cognizant | **G**o**o**g**le** Cloud

Manufacturing Industry

Generative artificial intelligence adoption accelerates value and innovation

With Generative AI, the manufacturing industry is poised for a new era of innovation to unlock unprecedented levels of productivity, operational excellence, growth, and talent empowerment

The manufacturing industry is in the midst of a transformational change, driven by advancements in technology such as Generative AI (Gen AI), global decarbonization and cost optimization imperatives. These have further been exacerbated by the evolving trade dynamics in the background of the two ongoing geo-political conflicts and the resulting transition to near-shoring as supply chain resilience drive enterprise goals. These challenges present opportunities for innovation through advanced technologies such as Gen AI. This whitepaper aims to provide insights to leverage Gen AI to address manufacturing industry challenges and create business value.
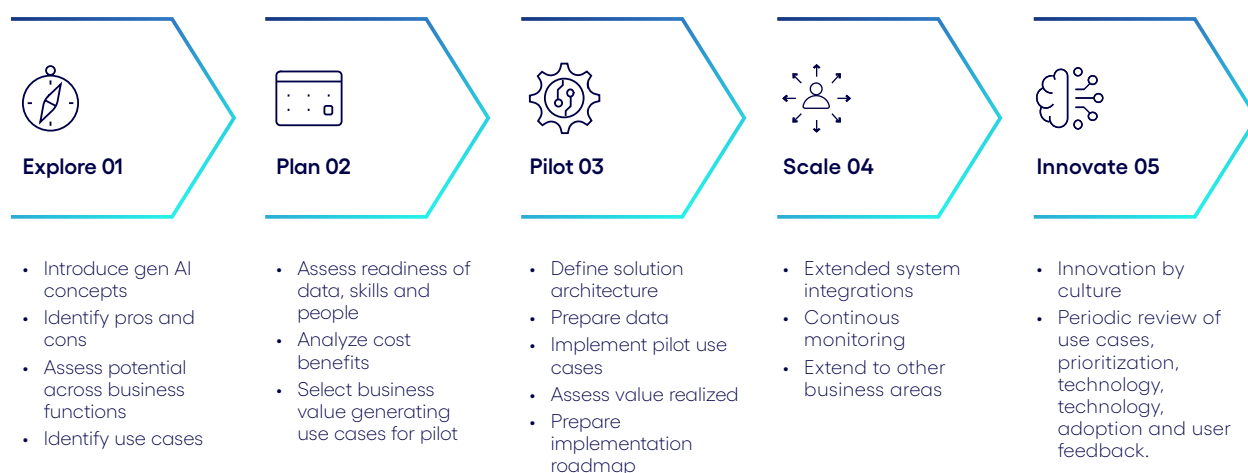
Contents

Getting started with gen AI

The linchpin for the Gen AI transformation is your enterprise data. If your data is not ready for Gen AI, your organization would not be able to use or scale this technology as data is the underlying foundation that is needed to unleash the power of Generative AI. Getting started with Gen AI solutions also require an understanding of the technology's capabilities and involves several key activities such as problem definition (use cases), Gen AI applicability assessment, data preprocessing, algorithm selection, building a prototype model, fine tuning the model and then scaling to business functions.

Seeing and assisting clients begin their journey to implement Gen AI into enterprise processes and operations, the introduction of the EU AI Act to ensure safe, transparent, non-discriminatory, and responsible AI, it is clear that harnessing the power of Gen AI has become a strategic imperative for CIOs. Cognizant recommends a five-step approach for organizations to undertake Gen AI adoption strategically, as depicted in the figure below.

Explore 01

- Introduce gen AI concepts
- Identify pros and cons
- Assess potential across business functions
- Identify use cases

Plan 02

- Assess readiness of data, skills and people
- Analyze cost benefits
- Select business value generating use cases for pilot

Pilot 03

- Define solution architecture
- Prepare data
- Implement pilot use cases
- Assess value realized
- Prepare implementation roadmap

Scale 04

- Extended system integrations
- Continous monitoring
- Extend to other business areas

Innovate 05

- Innovation by culture
- Periodic review of use cases, prioritization, technology, technology, adoption and user feedback.

