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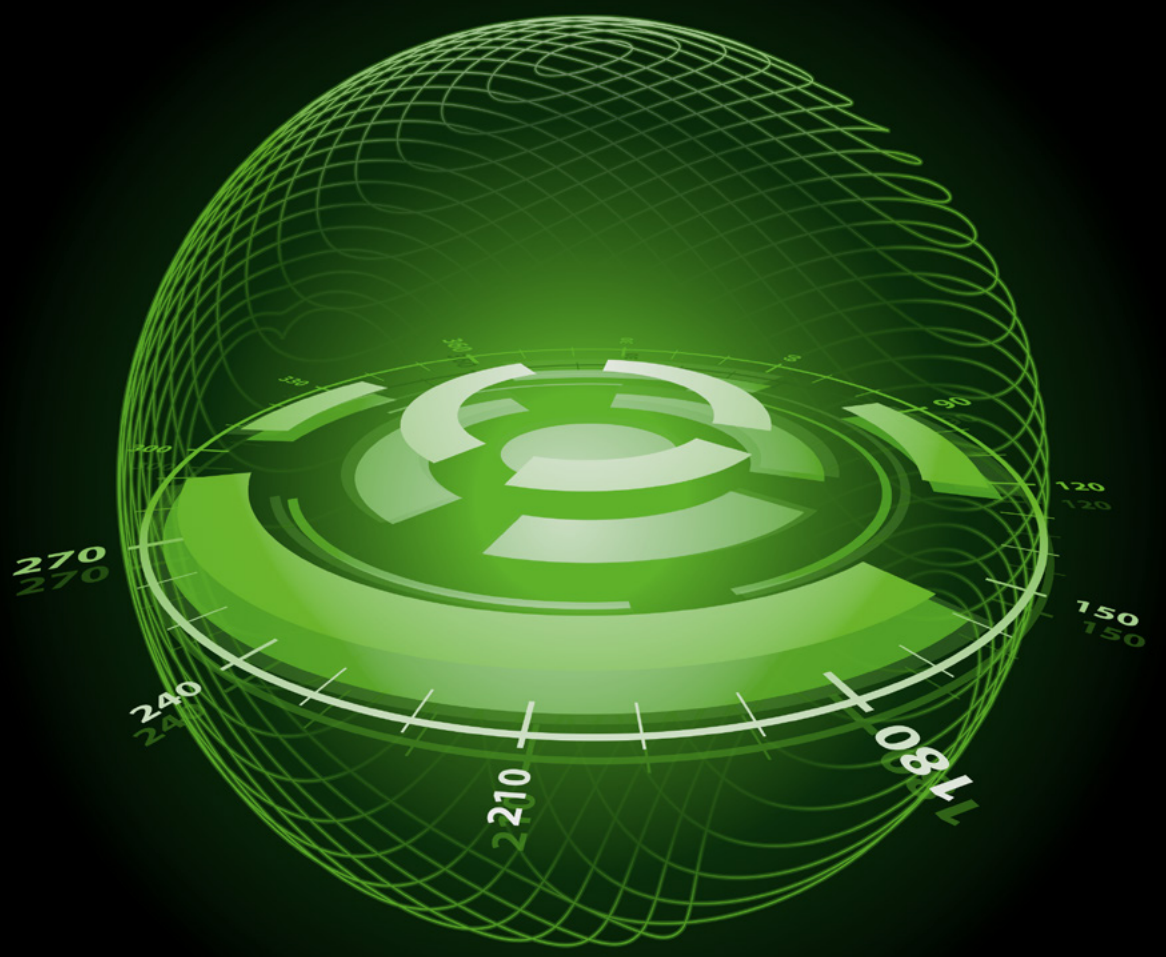

Manufacturing Innovation Conclave 2021

AI/ML: New way of modern digitisation

July 2021

Contents

Foreword by CII

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Technology innovation promises to have an impact on every aspect of the manufacturing sector, ranging from design, research and development, production, supply chain, and logistics management to sales, marketing, and even life-cycle management. Advanced digital technologies will transform manufacturing processes, products, and services; new business models are emerging that will deliver commercial value and catalyse growth opportunities. We are looking at a future with highly intelligent, information-driven factories and distributed business models that will be able to respond rapidly to change, and deliver new and customised smart products and services.

The launch of new technologies, such as additive manufacturing, and the emergence of 'industry 4.0, will also have a significant impact on the direction of the industry's innovation efforts. Finding the right mix of investments in incremental, breakthrough, and radical innovation across the whole range of innovation areas in manufacturing is of paramount importance.

