

# AI Trends: Salient Aspects for the Manufacturing Sector and Its Global Supply Chain

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## Abstract

There has been a lot of buzz around latest AI chatbots. No doubt generative AI comes with the potential to significantly increase productivity for specific tasks in the corporate world. However, we must keep in mind that AI trend is currently in a hyped context and it is important to demystify what are just inflated expectations. The manufacturing sector and its global supply chain are areas where the chatbots implementation can help to achieve sustainability goals and identifying ways for improvement. In summary AI algorithms are transforming the manufacturing sector and its global supply chain by enabling predictive maintenance, improving quality control, optimizing the supply chain and manufacturing processes, enabling mass customization, facilitating autonomous operations and promoting sustainability. To answer the question what the AI strategies for the manufacturing sector and its global supply chain are, it was conducted a review of the recent scientific literatures to detect the salient aspects. With these identified directions it was cross-checked the news press articles of seven large global consulting companies to pinpoint the highlights and lowlights. For better understanding of the AI expectations, a cross table survey had been considered with strengthen, opportunities and limitations. However, the roadmap to implement those directions is up to each corporate company.

## Keywords

AI, manufacturing sector, global supply chain, AI algorithms, AI chatbots, consulting

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## Introduction

There are several trends that are to emerge in post-pandemic times: increased adoption of automated robotic processes. Acronym AI refers to Artificial intelligence which is the simulation of human intelligence processes by machines, especially computer systems. Even before the pandemic it was used various AI applications including advanced web search engines, recommendation systems, chatbots understanding human speech, self-driving cars, translation between natural languages, automated decision-making and competing in chess or other strategic games. However, for large and complex problems, AI algorithms consume considerable resources and computational time due to exceeding large, big data searching approaches (Zhang et al, 2014). The pandemic has brought new aspects and needs in the immediate attention: the growth of remote work and increased focus on cybersecurity (Jaber et al, 2021) The pandemic has forced many companies to embrace remote work. AI applications such as chatbots and virtual assistants helped to facilitate communication and collaboration between remote workers. With more people working from home into the cloud systems or data had been transmitted online, there is a trigger and great need for cybersecurity. Here also AI-powered solutions can help to detect and prevent cyber threats in real-time (Pritom et al, 2020). It is important to mention that pandemic had more emphasis on the AI-driven healthcare strategies. AI can be used for diagnosis and even predicting outbreaks or diseases (Devaraj et al, 2021; Jaber et al, 2021). Last not least the pandemic has highlighted the importance of ethical AI practices. Specific AI applications become more transparent and traceable, with fair accountability in the development and deployment of AI systems (Cave et al, 2021). Overall, post-pandemic times are likely to see greater adoption and development of AI and chatbots technologies across a range of industries, as businesses and

organizations seek to adapt to new challenges and opportunities. AI is likely to play an increasingly important role in the industry and specific in the manufacturing industry sector (Velu et al, 2020). The use of the AI in industrial sector and its global supply chain dates back to the 1990s (Kar et al. 2019; Kaushik et al, 2023). That time early application for planning and some decision support systems were used to optimize various aspects of the global supply chain. However, only until the mid-2000s the use of the AI has gain significant attention, due to increased data memory of the largest computers (Molas et al, 2021). Another area where AI has been used in global supply chain have been the planning optimization. AI-based algorithms have been used to optimize transportation, logistics and transit planning (Agarwal, 2016; Kar et al, 2019; McKinsey, 2022). An AI chatbot is a computer program that can simulate human interactions using natural language processing and machine learning (Adamopoulou et al. 2020; Gupta et al., 2020). AI chatbots can learn from machine learning algorithms, scripts and stored big data. Also, they understand the context and are able to associate questions with answers, learn from each interaction and enlarge human decision with additional context. In the recent post-pandemic years, the AI algorithms have also been used to mitigate supply chain resilience, with accurate traceability and to improve supplier selection and negotiation (Atwani et al, 2022). This aspect had enabled organizations to ensure products on-time-delivery, quality requirements and competitive price level. To ensure supply chain resilience the main query was formulated as follows:

*RQ1: What are the salient aspects from the AI perspective for the manufacturing sector and its global supply chain?*

Overall, the use of AI chatbots in global supply chain has evolved significantly over the years. Today it is a critical tool for organizations looking to optimize their supply chain operations, enhance customer service and improve sustainability.