Foundational systems and data assessment, and readiness
Assess organizational data, architecture, Infra requirements and build a strong foundation (Including operating model and governance)

Organization readiness and change management
Help employees understand and adapt gen AI to drive company's business, value and strategy

Cross-disciplinary governance approach
Engage cross-disciplinary teams to define AI strategy as well as track and report progress over time to provide openness on adoption and success
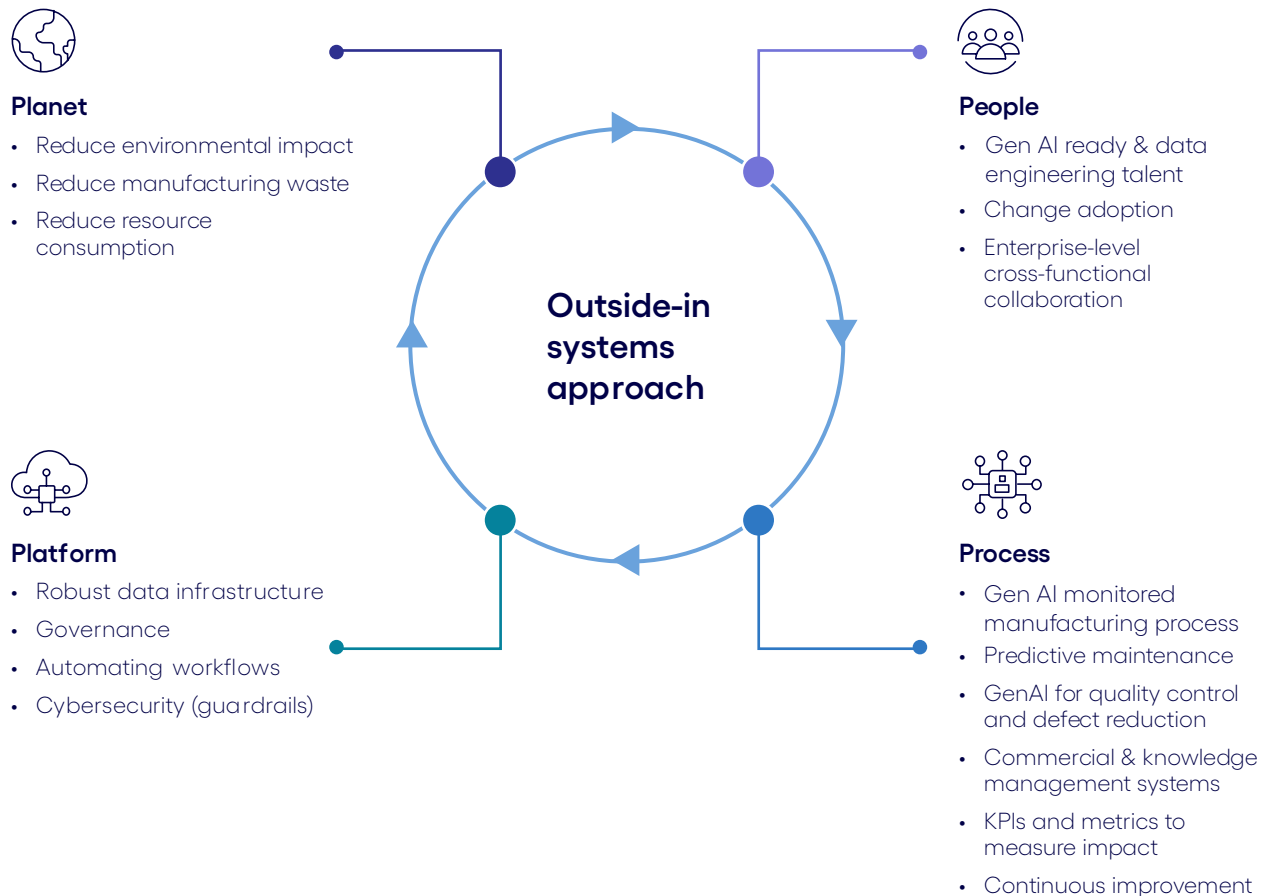
Security and compliance
Avaluate potential risks, regularly requirements & compliance and proactively manage these through policy, control, enables & training

An agile 4P framework to unlock quick wins and build competitive advantage requires a 'systems thinking' and an 'outside-in' approach

A simple framework that calls out the four pillars that experts in the manufacturing industry can apply to leverage Generative AI: The 4P Framework: People, Process, Platform, and Planet

Planet

- Reduce environmental impact
- Reduce manufacturing waste
- Reduce resource consumption

People

- Gen AI ready & data engineering talent
- Change adoption
- Enterprise-level cross-functional collaboration

Outside-in systems approach

Platform

- Robust data infrastructure
- Governance
- Automating workflows
- Cybersecurity (guardrails)

Process

- Gen AI monitored manufacturing process
- Predictive maintenance
- GenAI for quality control and defect reduction
- Commercial & knowledge management systems
- KPIs and metrics to measure impact
- Continuous improvement

In a generative AI research report conducted earlier this year, Cognizant and CIONET interviewed 30 CIOs/DDOs in Benelux and uncovered that more than 80% of businesses in the region are currently using or considering using Gen AI technology. They believe it will either significantly change or transform their industry but managing their data is already one of their top challenges preventing exploitation of Gen AI at its full potential. A Google Cloud Gen AI Benchmarking Study, July 2023, highlighted that by enhancing manufacturing processes Gen AI can significantly minimise downtime, boost output, realize cost savings, and improve end-user satisfaction.