Introduction

The manufacturing industry has always been keen to embrace innovative technologies. Industrial cobots and low-tech robots have been a part of the manufacturing industry for a long time. The new-age automation revolution is triggered by industry 4.0 technologies. With the implementation of disruptive technologies, such as Artificial intelligence (AI), Machine Learning (ML), and industrial internet of things (IIOT), organisations can improve operational efficiency, reduce cost, and keep inventories lean. These technologies will enable the manufacturing industry to achieve sustainable competitive advantage. That said, the manufacturing sector must be prepared for organised manufacturing plants where supply chain, design team, production line, and quality control are coordinated into an intelligent engine that provides insights.

AI is bringing radical disruptions in the manufacturing sector. Today we see intelligent machines enabling high-level cognitive processes, such as thinking, understanding, learning, problem-solving, and decision-making. This, coupled with advances in data collection and aggregation, analytics, and computer processing power, has prepared the white space to complement and supplement human intelligence and enrich the way people live and work. AI applications are rapidly increasing, covering the entire value chain from consumers to producers and delivering significant value. With the massive accumulation of data, manufacturing has turned into a blue ocean for AI adoption. AI can locate and solve pain points in manufacturing. It will have perceivable effects on the industry over the next 5–10 years. According to a Deloitte survey,1 manufacturing companies' key pain points in operations and production are rising operational costs, inflexible design of production lines, high variation in the quality of input materials, and lower yields. AI has the power to help producers elevate process automation, analyse forecasts of market trends, schedule production, and improve the efficiency of inspections.

Initially perceived as a technology that could mimic human intelligence, AI has evolved in ways that far exceed its original conception. With incredible advances made in data capturing, processing, and computation power, intelligent systems can now be deployed to take over a variety of tasks. This enables connectivity and enhances productivity. As AI's capabilities have expanded, its utility has spread over numerous fields.
On the other hand, ML is a data analysis tool that automates the building of analytical models. ML

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models are at the core of AI capabilities, including applications that enable intelligent engagement and process automation. ML has enabled new applications and use cases that were difficult or impossible under traditional programming paradigms. The technology can be deployed to automate tasks that can be codified, are criteria-driven, and repetitive or rote in nature. It is also being used to complement human decision-making or introduce entirely new capabilities augmenting human intelligence. Some practical examples of ML include language translation, image recognition, chatbots, and predictive analytics.

As global supply chains are becoming more complex, the tolerance to have a margin of error is rapidly shrinking. With stiff competition in a connected digital world, it becomes even more critical to maximise productivity by eliminating uncertainties. Rising expectations and the need for higher efficiencies between suppliers and business partners of types further elevate the need for the industry to use AI and ML in supply chains and logistics. In supply chains, AI is delivering accurate capacity planning, improved productivity, high quality, lower costs, and greater output, while ensuring safer working conditions. Using intelligent ML software, supply chain managers are optimising inventory and finding the most suited suppliers to keep their businesses running efficiently. Many manufacturers are showing interest in using ML, fully leveraging the huge amounts of data collected by warehousing, transportation systems, and industrial logistics. ML is also helping enterprises create an entire machine intelligence-powered supply chain model to mitigate risks, improve insights, and enhance performance; these are extremely crucial to build a globally competitive supply chain model.

Deloitte research suggests that AI and ML can deliver unprecedented value to supply chain and logistics operations – starting from cost savings (through reduced operational redundancies and risk mitigation), to more accurate supply chain forecasting and timely deliveries (through more optimised routes) to improved customer service. Therefore, several manufacturers globally are using AI in supply chains.

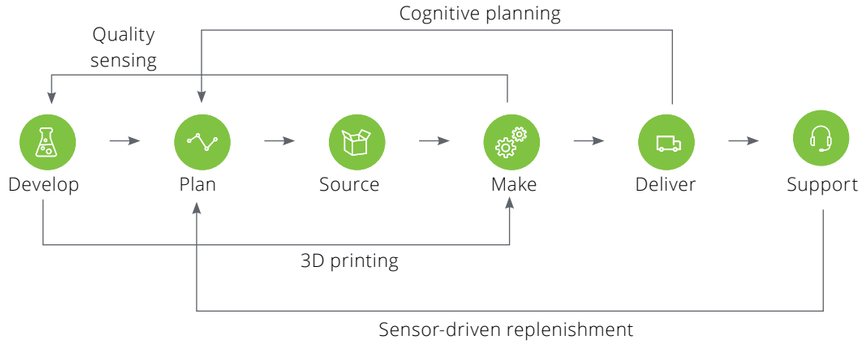
According to a Deloitte Global survey conducted by Deloitte USA in 2020, ~60 percent of manufacturing executives report decreased costs and ~50 percent reported increased revenues as a direct result of introducing AI in the supply chain. Some high-impact areas in supply chain management for AI and ML include planning and scheduling, forecasting, spend analytics, and logistics network optimisation.

