

Review of Generative Artificial Intelligence Use Cases Applicable to Manufacturing Industry

Nilesh D. Kulkarni¹, Saurav Bansal²

¹Sr. Director – Enterprise Architecture, Fortune Brands Innovations
Email: [nkulkar\[at\]gmail.com](mailto:nkulkar[at]gmail.com)

²Sr. Manager, Architect, Fortune Brands Innovations
Email: [Saurav.bansal.kbl\[at\]gmail.com](mailto:Saurav.bansal.kbl[at]gmail.com)

Abstract: *This paper provides a comprehensive overview of the application of generative artificial intelligence (AI) in manufacturing, highlighting the transformative impact of AI on business processes and customer experiences. It discusses the shift from traditional logic-based algorithms to AI algorithms, which learn from data, thereby enabling digital transformation across various business functions. The document covers specific AI use cases in manufacturing, including generative AI applications in digital media, sales, marketing, and back-office processes. It emphasizes the economic benefits of AI, the necessity of upskilling the workforce, and the importance of choosing the right AI use cases for maximum value. The document concludes by stressing the critical role of AI in modern manufacturing and the growing demand for AI skill sets.*

Keywords: Artificial Intelligence (AI), Digital Transformation, Manufacturing, Generative AI, AI Use Cases, Computer Vision

1. Introduction

Logic-based algorithms represents the core of traditional computer science. For decades, computer scientists were trained to think of algorithms as a logic series of steps or processes that can be translated into machine-understandable instructions and effectively used to solve problems. Logic-based algorithms have derived transformative value over the last 50 years in all aspects of business - from enterprise resource planning to supply chain, manufacturing, sales, marketing, customer service, and commerce.

Traditional logic-based algorithms effectively handle a range of different problems and task. But they are not effective at addressing many tasks that are often quite easy for humans to do. Consider a basic task such as identifying an image of a dog. Writing a traditional computer to correctly do this would involve developing a methodology to encode and parameterized all variations of dogs - all different sizes, breeds, color and their orientation and location within the image field. While a program like this would enormously be complex, a two-year-old child can effortlessly recognize the image of a dog and a two-year-old can recognize many such object beyond dogs.

AI algorithms take a different approach than traditional logic-based algorithms. Many AI algorithms are based on the idea that rather than code a computer program to perform a task, design the program to learn directly from data. So instead of being written explicitly to identify picture of a dog, the computer program learns to identify dogs using an AI algorithm derived by observing a large number of different dog images. In essence, the algorithms infer what an image of a dog is by analyzing many example of such images, much as a human learns. So wherever within the organization it is possible to capture sufficiently large data set across their operations, organizations can transform business processes, and customer experiences using AI-making possible the age of AI driven digital transformation.

As an example, Netflix uses AI to power movie recommendations. Amazon uses AI to provide product

recommendation on its ecommerce platform, manage pricing, and offer promotions [1]. And numerous other companies like bank of America to domino's pizza uses AI powered "chatbot" in a variety of use cases including customer service and ecommerce. The economic benefits of AI and applying AI within the business will be significant, McKinsey estimates AI will increase global GDP by about \$13 trillion in 2030, while 2017 PwC study puts the figure at dollars 15.7 trillion-a 14% increase in global GDP.

In recent years, many countries have been focusing on the importance of upgrading and transforming their manufacturing sector, simulating significant attention towards smarter solution in factories. Researchers and manufacturers have built two main paradigms to define the great interactions between manufacturing and innovative information technologies, especially artificial intelligence and Internet of Things. In manufacturing systems, accurate information and communication techniques are required to meet the ongoing development of industrial systems and smart technologies.