The use cases with potential for Gen AI application across the Manufacturing value chain include product development, production, planning and procurement, performance, maintenance and health and safety as enumerated below.

R&D

- Assist in product discovery through creation of initial concepts & engineering drawings
- Discovery of new materials
- Reduction in time–to–market and ownership costs
- Interactive ability : Predict product-market adoption

Product developement & engineering

Sustainability

- Discovery environmentally friendly products
- Design materials with low carbon footprint (both resource consumption & GHG emissions)
- Discover materials for reuse and upcycle production waste
- Automated exception notification for hazardous working conditions

Carbon footprint & health and safety

Production

- Workforce training & onboarding manuals/ vedios
- Author SOPs and translation of manuals
- Conversational troubleshooting with references from OEM manuals
- Identify machinery failures modes prior to breakdown & automate notifications to planners & intervention teams
- Automated root-cause–analysis & repair plans
- Adjust production orders in real time
- Dashboards : Receive performance updates from IoT sensors, chatbots & order tracking data

Performance : Operational & costs optimization

Warehousing & Logistics

- Dynamic routing to reduce fuel consumption and delivery time
- Automated customer updates on track & trace ETAs
- Generate & verify transportation/customs documents
- Improve yard management using camera & LoT sensors
- Automated sensing & interventions : Disruptions in supply chain
- Optimize warehouse stowage plans for optimum order–picking

Supply chain excellence & cost optimization

Planning–S&OP

- Automated demand sensing
- Automate development of production plans
- Discover new source of supply
- Document search and synthesis for extraction of relevent contract clauses & access risks
- Automated ERP actioning : Inventory levels optimization

Production planning & supply chain

Early industry adopted use cases in manufacturing value chain

Leveraging its exceptional capability to process and interpret extensive datasets, Gen AI can be deployed across a broad spectrum of applications, transcending traditional productivity and efficiency improvements. Taking a portfolio level view on value, the advanced use cases where Gen AI is revolutionizing the manufacturing sector are discussed in the following section.

Unified knowledge source

Consolidate enterprise customer, product portfolio, assets, product flow data bases across business units, where employees can query in natural language to find instant responses

A leading Sugar producer in Central America adopted C3 Generative AI to integrate over 600 contracts into a unified knowledge source, incorporating multi-language support and automated metadata extraction. Procurement teams could swiftly access specific insights, such as terms and conditions, timelines and involved parties, enabling effortless comparison of contracts ($5M potential savings from contract consolidation) and diligent tracking of compliance.

Document search and synthesis

Manufacturing engineers can use natural language to query and read information with extracts/references directly from different data sets such as OEM manuals, contracts, invoices, legal etc. making it accessible to the current workforce and attractive to new employees.

Improve design (R&D/Prototyping) process

Airbus used Gen AI (generative design) to design components for future planes that were much lighter, resulting in less fuel consumption (3.1 tonnes/partition/yr) and a smaller carbon footprint (by 166 MT CO2e/yr/plane) thereby helping product designers reduce costs by selecting and using materials more efficiently (95% lesser raw materials). Airbus decided on using algorithms created via Gen AI to design the partition that separated the passenger compartment from the galley in the Airbus A320.

Product development

Mitsui Chemicals, Inc. used Gen AI to efficiently analyze big data and discover new applications for their products that exceed human preconceptions and current knowledge. To assess agility and accuracy in discovering new applications of Mitsui Chemicals products, a Generative Pre-trained Transformer (GPT), a generative AI, was combined with IBM Watson Discovery. This initiative aimed to expand top line and revenue share of Mitsui Chemicals products by accelerating the process from market development to product development by integrating data between different departments, Lines of Business and R&D, utilizing Sales Force Automation (SFA)/Marketing Automation (MA), Materials Informatics (MI) and Robotics. Gen AI can significantly reduce testing time of complex systems and accelerate trial/testing/tunning phases involving user evaluation through its ability to draft scenarios and profile testing conditions.

