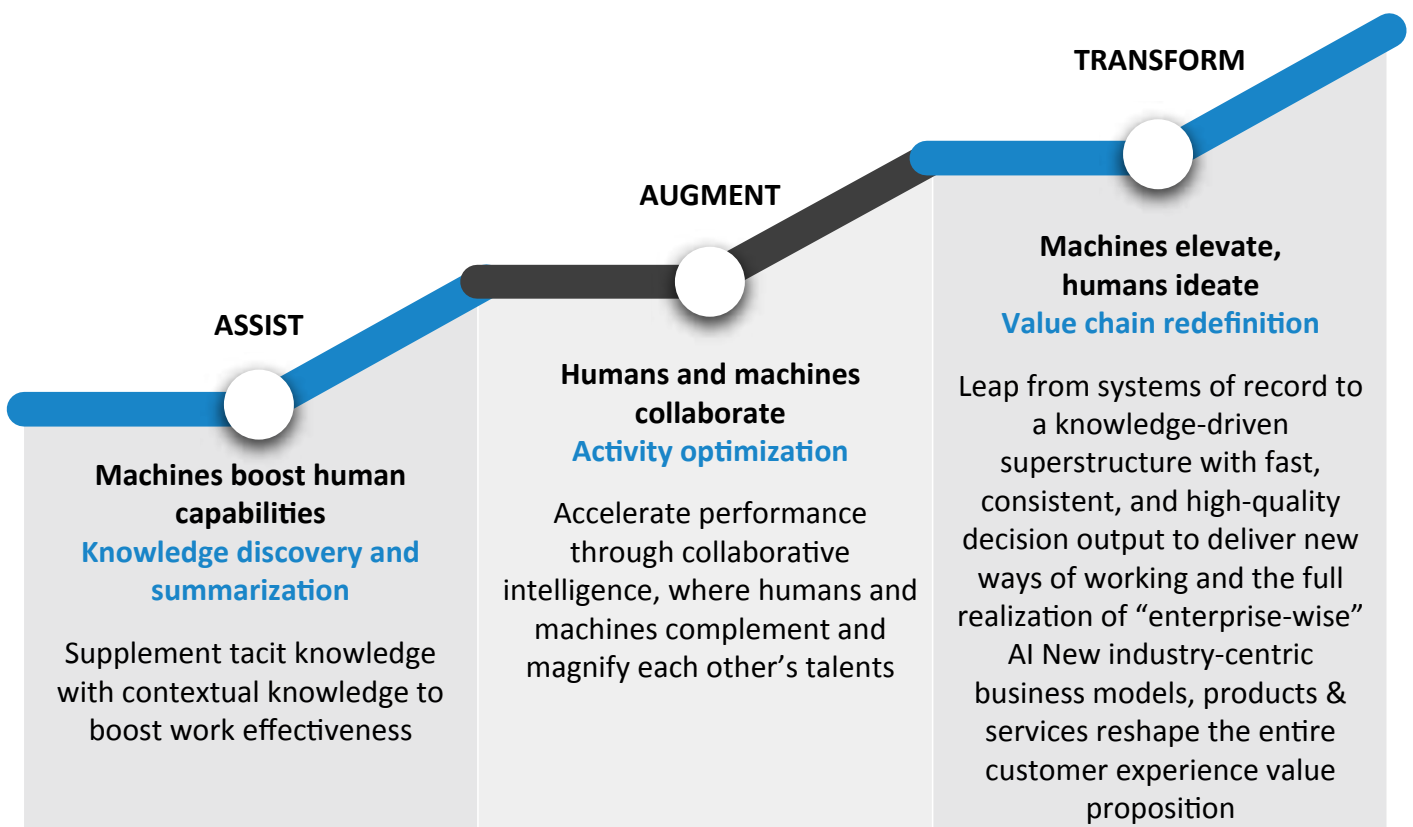


Figure 3: TCS AI Continuum – Manufacturing

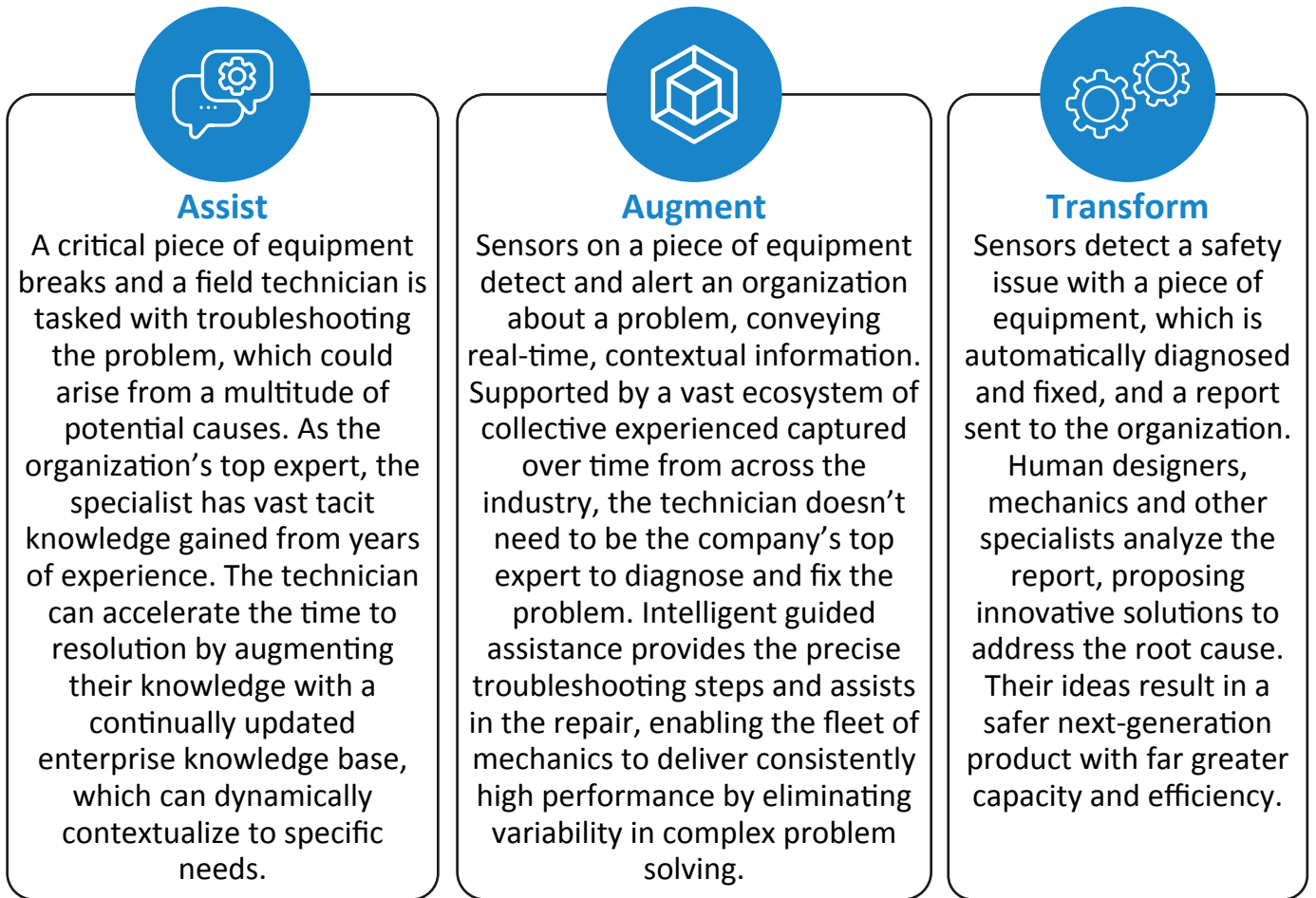


Figure 4: An AI evolution in action

Case in point: Plant operations

We empower companies to jump-start their generative AI-led business reimagination journey. For example, TCS infuses GenAI into the daily activities of plant operators as a co-pilot template to help solve pressing business challenges like troubleshooting and maintenance.