The applications of AI and ML in manufacturing and supply chain are many. Some of them can make a difference in a sector that is seeking to renew itself. Using predictive analytics, big data, and ML can result in a significant reduction in operational costs. Therefore, the future potential for this sector looks huge.

Exponential technology solutions driven by AI and ML is transforming the traditional supply chain into a digital supply network.

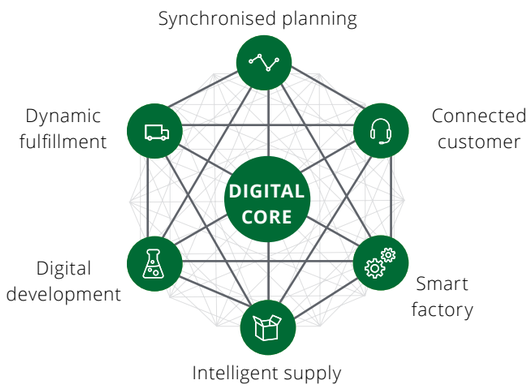
Traditional supply chains

Linear and sequential flow of product and information where each step depends on the preceding step



Digital supply networks

Real-time visibility into each node of the supply chain network powered by an interconnected flow of information



Source: Deloitte.com/content/dam/insights/us/articles/4051_The-smart-factory/DUP_The-smart-factory.pdf

How are AI and ML transforming the manufacturing sector?

AI has multiple applications in manufacturing that can be classified into five fields: smart production, products and services, business operations and management, supply chain, and business model decision-making. In smart production, AI is the primary choice for most Indian manufacturers followed by product and service applications. Popular applications of AI are using AI to shorten the design life cycle; improve productivity and efficiency; and ensure asset, equipment, and energy management.

In the field of smart production, AI and ML are mostly used in factory automation, order management, and automated scheduling. The increasing use of robots and cobots in manufacturing is further fostering the adoption of AI. However, most of the industrial robots in India run on generic programming, and are deployed to carry out high-accuracy and repetitive tasks. AI robots and cobots can develop the ability to sense changes in the environment, recognise patterns, and take decisions in some cases. In automated production scheduling, AI applications focus mainly on optimisation of delivery time, production planning, resource allocation, and process sequencing. This particularly comes in handy in the manufacturing sector that has a large number of processes.

In the next few years, AI applications are expected to rise more rapidly in quality monitoring and defect management, largely due to the advancements in the field of ML. ML algorithms can be trained to manage very small volumes of sample images and ML tools can identify microscopic defects in precision products. AI and ML can also study key product techniques and increase yield. In present times, the rise of IoT and the unprecedented amounts of data it throws off, have provided numerous opportunities to use ML. ML is widely used in predictive monitoring; ML algorithms assist in forecasting equipment breakdowns before they occur and schedule timely maintenance. Not just the assembly line, ML algorithms are transforming areas of inventory management and logistics.

Using AI and ML in manufacturing helps predict process bottlenecks, identify quality control issues, and suggest corrective actions. Some of the examples are given below:

- **AI technology reduces manual supervision** in manufacturing operations, and allows tighter control of quality and operating costs.
- **ML enables real-time quality control** to study manufacturing data from multiple batches and product lines to identify process variations and predict quality issues. This can provide intelligent inputs to staff to investigate only those batches that are most likely to have quality issues, saving time and resources.
- AI, coupled with Robotic Process Automation (RPA, used to **automate batch release** and documentation), can generate comprehensive and auditable data trail to meet regulatory and compliance requirements.
- AI-enabled simulations and modelling can assess various parameters during the manufacturing process to enable corrective actions, and **optimise yield and output.**
- AI-enabled **predictive maintenance** activity reduces machine downtime, production disruptions, and loss of expensive API materials, lowering operating costs.
- Finally, the integration of cyber and physical spaces through the amalgamation of AI, ML, and IIOT, helps map digital images of physical objects to its last physical manifestation. **This is called digital twin.**

How are AI and ML transforming the end-to-end supply chain?

- **AI and ML are changing the way supply chain planning and scheduling is done.**
  In India, supply chain managers often struggle to establish an end-to-end process to plan for a profitable supply network, especially because they are daily faced with increasing globalisation and complexity, expanding product portfolios, and fluctuating customer demand. Lack of complete visibility into existing product portfolios due to unplanned events, plant shutdowns, or transportation problems makes this task even more daunting. Supply chain managers can use AI to enhance their decision-making by predicting building-up bottlenecks, unforeseen abnormalities, and solutions to streamline production scheduling that otherwise tends to have high variations due to external dependencies.