2. Leveraging AI across Manufacturing Business Stacks

Artificial intelligence technologies are going to fuel the next wave of digital transformation. The ability of enterprises to leverage AI as a core capability will differentiate the digital leaders from the laggards in their attainment of competitive advantage in the digital era. Manufacturing enterprises must think of leveraging AI capabilities across the business track dash customer experience business operations back-office operations as well as technology ecosystem. As they reimagine digitally driven business processes, enterprise need to systematically curate opportunities across the business stack where they can make fundamental impact. The key lies in redesigning AI enabled digital process maps, enabling better, real time and autonomous decision making, driven by insightful recommendations and automation [2]. New AI techniques like convolutional neural networks, self-learning algorithms like reinforcement learning, cognitive intelligence

Volume 13 Issue 1, January 2024

Fully Refereed | Open Access | Double Blind Peer Reviewed Journal

www.ijsr.net

technologies such as computer vision, are all growing in capability and unleashing new possibilities of application across various business processes within manufacturing industry.

AI for manufacturing is expected to grow from dollar 1.1 billion in 2022 dollars 16.7 billion by 2026 - an astonishing CAGR of 57%. The growth is mainly attributed to availability of big data, increasing industrial automation, improving computer power, and a larger capital investment [3]. To choose the correct use case that can yield into maximum value and has the potential feasibility it is important to use a metrics that can help organization to determine the right use case.

3. Method

While there are multiple AI use cases that can be applied to the manufacturing industry, the application of a specific use case depends upon the positioning of individual organization which will vary in some cases, dramatically, based on sector, technical readiness, risk appetite, internal readiness. The fig 1. and fig 2. shows the use case dimensions based upon value and feasibility which will be used as a for evaluating each AI use case that can be applied within manufacturing industry.

Table 1: Value

Increased revenue	The ability of the use case to deliver additional financial sources to the organization through sales of products and services or grant funding that will result in top-line growth.
Increased efficiency	The ability of the use case to meet or exceed current performance goals with equal or fewer resources, resulting in reduced costs.
Managed risk	The ability of the use case to remove uncertainty from the organization’s future performance by reducing potential reputational, security or operational risks or creating agility to respond to future market disruptions.
Nonfinancial value	The ability of the use case to assist the organization in meeting its nonfinancial or mission-related goals. These goals can include the nonfinancial value of innovation; diversity, equity and inclusion (DEI); sustainability; or community development.

Figure 1: Use case evaluation based on value

Table 2: Feasibility

Technical feasibility	The ability of an organization to meet the technical requirements of a use case. Considerations include the core capabilities of the AI technology itself, the availability of vendor support, the current state of the organization’s technology infrastructure, and the technical talent required by the use case.
Internal readiness	The organization’s ability and openness to use and incorporate the use case. This includes the willingness of internal stakeholders to understand, trust and effectively execute the use case.
External readiness	The extent to which the environment outside of the organization is conducive to successful execution of the use case. This includes consideration of the legal and regulatory environment; public opinion of the use case; and the digital access, literacy and engagement required by the use case.

Figure 2: Use case evaluation based on feasibility

Generative AI Use cases

Generative AI refers to AI technique that learn a representation of artifacts from data and use it to generate

brand-new, completely original artifact that preserves a likeliness of original data. Generative AI will have direct impact on manufacturing, digital media, sales, marketing, product design, and back-end department processes like finance, corporate communications, training, and software engineering by augmenting the core processes as well as the back office processes using AI based models.

Few high-level Generative AI use cases

- Automating repetitive tasks
- Providing financial insights
- Streamlining communication
- Enhancing collaboration
- Improving employee engagement

A. Digital Sales & Marketing (fig3)

- Live Chat Support - Ability to crawl the website to provide a contextual, personalized, dynamic response to queries by the website visitor based on the search, sentiments, and number of visits rather than same response every time.
- Product Review Moderation - Respond to the product, and service reviews with automated AI moderation eliminating human intervention.
- Price Optimization/Dynamic Pricing - AI can monitor competitor pricing in real-time and provide insights on how competitors are adjusting their prices. By analyzing this data, AI algorithms can recommend optimal pricing strategies to stay competitive in the market and maximize profitability.
- Campaign Builder - Build intelligent marketing campaigns, and identify the competitive products based on consumer interactions with web properties with various tools like Hotspots, search keywords, etc. to optimize spend on Amazon Advertising.