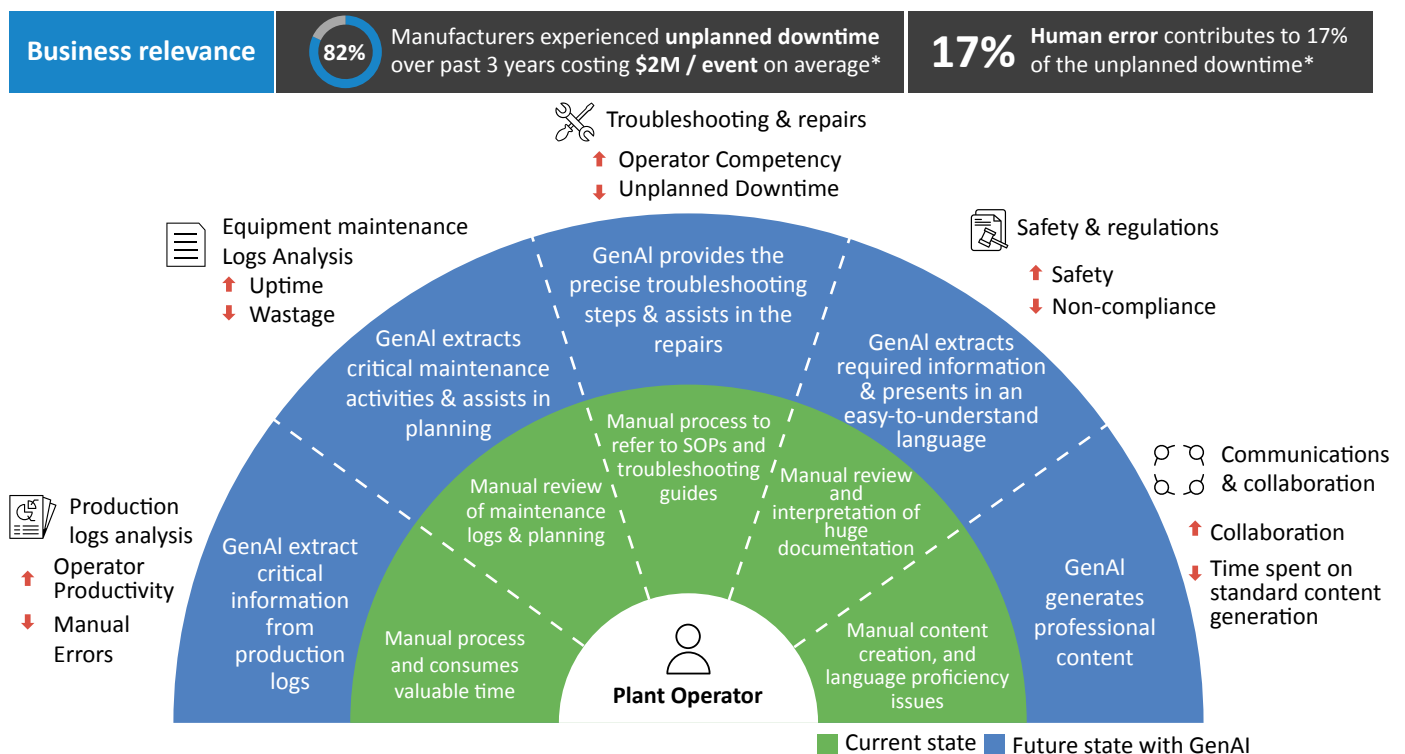


Figure 5: Case in point: GenAI infusion in to the daily activities of the "plant operator" persona

*Potential benefits based on TCS' experiential and contextual knowledge, domain expertise and internal model estimates; actual results may vary.

Navigating the complexity: A multi-layered architecture

How does a manufacturer actually prepare itself for an AI evolution? The design of an AI solution must start with a value-augmentation opportunity for business; prioritizing top-down structures, rather than starting with technology adoption.

Further, it is critical to make the model safe. Manufacturers need to establish a governance model for information security, regulatory compliance, and bias mitigation guardrails.

For manufacturers to fully exploit the potential of AI, it is essential to have access to a multitier architecture and integration to enterprise systems. *Figure 6* shows the dimensions of AI applicability in the AI architecture in manufacturing can be segmented into four layers.