## 1. Review of the scientific literature

This paper research is looking to identify the important directions of applicable AI trends by reviewing the scientific literatures for the chosen key words. The recent post-pandemic researchers bring a multitude of various scenarios including lesson learnt. Focus of this paper research is to acknowledge potential study cases which might be further developed by the manufacturing organizations. It is not the focus to ensure a safe way to validate use cases scenarios, but only to setup general directions for the salient aspects.

EU Commission experts from research and technology organizations have discussed the Industry 5.0 concept in July 2020 ([https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/industry-50\\_en](https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/industry-50_en)). AI algorithms have the potential to transform the manufacturing sector in several ways. For further analysis, with no specific prioritization it was identified and considered following six areas and directions of applicability with potential benefits: predictive maintenance, quality control, supply chain optimization, manufacturing process optimization, product customization.

1. Predictive Maintenance: AI enables predictive maintenance by analyzing data from sensors embedded in machines. This helps manufacturers identify potential problems before they occur and proactively schedule maintenance, thereby reducing downtime and costs. AI-powered sensors and analytics can help manufacturers identify potential equipment failures before they happen, allowing for proactive maintenance and reducing downtime. Artificial Intelligence for predictive maintenance refers to the use of advanced machine learning algorithms and data analysis techniques to predict when maintenance is required for machinery or equipment. This approach enables organizations to detect potential equipment failures before they occur and take corrective action to prevent unplanned downtime, increase reliability, and reduce maintenance costs (Stewart et al, 2022). AI for predictive maintenance typically involves collecting and analyzing large amounts of sensor data from machinery and equipment, such as temperature, vibration, and other performance metrics. Machine learning algorithms are then used to identify patterns and anomalies in this data, and to generate predictions about when maintenance is likely to be required. These predictions can be used to schedule maintenance proactively, minimize downtime, and optimize maintenance resources. Overall, AI for predictive maintenance can help organizations to improve the efficiency and effectiveness of their maintenance operations, extend the lifespan of their equipment and reduce overall maintenance costs (Wang et al, 2018).

2. Quality Control: AI-powered vision systems can detect defects in real-time, enabling manufacturers to identify and rectify quality issues quickly. This results in fewer defective products and higher customer satisfaction. AI can be used to monitor production lines and detect defects or anomalies in real-time, improving product quality and reducing waste. Artificial Intelligence for Quality Control refers to the use of advanced machine learning algorithms and computer vision techniques to automate the process of

detecting defects or anomalies in manufacturing or production processes (Adamopoulou et al. 2020). With AI for quality control, cameras and sensors are installed along the production line to capture images of products as they move through the production process. The images are then analyzed using machine learning algorithms to identify any defects or anomalies in the product, such as scratches, dents, or misalignments. This approach can be used to identify defects that might be difficult or impossible for human inspectors to detect and it can operate 24/7, enabling continuous monitoring of quality. In addition to detecting defects, automation for quality control can also be used to identify patterns and trends in the manufacturing process that may be contributing to quality issues and provide insights into ways to improve processes or adjust production parameters. Generally, AI strategies for quality control can help organizations to improve the consistency and quality of their products, reduce waste and rework, and increase efficiency in manufacturing or production processes.