Figure 3: Commercial Sales & Marketing GenAI Usecases

B. Digital Content & Media

- PDP Content Creator - An AI engine, that evaluates the content, and scores it across multiple e-commerce channels like Amazon, Lowes, etc. providing the optimized content using AI-based prompt engineering. Develop compelling product features and descriptions using the keywords that are commonly used by search engines to ensure Google auto crawl.
- Realtime Language Localization - Convert the English content into multiple languages with the human context to improve the cost and time required for multilingual content development applicable to the products sold on multiple regions on various eCommerce platforms.
- Digital Search - Convert the elastic keyword search capability to the contextual search using AI and Natural Language Processing with the capability to personalize the search results catering to the products based on the previous searches.

- User-Generated Content (UGC) Analysis - Analyze user-generated content, such as customer photos, social media posts, or comments, to extract insights and sentiments, helping businesses respond to feedback effectively.
- Customer Service (fig 4)
- Product support (Chat) - Help the end consumer or installers of the products with the more intuitive installation hand holding to resolve the installation issues or repair or rectify the issue with the conversational chat where a customer can pose a questions using (IM, Phone) and receive more personalized response vs generic response with FAQs and videos.
- CS Agent Automation - An AI Agent that responds to the customer based on the context (type of inquiry) by looking into the relevant information within various data sources. Acts as a virtual human providing order management assistance from order status, order changes, and refund processing.



Figure 4: Marketing and Customer Service GenAI Usecases

C. Manufacturing - Product Development & Supply Chain

- BOM Design - AI analyzes historical BOM-Bill Of Material data and identifies patterns and trends to predict future demand for components. Help optimization of the BOM by analyzing the manufacturing constraints and providing recommendations on component choices that align with the manufacturing capabilities.
- Product Ideation - An AI Engine that performs product brainstorming and ideation of new products based on the consumer or customer insights towards new demand and trends.
- Supply Chain & Inventory -Analyze supplier data, including factors such as quality, pricing, and delivery performance, to recommend the most suitable suppliers. Help with inquiries on inventory levels, order tracking, and shipment schedule, optimization.

D. Manufacturing - Planning & Quality Management

- Mfg. Planning - AI algorithms can help with demand forecasting and production scheduling based on machine availability, capacity constraints, and material availability. Real-Time equipment monitoring and predictive maintenance, help optimize the allocation of resources such as labor, materials, and energy.
- Defects Inspection - AI-based Computer vision algorithms can analyze images or videos of manufactured components or products to automatically detect defects such as cracks, scratches, dents, missing parts, or color variations with enhanced speed and accuracy.
- Packaging Simulation - Computer vision can analyze 3D models or images of packaging designs and simulate real-world scenarios and the effects of transportation and

handling on packaged products, it can also help measure the dimensions of packaging components, such as boxes, bottles, or containers.

E. Manufacturing - Shopfloor Employee Safety

- Worker Motion Efficiency - AI (Computer Vision) can analyze video footage or sensor data to evaluate worker movements and identify potential inefficiencies or ergonomic issues and assist with identifying opportunities for workflow optimization.
- Worker Safety & Training - AI-powered systems can provide real-time guidance to workers, offering step-by-step instructions or visual cues to perform tasks more efficiently. AI systems can monitor shop floor activities and identify potentially hazardous situations or safety violations, by alerting workers to safety risks in real-time.
- Equipment Safety - By monitoring equipment performance and identifying abnormal behavior, computer vision systems can enable proactive maintenance interventions, reducing the risk of accidents caused by equipment breakdowns.



Figure 5: Manufacturing Supply Chain, Worker Safety GenAI Usecases

F. Back-office - Human Resource (fig 6)

- Automated Screening, Onboarding - Automate tasks such as resume screening, scheduling interviews, and answering frequently asked questions, freeing up time for more strategic tasks
- Employee information - Provide quick and accurate answers to HR-related questions, reducing the need for manual interactions, increasing the speed of decision-making
- Improving employee engagement - Can interact with employees and provide information on benefits, policies, and procedures, improving employee satisfaction and engagement.
- Promotion & Reward Program - Collect companywide performance comparatives based on multiple factors to normalize the promotions and rewards.