Gen AI enabled image generation; design-to-make process, product quality intelligence, vision quality (defect detection model)

Merck & Co., Inc. (Merck) a global pharmaceutical company wanted to solve the issue of false rejects, a common problem in pharmaceutical production. Merck's AI Engineers leveraged generative AI techniques, including Generative Adversarial Networks (GANs) and Variational Autoencoders. Leveraging Gen AI they created synthetic defect image data for complex defects which played a critical role in training defect detection models, resulting in remarkable accuracy improvements and a significant reduction in time-to-market for new models.

Early anomaly detection in machinery

LeewayHertz, a Hackett Group Company, develops custom AI agents and copilots specialized in anomaly detection (including analyses of potential impact and urgency and automatically notifies relevant stakeholders based on severity levels), anomaly investigation

and RCA, resolution proposal, anomaly mitigation and monitoring to enhance operational efficiency and decision-making across various domains. The company aims to pinpoint potential problems before they evolve into expensive breakdowns, which can enhance OEE and extend the lifespan of equipment. GE Vernova uses AI for predictive maintenance to reduce down time and maintenance costs of its Gas Turbines, by analysing sensor data to predict when equipment is likely to fail, allowing for proactive maintenance. Predicting failures via advanced AI analytics can increase equipment uptime by up to 20%, it increases productivity by 25% and lowers maintenance costs by 25% (Google, 2023).

Workforce self-service

Gen AI (LLMs) can be used by maintenance engineers to identify and rectify possible equipment failures before they happen. A large multinational manufacturing group that manufactures HVAC and Boiler products across 31 industrial plants with over 200 field engineers and thousands of third-party field operators leveraged 'C3 Generative AI' for use by it's field engineers with a total of over 300 user queries shortening the time required to find information by over 90% enabling field engineers to instead focus on critical installation and maintenance tasks.

Factory asset efficiency

Bosch used generative AI to create synthetic images to develop and scale AI solutions for optical inspection and optimize existing AI models to inspect welds of copper wires in electric motor production, while another use case focuses on the quality assurance of high-pressure pumps by allowing for the inspection of components independently, minimizing the need for visual inspectors and increasing the reliability of inspections. This innovation aims to reduce the time required for planning, launching and ramping up AI applications from six to 12 months to just a few weeks.

Process optimization

In the manufacturing industry process optimization solutions are aimed to increase throughput, optimise quality, drive efficiency, and facilitate knowledge transfer. Elements such as machine temperature, vibrations, etc. most affect Overall Equipment Effectiveness (OEE) and historical data analysis can identify critical variables. Pantaleon the top sugar producer in Central America has implemented Gen AI in the form of C3 AI Production Schedule Optimization solution to plan their sugar cane harvesting process and C3 AI Process Optimization to maximize sugar production. These applications including C3 Generative AI are running on Google Cloud and leveraging Google Cloud's services and solutions at scale. In addition, Pantaleon uses Gen AI to optimize the process to develop pricing outlooks which is a crucial function for the sugar producer, as 80% of production is pre-sold before the harvest season begins.

Improving productivity

U. S. Steel and Google Cloud collaborated to use Google Cloud's generative artificial intelligence to drive efficiencies (reduction in time required for work by an estimated 20%) and improve employee experiences in the largest iron ore mine in North America.

Software engineering/development

Software generated code based on natural-language prompts, among many other tasks are among the high value areas of Gen AI across industry. Philips wanted to create a solution to bridge the siloed toolchains and processes across its business groups. These silos prevented code reuse, limited possibilities for collaboration and wasn't in line with the company's agile organizational transformation. Philips leveraged GitHub to create a modern collaboration ecosystem, resulting in 80% reduction in infrastructure costs from self-hosted runners 85% repos shareable with entire software organization.

Scheduling/Operations

Coordination and efficiency in scheduling and operations are vital for the manufacturing industry and Gen AI can add precision to this area through analysis of data points and recommend 'Quality Operators' - which operators are linked to the highest quality outputs through analysis of factors like experience and past performance can enhance scheduling decisions; Production Sequence Efficiency - how does the order of production steps influence energy consumption and different sequencing can be assessed to derive the most efficient workflows; and finally 'Inventory Insights' - what's the relationship between inventory levels and material shortages on the manufacturing floor? Predictive modelling can prevent stock-outs, saving on lead times and expediting costs.