3. Supply Chain Optimization: AI can be used to optimize the global supply chain by predicting demand, reducing inventory and identifying the best suppliers. This enables manufacturers to streamline their supply chain, reduce costs and improve lead times. AI data control can help manufacturers optimize their supply chains by predicting demand, identifying bottlenecks, and optimizing inventory levels. Artificial Intelligence refers to the use of advanced computer algorithms and machine learning techniques to enable computer systems to perform tasks that typically require human-like intelligence, such as decision-making, problem-solving, and natural language understanding. When applied to supply chain optimization, AI algorithms can help organizations to better manage their inventory, production, and distribution processes, by providing real-time insights and recommendations based on data analysis and predictive modeling (Agarwal, 2016). AI can also be used to automate repetitive tasks, office routines, improve efficiency and enhance collaboration across the entire supply chain ecosystem. Ultimately, AI can help organizations to achieve their supply chain goals, such as reducing costs, improving quality, and increasing customer satisfaction (Velu et al, 2020; Atwani et al, 2022; Deloitte, 2022). Furthermore, AI algorithms can be used to analyze data from various sources, including suppliers, customers, and regulatory agencies, to identify opportunities for sustainable practices and develop strategies to achieve sustainability goals. This can include using predictive analytics to forecast demand and optimize inventory levels, as well as using machine learning algorithms to identify patterns and predict potential risks before they occur. Overall, AI can be a powerful tool for promoting sustainability in the supply chain, enabling organizations to reduce their environmental impact, promote social responsibility, and enhance economic sustainability by optimizing operations and reducing waste.

AI for supply chain risk mitigation refers to the use of advanced technologies and machine learning algorithms to identify potential risks in the supply chain and develop strategies to mitigate those risks (Deloitte – OmniaAI; The AI opportunity in sourcing and procurement, 2023) AI algorithms can help supply chain managers to identify potential risks, such as disruptions in the supply chain due to natural disasters, geopolitical conflicts, or other unforeseen events, and develop proactive strategies to mitigate those risks. This can include identifying alternative suppliers, optimizing inventory levels, and developing contingency plans for various scenarios. Furthermore, AI chatbots can be used to analyze data from various sources to identify patterns and predict potential risks before they occur. This can help supply chain managers to take preemptive action to avoid disruptions and ensure continuity of operations (Modgil et al, 2020). AI can help manufacturers optimize their supply chains by predicting demand, identifying bottlenecks, and optimizing inventory levels. When applied to supply chain optimization, AI can help organizations to better manage their inventory, production and distribution processes, by providing real-time insights and recommendations based on data analysis and predictive modeling. AI can also be used to automate repetitive tasks, reduce waste, improve efficiency, and enhance collaboration across the entire supply chain ecosystem. Ultimately, AI strategies can help organizations to achieve their supply chain goals, such as reducing costs, improving quality, and increasing customer satisfaction.

4. Process Optimization: AI can optimize manufacturing processes by analyzing data from sensors, predicting and preventing equipment failures, and identifying process inefficiencies. This leads to improved productivity, reduced waste, and cost savings. Artificial Intelligence for production optimization refers to the use of advanced machine learning algorithms and data analysis techniques to optimize various aspects of manufacturing or production processes, such as scheduling, inventory management, and equipment utilization. AI algorithms for production optimization typically involves collecting and analyzing large amounts of data from various sources, such as sensors, production logs, and supply chain data. Machine learning algorithms are then used to identify patterns and insights in the data, and to generate recommendations or predictions for optimizing production processes (Atwani et al, 2022; Kutz et al, 2022). For example, AI can be used to optimize production scheduling by predicting the availability of raw materials and the capacity of production lines, and generating optimal production plans that minimize downtime and maximize efficiency. AI can also be used to optimize inventory management by predicting

demand for products and generating optimal inventory levels that minimize costs while ensuring sufficient supply. AI for production optimization can also be used to improve equipment utilization by predicting equipment failures before they occur and scheduling preventive maintenance to avoid unplanned downtime. In addition, AI can provide real-time insights into production processes, enabling operators to make informed decisions and adjust processes as needed to optimize performance. Overall, AI strategies for production optimization can help organizations to improve the efficiency and productivity of their manufacturing or production processes, reduce waste and costs, and enhance the overall quality of their products (Capgemini, 2022)