G. Back-office - Finance Operations

- Automating repetitive tasks - Automate routine tasks such as data entry, analysis, and report generation, freeing up time for more strategic tasks.
- Providing financial insights - Analyze financial data and provide insights, trends, and forecasts, enabling faster and more informed decision-making.
- Streamline financial operations - Automate repetitive and time-consuming tasks such as invoicing, payment processing, and expense reporting, freeing up finance teams to focus on higher-level tasks.
- Improve financial fraud detection - AI algorithms can identify potential instances of financial fraud by analyzing transaction data and identifying patterns that deviate from normal behavior.

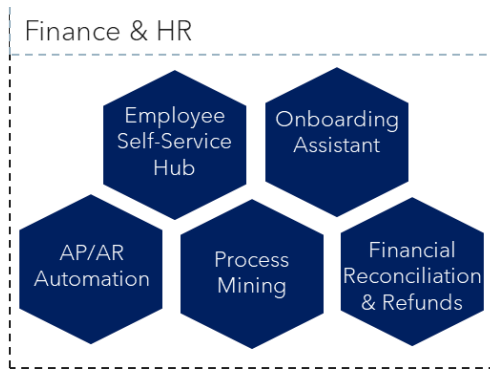


Figure 6: Back-office Finance & HR GenAI Usecases



Figure 7: Technology GenAI Usecases

H. Back-office - Communication & Collaboration

- Enhancing collaboration - Facilitate collaboration by allowing teams to share and access information in real-time, reducing the need for manual coordination and increasing the speed of decision-making
- Streamlining communication - AI Act as an intelligent assistant, facilitating communication between HR, employees, and managers, reducing delays and improving human efficiency.

I. Strategic decisions

- Enhance investment decision-making - AI can analyze large amounts of financial and market data to assist organizations in making informed investment decisions
- Automate financial forecasting and budgeting - AI algorithms can analyze large amounts of financial data and predict future financial performance, enabling organizations to make more informed financial decisions.

J. Innovation - Technology Development

- Automated Testing - Allow the AI bot to help test various scenarios based on the conversational test scenarios and converting those into the technical pseudocodes that will help developer write a code based on the various test scenarios. Also, the advanced AI capabilities will allow to build interactive test scenarios based on the previous conversations with the BOT
- Technology Helper for Citizen Developer - Provide the conversion of the code into the human readable format to help business users develop technology capabilities without IT assistance
- Developer assistance - Help developer write the code or convert the code into any programming language with ability to review code and potentially automate the entire deployment life cycle

K. Technology – Support

- IT Help Desk - Provide chat, email or search support to the company employees with IT request, incidents, communication and troubleshooting
- Infrastructure Monitoring - Build a communication and handle customer enquiries during the outages, performance degradation of the systems to ensure automated business support with immediate repose to allow humans to focus on fixing problem

4. Conclusion

To reap the benefits of ai in manufacturing, it is essential to incorporate AI as soon as possible. However, doing so demands a substantial investment of time, effort, and resources, as well as the upskilling of your workforce. Identification of the right use case using use case dimensions, investing in the pilot projects to be scaled up rapidly and out of the pilot phase is crucial.

AI is now at the heart of the manufacturing industry, and it's growing every year. While there are multiple use cases applicable in the manufacturing categorized within Sales & Marketing, Customer Service, Production shopfloor, Worker Safety, Supply chain, back-office, and Technology. Choosing the right use cases and then piloting on those use case with measuring the value generated will make organizations successful in adopting AI revolution.

References

- [1] T. Siebel, 2019, "Digital Transformation: Survive and Thrive in an Era of Mass Extinction"
- [2] N. Seth, 2021, "Winning in the Digital Age: Seven Building Blocks of Successful Digital Transformation"
- [3] By Simplilearn, Sep 2023, "AI in Manufacturing: Here's Everything You Should Know".[Online]. Available: <https://www.simplilearn.com/growing-role-of-ai-in-manufacturing-industry-article>.