Supply chain advisor

Supply chain disruptions are having a significant impact on manufacturers. As well as dealing with these long-term disruptions, manufacturers are increasingly tasked with more responsible, ethical, and sustainable sourcing of materials. Gen AI can act as a supply chain advisor, providing greater visibility across complex networks and delivering recommendations for best-suited suppliers based on relevant criteria — such as bill of materials specifications, raw material availability and delivery schedules, or sustainability metrics. Further Gen AI can optimize fulfillment by recommending best-suited suppliers based on relevant criteria.

Supplier impact analysis

Gen AI combined with AI can predict effect of changing material vendors on product quality and yield by analysing various input sources, to reveal any underlying correlations.

Predict storage conditions

How do factors such as temperature during raw material storage relate to final product quality: Systematic testing can demystify these relationships.

Marketing and sales: sontent to boost hyper-personalised campaigns and sales productivity

One of the most popular use cases of Gen AI is in creation of text-based marketing and sales communications to drive hyper-personalization significantly reducing the time and effort required for ideation and content drafting. Gen AI enables overcoming challenges of unstructured, inconsistent, and disconnected data—for example, interpreting insights from abstract and from different databases. Search Engine Optimization (SEO) can help reduce costs and achieve a higher conversion by synthesizing key SEO tokens, supporting specialists in SEO digital content creation, and distribute hyper-personalised content to clients.

ASML which specializes in the production of lithography machines, used generative AI to produce their brand film 'Standing on the shoulders of giants' that would serve as a proof point of generative AI tools deployed for a creative purpose. The film was made with 1,963 natural language prompts that yielded 7,852 images, which were edited and then rendered by more than 900 computers.

A Leading global airline supplier GA Telesis with Google Cloud's Gen AI tech to revolutionize the sales and service processes for the parts it company supplies to major global passenger and cargo carriers to automatically synthesize purchase orders and quickly provide customers a quote, eliminating the need for sales teams to manually cross-reference emails with their inventory availability.

Customer experience

General Motors teamed up with Google Cloud to bring conversational AI technology into millions of GM vehicles for tailored, location and preference-based experiences for customers through GM's OnStar Interactive Virtual Assistant (IVA) powered by advanced, intent-recognition algorithms that use Google Cloud's conversational AI technologies, providing OnStar clients with responses to common inquiries, as well as routing and navigation assistance. Further, GM is leveraging Google Cloud's Dialogflow technology

to deploy chatbots that can conversationally assist answer customer queries about GM vehicles/product features relying on GM's extensive vehicle data repositories.

Frontline customer service automation

Gen AI will potentially revolutionize the entire customer operations function, improving the CX and agent productivity through digital self-service and enhancing and augmenting agent skills. Quick wins in operational improvements can be achieved through Gen AI-fuelled self-service chat bots,

According to Salesforce 80% of business buyers expect companies to respond to them in real-time and 82% say personalized care influences their loyalty. Manufacturers are now leveraging Gen AI to automate and accelerate time-to-resolution for customer interactions like product troubleshooting, ordering replacement parts, scheduling service, product information, and product operation.

Cross-selling/up-selling synergies

Cross-selling/ up-sell synergies can leverage Gen AI for seeking insights on Next Best Offer (NBO)/ Next Best Action (NBA) and Customer Lifetime Value (CLTV) to improve top and bottom lines and allocate resources based on value generation potential.

Automated content generation

Drafting contracts, legal documents incorporating specific regulatory clauses, email responses, Playbooks/SOPs for negotiating with suppliers, and risk models that need to be regularly updated for regulatory content, draft medication instructions/risk notices for resale in the drugs manufacturing industry are the Gen AI value added use cases.

Product/content catalogue discovery

Using Gen AI, manufacturers gain an efficient method to match requirements to the specifications of products they buy and provide the same service to their customers.

Invoicing and settlement

Approvals of utility bills, employee expenses, delivery claims, quality claims, etc. can be triaged using LLMs.

Factors manufacturing industry must consider before integrating generative artificial intelligence that could limit benefits capture

- **Data quality and integration issues.**
  High-quality data is essential for effective AI/ML applications. Organizations must address data quality issues and ensure seamless integration of data from various sources.

- **Need for human in the loop.**
  Bring into force new quality checks on processes that shift from the workforce to Gen AI. representative-generated emails, or more detailed quality analysis on Gen AI-assisted processes, such as product design, drug discovery etc to substantiate whether the generated content is fact based or inference which elevates the need for an additional level of quality control.

- **Scalability and performance concerns.**
  Generative AI solutions must be scalable to handle large volumes of data and deliver real-time insights. Organizations should design systems that can scale efficiently and maintain high performance.