5. Personalization: AI can enable mass customization by analyzing customer data and tailoring products to meet their specific needs. This enables manufacturers to differentiate themselves in a crowded market and increase customer loyalty. AI algorithms can help manufacturers offer more personalized and customized products by analyzing customer data and preferences and enabling flexible production processes. Artificial Intelligence for product customization refers to the use of advanced machine learning algorithms and data analysis techniques to enable personalized and customized products or services that meet the specific needs and preferences of individual customers (Wang et al, 2022). With AI for product customization, customer data such as purchase history, preferences, and behavior are analyzed using machine learning algorithms to identify patterns and insights. This analysis is used to generate recommendations and customized products or services that are tailored to the individual needs of each customer. For example, AI can be used to generate personalized product recommendations based on a customer's purchase history and preferences. AI can also be used to enable mass customization of products, allowing customers to select specific features or options that meet their needs. AI for product customization can also be used to improve the design and development of products, using techniques such as generative design and predictive modeling to create products that are optimized for individual customers. Overall, AI for product customization can help organizations to improve customer satisfaction and loyalty, increase sales and revenue, and differentiate themselves from competitors by offering unique and personalized products and services. AI strategies has the potential to revolutionize the manufacturing sector by improving efficiency, reducing costs, and increasing quality and customization. However, its successful implementation requires careful planning, investment in infrastructure and talent, and a focus on ethical and responsible AI practices (OECD, 2021)

6. Autonomous Operations: AI can enable fully autonomous operations by automating repetitive tasks, such as assembly line operations, inventory management, and quality control. This reduces the need for human intervention, increases productivity, and reduces costs. AI-powered robotics and automation can help manufacturers automate repetitive tasks, increase efficiency, and reduce labor costs. Artificial Intelligence for robotics and automation refers to machine learning techniques to enable robots and automated systems to perform tasks that typically require human-like intelligence and decision-making. AI for robotics and automation can be used in a wide range of industries, including manufacturing, logistics, healthcare, and agriculture. It can be used to improve the accuracy and efficiency of robotic systems, reduce the need for human intervention, and enhance the overall performance and reliability of automated processes. For example, AI can be used to enable robots to learn and adapt to new tasks and environments, using techniques such as reinforcement learning and deep learning. AI can also be used to enable robots to perceive and interpret their surroundings, using computer vision techniques such as object recognition and image segmentation. This can enable robots to perform tasks such as picking and packing items in a warehouse or performing surgical procedures in a hospital. AI for robotics and automation can also be used to optimize the performance of automated systems by predicting equipment failures before they occur, scheduling preventive maintenance to avoid unplanned downtime, and adjusting production processes in real-time to optimize efficiency and reduce waste. Overall, AI strategies for robotics and automation can help organizations to improve the efficiency and effectiveness of their operations, reduce costs, and enhance the safety and quality of their products and services (Kutz et al, 2022).

## 2. Research methodology

The research was carried out in the form of a case study that covered nine global major consulting companies with focus on the global supply chain and the manufacturing industrial sector. The selection of the consultant studies have been based on the six areas detected by the analyses of the literature reviews (Predictive maintenance, Quality control, Supply chain optimization, Personalization, Process Optimization, Autonomous Operations). The research consists in structuring the consultant opinion as high- or lowlights with main statements for these specific areas. The main aspects have been considered from a broaden range of articles and topics. The presentation and interpretation of the results with pros and cons had the focus on „global supply chain” for „manufacturing sector” as key words. Opinions as high-/low-

lights had been organised within a structured table in order to highlight specific conclusions and also with the limitation of the references.

### 3. Results and Discussions

AI algorithms and chatbots have been the central theme of the post-pandemic time and continue to further develop. The study focuses on the detailed analysis of these companies and may be treated as a case study.

Table 1: AI statements from major international consulting groups – Surveys summary for global supply chains – Highlights/Lowlights Overview