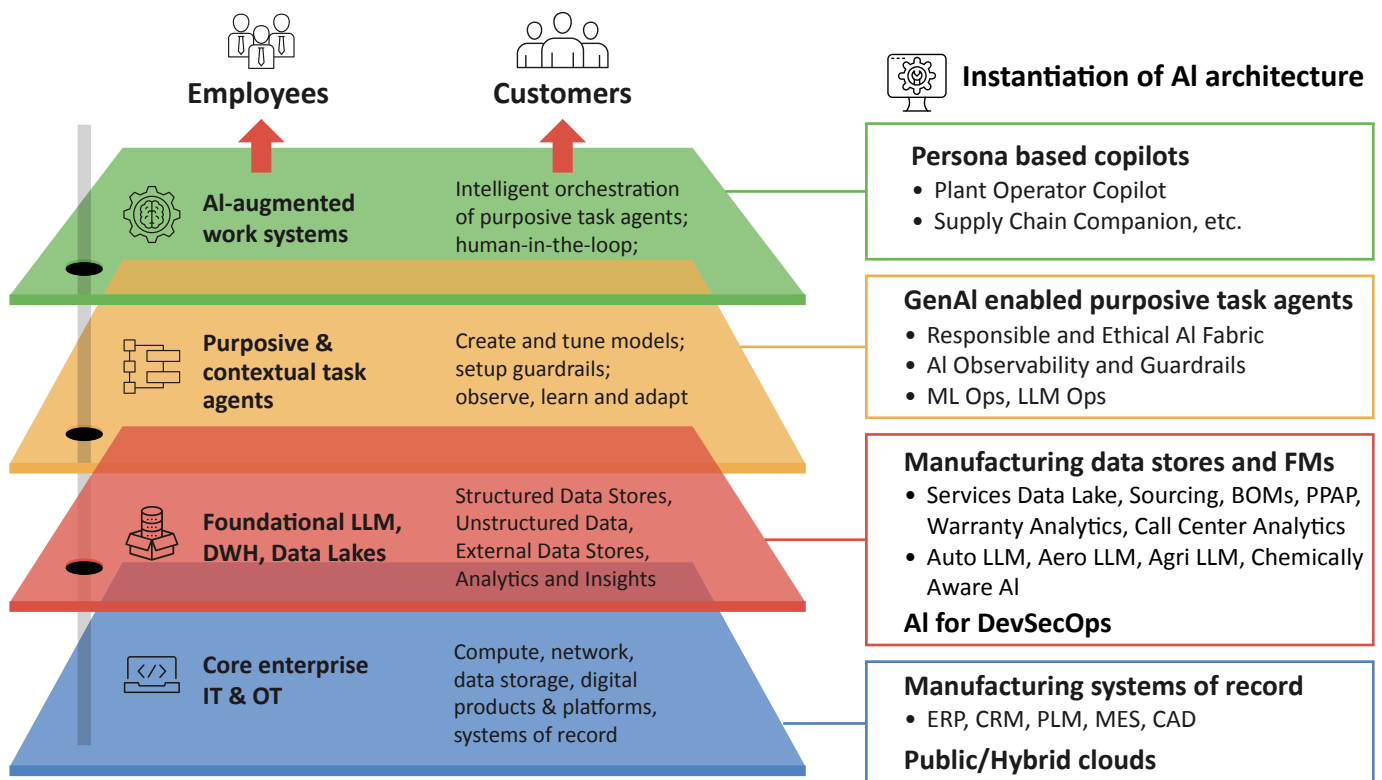


Figure 6: TCS AI Architecture for Manufacturers

- The bottom-most layer predominantly enables the compute, network and storage as a foundation coupled with public and hybrid clouds, and the existing enterprise IT and manufacturing systems of record such as enterprise resource planning (ERP) systems, manufacturing execution system (MES), and product lifecycle management (PLM).
- The layer above enables foundational large language models (LLMs) for a variety of knowledge management use cases—auto or aero LLMs, sourcing and procurement data lake, and warranty analytics and insights embedded in a frictionless DevSecOps ecosystem.
- The next layer constitutes AI-enabled purposive and contextual task agents that enable various moving parts of AI, such as fine-tuning of AI models on an ongoing basis, establishing the necessary guardrails for responsible and ethical implementation of AI, and a strong ML and LLM capability for continuous learning by the models.
- The final layer comprises task agents that interact with each other in a seamless fashion with a human-in-the-loop for validation, verification, and disambiguation.

The TCS advantage

Deep domain and contextual expertise

TCS has a vast expert pool of industry experts with well-established experience in multiple manufacturing functions, from plant operators, to dealer managers to production planners, to help identify, build and support the latest and fittest solutions and technologies for clients.

Cross-industry experience

Today's businesses are more interconnected than ever before and need cross industry expertise and leading practices. Working with customers across industries such as travel and transportation, retail and insurance bring an end-to-end holistic view of enterprise business functions and knowhow.

Enterprise AI at scale

Our 3P strategy - patents, products, and platforms - and more than 100,000 trained associates help us enable enterprise AI at scale.

Partner ecosystems

Scale and accelerate the path to value through a network of joint solutions and established hyperscaler partnerships, extensive TCS COIN™ network and co-innovation facilities such as TCS Pace Port™.

Evolving solutions

To help accelerate their journey, TCS leverages its contextual knowledge and expertise to enable multiple purpose-built solutions for manufacturers that incorporate GenAI technologies.



Executive champions

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Tata Consultancy Services is an IT services, consulting and business solutions organization that has been partnering with many of the world's largest businesses in their transformation journeys for over 55 years. Its consulting-led, cognitive powered, portfolio of business, technology and engineering services and solutions is delivered through its unique Location Independent Agile™ delivery model, recognized as a benchmark of excellence in software development.

A part of the Tata group, India's largest multinational business group, TCS has over 615,000 of the world's best-trained consultants in 55 countries. The company generated consolidated revenues of US \$27.9 billion in the fiscal year ended March 31, 2023, and is listed on the BSE and the NSE in India. TCS' proactive stance on climate change and award-winning work with communities across the world have earned it a place in leading sustainability indices such as the MSCI Global Sustainability Index and the FTSE4Good Emerging Index. For more information, visit www.tcs.com

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