- **Real-time and impactful decision-making**
  AI helps supply chain managers take informed decisions using cognitive predictions and recommendations on optimal actions, enhancing the overall supply chain performance. The technology also helps manufacturers with possible interruptions across various scenarios in terms of time, cost, and revenue. Moreover, deep learning continuously improves these recommendations as operating conditions change.

- **End-to-end visibility**
  Given the complex network of supply chains, manufacturers must get complete visibility of the entire supply value chain with minimal effort. Having a cognitive AI-driven automated platform offers a single virtualised data layer to reveal cause and effect, eliminate bottleneck operations, and pick improvement opportunities – all of this is done using real-time data instead of historical data.

- **Insights based on advanced analytics**
  At present, many companies face challenges of not having key insights to drive timely decisions that meet customer expectations with agility. Cognitive automation that uses the power of AI can scan through large amounts of scattered information to detect patterns and quantify tradeoffs at a scale, much better than what is possible with conventional systems.

- **Supply chain forecasting accuracy**
  In supply chain forecasting, ML and AI ensure material bills and purchase order data are structured and accurate predictions are made on time. This empowers field technicians involved in data-driven operations to maintain the optimum levels required to meet current (and near-term) demand.

- **Boasting logistics efficiency**
  In logistics, AI provides real-time tracking mechanisms to gain timely insights, including the optimal times by where, when, and how deliveries must and should be made. Powerful and multi-dimensional data analytics further help reduce unplanned fleet downtime, optimise fuel efficiencies, and detect and avoid bottlenecks. It provides fleet managers the intelligent armour to battle against the otherwise unrelenting fleet management issues.

Select Case Studies:

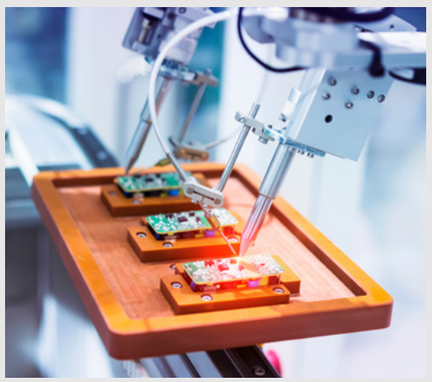
Optimising manufacturing activities using AI

To improve current manufacturing processes, a leading automobile player used applied analytics and neural network technology at one of its sites in the UK. This technology improved manufacturing line's speed by 21 percent, reduced downtime, and improved overall equipment effectiveness by 10 percent. Additionally, the organisation was able to reduce quality rejections and optimise machine throughput.

Source: Deloitte Insights: Setting up AI across the value chain

ML to automate forecasting

A large electronics manufacturing company in Europe implemented an ML-based demand forecasting tool for sales and operational planning. The algorithms used market intelligence data to predict variations and improved planning accuracy by more than 50 percent.



Source: Deloitte Insights: Setting up AI across the value chain

Case Study for AI and ML in Supply chain in India

ML to predict commodity prices

A leading tyre manufacturer in India developed an ML model to get short-term and long-term views of natural rubber prices. The predictive model augmented a buyer's capability and helped the organisation improve its buying efficiency. Using the model, buyers improves the timing of their purchasing decisions.

Source: Deloitte research

NLP model to gauge market sentiment

A leading Engineering Procurement and Construction (EPC) company in India implemented a Natural Language Processing model to identify and tag important news items for steel commodities on various websites based on news sentiment.
The output of this model helped buyers understand the pulse of the market. Buyers use this information during commercial discussions with suppliers.

Source: Deloitte research

Adoption of AI/ML in the Indian manufacturing sector

Table 1. Popular AI/ML applications in manufacturing and their level of adoption in India

Area	Level of Adoption in India
Factory automation	High
Order management and automated manufacturing scheduling	Medium
Quality monitoring and defect management	Medium
Risk prevention and control for safe production	Low
Performance monitoring and asset health monitoring	Medium
Order delivery management	Low
Demand planning and forecasting	Medium
Product design	Low

Table 2. AI/ML models and their perception with Indian manufacturers

Area	*Interest level among Indian Manufacturers
Optimisation models (e.g., inventory and direct material cost)	High
Predictive analytics	High
Visual surveillance	Medium
Robot localisation	Medium
Image identification	Medium
Robot motion programme	Low
Smart language processing for customer services	Low
Automated guided vehicles	Medium
Voice recognition/bots	Medium
Digital assistant	High

*Per Deloitte research conducted in 2020

What is the future of AI/ML in manufacturing and supply chain in India

Industrial automation has advanced considerably in the past few years using industry 4.0 tools, such as AI and ML. Advances in ML algorithms, sensor technology, and computing power have helped produce a new generation of robots. AI allows machines to gather and extract data, identify patterns, and learn and adapt to new things or environments through machine intelligence, learning, and speech recognition.