No.	Source of research	Authors opinion as Highlights	Authors opinion as Lowlights
1.	<p><b>Alvarez&amp;Marsal</b></p> <p><a href="https://www.alvarezandmarsal.com/insights/artificial-intelligence-goes-mainstream">https://www.alvarezandmarsal.com/insights/artificial-intelligence-goes-mainstream</a></p>	<p>■ Most powerful technology available through low code in history and will fundamentally transform every element of a modern organization including marketing, sales, product development human resources and supply chain. ■ AI is the next transformative force in business. It will fundamentally change customer expectations, bring about new and innovative business models</p>	<p>■ increased reliance on suppliers means an increase in the risks associated with suppliers. Service interruptions, data breaches and compliance and quality issues represent just a few of the challenges topping news stories, and as new risks are identified, regulations associated with the use of suppliers grow more numerous and complex. Use of AI in supply chain risk mitigation is a complex challenge.</p>
2.	<p><b>Ernst&amp;Young Global</b></p> <p><a href="https://www.ey.com/en_gl/ai">https://www.ey.com/en_gl/ai</a></p>	<p>■ The application of artificial intelligence goes beyond “better” or “faster” processes. It inspires new ways of operating and growing a business. ■ AI is maturing and being embedded in enterprise systems or becoming more accessible for nontechnical users.</p>	<p>■ “Pervasive intelligence” will emerge through a massively distributed, digital connectivity and cloud fabric, transforming our economy.</p>
3.	<p><b>Boston Consulting Group</b></p> <p><a href="https://www.bcg.com/publications/2022/benefits-of-ai-driven-supply-chain">https://www.bcg.com/publications/2022/benefits-of-ai-driven-supply-chain</a></p>	<p>■ A recent study by BCG and Aera Technology sought to pinpoint the source of companies’ struggles to maximize value from AI in supply chains. The root cause lies how and where companies are applying it. Most still focus on using AI for analytics and prediction</p>	<p>■ Companies have not pursued the more valuable application of using AI to make recurring decisions by recognizing patterns in big data that humans cannot see. ■ To unlock the full potential, companies need to deploy an AI-powered learning system that is integrated across functions ■ identify the efforts required and potential impacts likely to have on supply chains</p>
4.	<p><b>McKinsey&amp; Company</b></p>	<p>■ Enabling end-to-end transparency and faster decision making ■ Areas to benefit from AI implementation: Marketing</p>	<p>■ Companies must take organizational steps to capture the full value from AI. ■ Supplementary effort to have stretched supply-chain functions.</p>

	<a href="https://www.mckinsey.com/industries/metals-and-mining/our-insights/succeeding-in-the-ai-supply-chain-revolution">https://www.mckinsey.com/industries/metals-and-mining/our-insights/succeeding-in-the-ai-supply-chain-revolution</a>	and Sales/ Procurement/ Planning/ Logistic and Distribution/ Production■Ai-driven Supply chain transformation	Concentrate on dynamically optimizing the company's global value rather than simply improving the performance of local functions. ■ AI will be able to provide teams with deeper insights. However, this visibility alone will not be enough to capture more value from AI-based supply-chain solutions.
5.	<b>Deloitte.</b> <a href="https://www2.deloitte.com/xe/en/insights/topics/emerging-technologies/ai-adoption-challenges.html">https://www2.deloitte.com/xe/en/insights/topics/emerging-technologies/ai-adoption-challenges.html</a>	■ Research continues to improve the AI technology. We even saw a bump in investment during the first couple of years of the pandemic■ Technology comes in packages, as any practical solution relies on a range of complementary technologies as well as the key innovation	■ Why hasn't AI delivered on its promise? We just haven't supported it with the right enablers—both technological and human.■ complementary technologies that transformed the solutions from technically possible to economically viable.■New solutions for old problems based on Augment/ Streamline/ Optimize/ Renegotiate■ The real opportunity, the path to unlocking the full value of AI, requires us to think about work differently (RPA, various AI techniques, even non-AI techniques)
6.	<b>KPMG</b> <a href="https://kpmg.com/xx/en/home/services/advisory/management-consulting/optimize-your-sector-operations/future-supply-chain.html">https://kpmg.com/xx/en/home/services/advisory/management-consulting/optimize-your-sector-operations/future-supply-chain.html</a>	■ Ethical supply chains. Businesses need to act to operationalize their sustainability strategy. ■ Data-driven decisions. Approach decision-making as a business discipline enabled with analytics technology■ New workforce for the future. Rapid workforce hiring and reskilling are critical organizational success factors.	■ Business as usual is not an option. The biggest limitation for supply chains is no longer technology but the imagination of the people who put it to work. As enterprises around the world face a perfect storm of change, today's supply chain leaders must transform business models, organizational structures and operations.
7.	<b>pwc</b> <a href="https://www.pwc.com/id/en/services/consulting/digital-supply-chain.html">https://www.pwc.com/id/en/services/consulting/digital-supply-chain.html</a>	■ The challenge is how to make it work effectively and affordably in a constantly evolving world.■Digital procurement. The procurement function plays a pivotal role in managing risk and cost across supplier management, strategic sourcing, contract management, purchase to pay and spend analytics.	■ more efforts to monitor continuously■ higher financial effort to invest in material stocks ■ more efforts and higher costs■ Customer behaviors and expectations are changing dramatically, challenging the established supply chain and operations setups of leading industrial companies. Supply chains are increasingly facing major disruptions, with the impact of COVID-19 at the top of the list.
8.	<b>Roland Berger</b>	■ Companies need to realize that customer centricity in supply chain management is a	■Global supply chains have often become 'monsters' that rob companies of a competitive advantage through