- **Explainability.**
  Lack of visibility into origins of the root data or the generated content could be a showstopper to identify risks and update self-learning AI technology. Gen AI can "hallucinate," to generate responses that are obviously inaccurate or inappropriate for the context. Systems need to be designed to specifically point to specific manuals, articles or data sources and then do the human-in-the-loop checks.

- **Data Privacy and Security.**
  Gen AI's use of data must include sufficient safeguards against copyright violations, branding recognition risks infringing on intellectual property rights, potential leak of PII data, plagiarism, and other related customer data. Organizations must implement robust data privacy and security measures to ring fence sensitive information from a legal and regulatory perspective such as those related to product safety standards.

- **Ethical use of gen AI assisted technologies.**
  AI/ML technologies should be used ethically, ensuring that decisions are fair and unbiased. Organizations should establish ethical guidelines and conduct regular audits to ensure compliance.

- **Lack of stakeholder/leadership buy-in.**
  Change can be challenging, especially in established industries like manufacturing. Stakeholders might be resistant to altering existing processes and systems, fearing disruption and the potential for initial productivity losses during the transition period. Further, implementing new technologies often requires significant upfront investment raising stakeholder concerns about the costs involved and uncertainty on ROI.
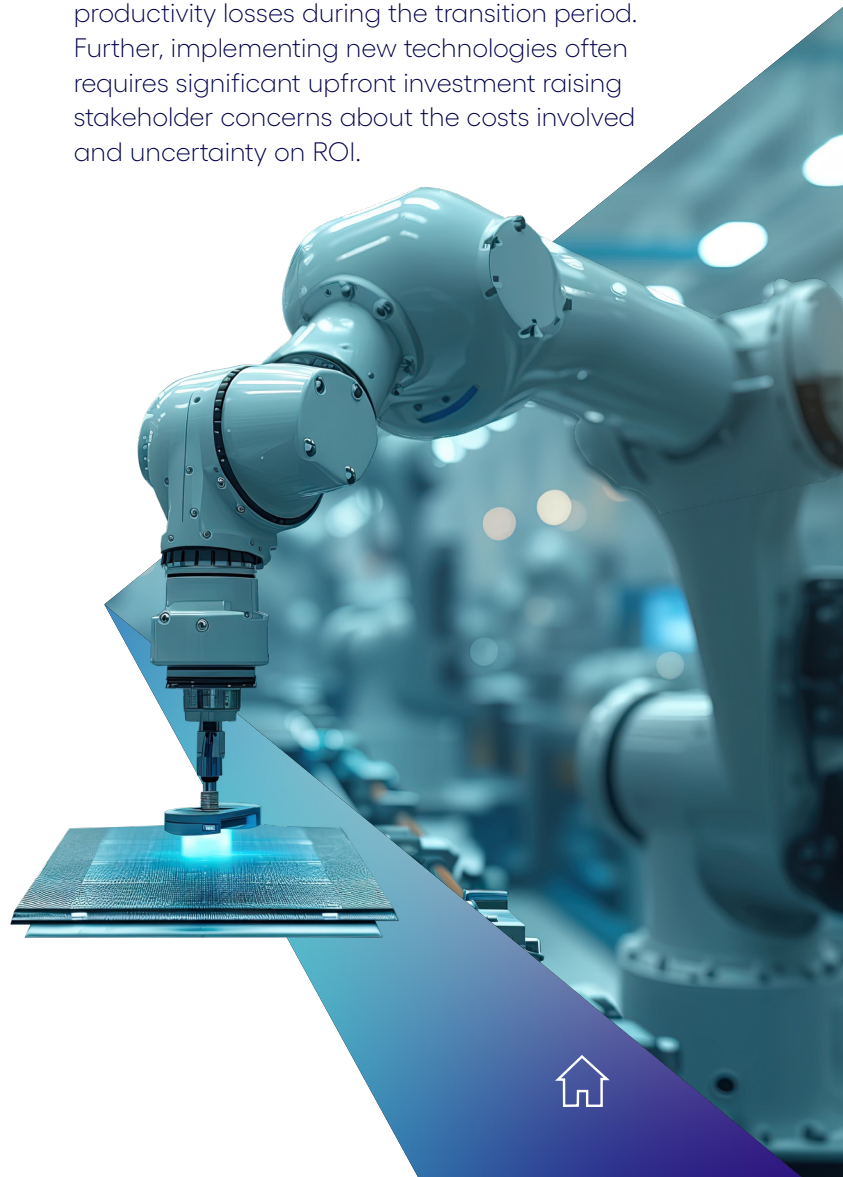
Generative AI Potential (value vs feasibility) for manufacturing industry