In the future, AI will keep affecting manufacturing in ways we have not yet anticipated. We can already look at some noticeable examples:

First, the meteoric enhancement in computer visualisation has long been used for quality assurance by detecting product defects in real-time. At present, manufacturing involves more information than ever. As plant managers are looking to automate the data capture mechanism, AI with computer vision can rationalise how information gets apprehended. In the future, a factory manager will be able to gather raw materials reserve from the shelf and have the transaction created automatically with an AI-based camera observing the process. This technology will play the role of a user interface, just carrying out the task at hand not inputting or scanning things into a system.

Second, AI, combined with IIoT, will have a profound impact. IIoT will empower manufacturers to realise improvements that were perceived impossible before. Additionally, IIoT can send in-depth telemetry back to producers and distributors to scrutinise quality and factors that might drive failures. In brief, IIoT is an inward tsunami of information that AI can use to make the solutions powerful. This will facilitate augmented design processes where products are re-imagined before manufacturing.

These newer ML and AI applications lead to fewer instances of equipment failures. These applications also ensure better on-time deliveries, improvements in equipment design, and effective training in a competitive world of industrial robotics. These improvements are gradually building over time. When added together and spread over such a large sector, the total potential savings are significant.

With global supply chains strengthening their roots, increasing profitability will force firms to extract every possible ounce of cost from their respective operations. This scenario is more common amongst local, regional, and national firms with limited economies of scale, currency hedge capabilities, market share, and technology and operational budgets.

In the future, robots can carry out a large part of manufacturing operations and cooperate with humans. They will have the capability to adapt to both the changing environment and changes in the product.

Given these influences, we are seeing a paradigm shift from simple reactive intelligence to predictive, adaptive, and continuous learning systems that drive better decisions for continuous improvements using ML and AI in the manufacturing sector and supply chain.

Appendix

1. **National Strategy for artificial intelligence – Niti Ayog https://niti.gov.in/**
2. **Samarth Udyog 4.0 – An industry 4.0 initiative of the government of India https://www.samarthudyog-i40.in/**
3. **Indian manufacturing industry analysis by Indian Brand Equity Foundation (IBEF) under Ministry of Commerce and Industry: https://commerce.gov.in/ and National Statistical Office: Ministry of Statistics and Programme Implementation: http://www.mospi.gov.in/**
4. **AI enablement on the way to smart manufacturing – Deloitte survey of the adoption of AI in Manufacturing**
5. **Scaling up AI across the manufacturing value chain – Deloitte Insights**
6. **Towards the next horizon of Industry 4.0: Accelerating transformation through collaborations and start-ups**

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1. **2019 Deloitte and MAPI Smart Factory study:** Capturing value through the digital journey. A report from Deloitte's research center for the energy and industrials group
2. **A Deloitte series on Industry 4.0, Digital Manufacturing Enterprises and Digital Supply Networks:** Deloitte University Press
3. **Towards the next horizon of Industry 4.0:** Accelerating transformation through collaborations and start-ups

About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, the government, and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organisation, with over 9,000 members from the private and public sectors, including SMEs and MNCs, and an indirect membership of more than 300,000 enterprises from 294 national and regional sectoral industry bodies.

For more than 125 years, CII has been engaged in shaping India's development journey and works proactively on transforming the Indian industry's engagement in national development. CII charts change by working closely with the government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialised services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists the industry to identify and execute corporate citizenship programmes. Partnerships with civil society organisations carry forward corporate initiatives for integrated and inclusive development across diverse domains, including affirmative action, livelihoods, diversity management, skill development, empowerment of women, and sustainable development, to name a few.

As India marches towards its 75th year of independence in 2022, CII, with the theme for 2021-22 as Building India for a New World: Competitiveness, Growth, Sustainability, Technology, rededicates itself to meeting the aspirations of citizens for a morally, economically, and technologically advanced country in partnership with the government, industry, and all stakeholders

With 62 offices, including 10 centres of excellence, in India, and 8 overseas offices in Australia, Egypt, Germany, Indonesia, Singapore, the UAE, the UK, and the US, as well as institutional partnerships with 394 counterpart organisations in 133 countries, CII serves as a reference point for the indian industry and the international business community.

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