	<a href="https://www.rolandberger.com/en/Insights/Publications/Supply-chain-platform-from-customer-to-core.html">https://www.rolandberger.com/en/Insights/Publications/Supply-chain-platform-from-customer-to-core.html</a>	<p>key competitive differentiator. ■ Turning legacy supply chain configurations into a company-wide platform that offers suitable supply chain configurations for all products in all markets</p>	<p>their opacity and complexity. ■ Reduce complexity, increase value – But where to start? The first step is to analyze the different operating models in use in the company and assess them in terms of standardization and harmonization.</p>
9.	<p><b>ACCENTURE</b></p> <a href="https://www.accenture.com/us-en/insights/artificial-intelligence/supply-chain-analytics-ai">https://www.accenture.com/us-en/insights/artificial-intelligence/supply-chain-analytics-ai</a>	<p>■ The keys to simultaneously addressing relevance, resilience and responsibility are advanced analytics and AI. ■ There are three use cases make the most sense as starting points—all of which can play a significant role in helping companies maximize relevance, resilience and responsibility: 1. Advanced scenario modeling 2. Unified demand planning 3. Supplier risk monitoring and resolutions.</p>	<p>■ Companies so far have only scratched the surface of what analytics and AI make possible. To rise to the occasion today, companies need a full-scale reconstruction of the supply chain and manufacturing network. ■ New demands are stressing the supply chain. Challenges to leveraging data and supply chain AI at scale. Despite recognizing the power and value of data and AI, companies will likely continue to find it difficult to leverage their investments more broadly.</p>

The same consulting groups are showing reluctance for the AI trends due to extra costs, limitations or potential failures (Deloitte, 2023; Accenture, 2023). In this age of digitization, technology resilience is essential for businesses. It prepares organizations to overcome challenges in the event of a failure, force majeure, cyberattack, data corruption, and other catastrophic system failures, While the pandemic major impacted the businesses and countries, the sustainability program had direct effect on the workforce health and safety and by sustainable supply chain monitoring and close collaboration (McKinsey & Company, 2020).

### Conclusions

AI systems can assist companies in analyzing large amounts of data, identifying patterns, and generating insights, but they cannot replace the strategic thinking and interpersonal skills of the human. Generally, the AI trends are described in very exciting aspects by all the consulting agencies. It is like these agencies are very keen to support the AI developments within the large corporate organization. Aligned conclusions is that companies must implement specific strategies which means struggle and costs. All the six main areas of applications for supply chain in manufacturing industry have to be developed in parallel. In summary, AI can be a valuable tool in improving supply chain resilience by providing real-time visibility, predicting potential disruptions, and optimizing purchasing processes for the manufacturing sector. However, it is important to note that AI has limitations and cannot replace human expertise and decision-making in all the situations. A holistic approach that combines AI with human expertise and risk management strategies is essential for building a resilient supply chain. The conclusions of this study align for the companies the AI benefits on the long term against various challenges within a very large and complex global supply chain for an manufacturing industrial sector.

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