Cognizant's Generative AI toolkit and accelerators Gen AI services viz, Customer Experience Navigator, Enterprise Knowledge Navigator, Process Optimizer, Development Lifecycle Navigator, Data Engineering Navigator, and Neuro AI accelerates your adoption journey and are aptly positioned to drive operational excellence and assist our clients unlock the potential of gen AI in a flexible, secure, scalable and responsible manner. Gen AI offers immense potential to drive productivity, improve user experience, across key areas of the manufacturing industry such as after-sales operation, research and product development and marketing and sales. Multiple analyst – Gartner and Google Cloud and Cognizant's own research and experience have been leveraged to draw up a 'Value Vs Feasibility' matrix to highlight the most used Gen AI use cases in figure below.
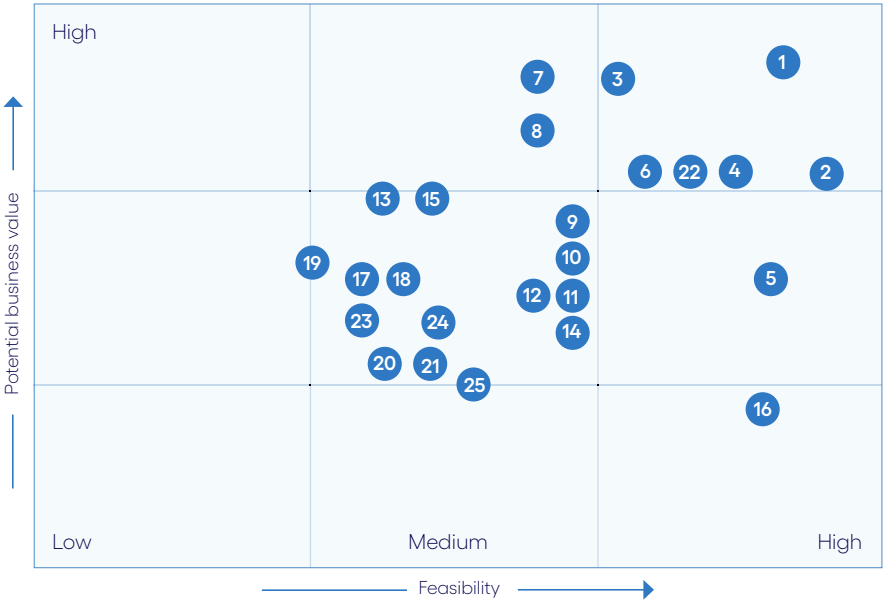
1. Data insights
2. AI image generation
3. Material processing efficiency
4. Avatar generation
5. Hyper–personalized curated content & delivery
6. KPIs for data driven ways of working
7. Industrial equipment longevity
8. Factory asset effectiveness
9. Design process optimization
10. Product development
11. Product quality prediction
12. Workforce enablement & training
13. Machine monitored predictive maintenance

14. Software engineering/development
15. Synthetic data for manufacturing effectiveness
16. Visual quality predictions
17. Robotics for hazardous conditions
18. On–demand operations
19. Supply chain optimization advisor
20. Workforce self–service
21. Customer self–service automation
22. Document search and synthesis
23. On demand operations dashboards
24. Regulatory filing and drafting
25. Curated automated onboarding and training

How we can help

Cognizant and Google Cloud have joined hands for a strategic partnership, to assist industry leaders chart their path forward with appropriate frameworks, tools, services, and governance structures and ingrain a responsible, consciously cautious approach to Generative Artificial Intelligence across your organization. We will help create inspiring omni-channel content, synthesize and organize information, automate workflows, and build engaging customer experiences.

Manufacturing is one of our priority verticals at Cognizant and Google Cloud. Combining the capability of Google Cloud's ecosystem of connected devices and products and Cognizant's services and accelerators we endeavour to help manufacturers drive revenue growth, operational excellence, and innovation across their value chain. Many manufacturing companies today use Google Cloud to measurably improve quality of decisions. They are crunching vast quantities of data to drive business insights and reduce infrastructure costs and time-to-market for their products. We're highly focused on demonstrating cloud's value to even more manufacturers as they embrace new digital technologies. Google research has highlighted that 'Cloud adoption' – which is essential for Gen AI and analytical AI/ML use – is high among manufacturers. Further, most (83%) already have a cloud strategy, regardless of region or sub-sector (Google Cloud Gen AI Benchmarking Study, 2023).

Conclusion

When a new technology moves as fast as generative AI, businesses could find it hard to keep up. The continued evolution of Gen AI will drive significant changes in the manufacturing industry and inevitably it's end-to-end value chain. Organizations must stay abreast of these trends to remain competitive. Today, the choices for businesses are either to jump onto the Gen AI
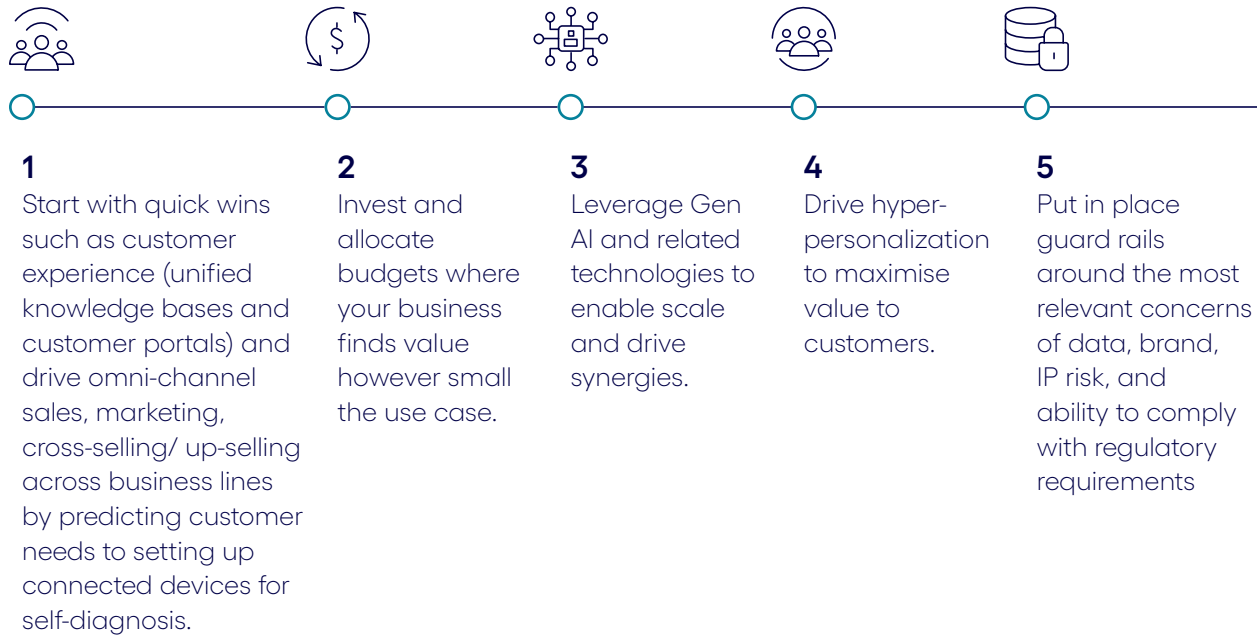
bandwagon or be left behind by the competition. As Generative AI models mature and establish business value and reliability, they will gradually converge with analytical Artificial Intelligence in operations irrespective of industry. Analytical AI has had significant impact in operations, and Generative AI is likely to assist with process acceleration, task simplification, and creating workforce surplus productivity.

The strategic collaboration between Google and Cognizant empowers enterprises with the necessary tools and specialized knowledge to proficiently implement these cutting-edge technologies. The establishment of the Gen AI Lab within the Cognizant Digital Studio in Amsterdam signals a pioneering leap forward, poised to emerge as a vanguard of innovation within the EMEA region.
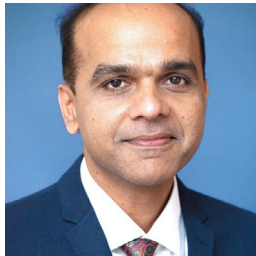
The key takeaways

Irrespective of where you are in your Generative Artificial Intelligence adoption journey:

1
Start with quick wins such as customer experience (unified knowledge bases and customer portals) and drive omni-channel sales, marketing, cross-selling/ up-selling across business lines by predicting customer needs to setting up connected devices for self-diagnosis.

2
Invest and allocate budgets where your business finds value however small the use case.

3
Leverage Gen AI and related technologies to enable scale and drive synergies.

4
Drive hyper-personalization to maximise value to customers.

5
Put in place guard rails around the most relevant concerns of data, brand, IP risk, and ability to comply with regulatory requirements

Author :

Arun George

MLEU Consulting Lead,
Benelux