# White paper

## Artificial Intelligence in manufacturing for factory of future

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### Introduction

Artificial Intelligence is the art of making computers to human task or assisting human to do the task. Given the recent break through with compute and also the algorithm and cloud, artificial intelligence developed as amplified to level where all industry can use for real world examples. There are so many use cases that we can use AI augmenting human (human to machine) where we can apply artificial intelligence. Most market predictions say AI is going to be used a lot in the next coming future.

Markets and markets are predicting The **AI in manufacturing market** is expected to be valued at USD 1.1 billion in 2020 and is likely to reach USD 16.7 billion by 2026; it is expected to grow at a CAGR of 57.2% during the forecast period. The major drivers for the market are the increasing number of large and complex datasets (often known as big data), evolving Industrial IoT and automation, improving computing power, and increasing venture capital investments.

[Artificial Intelligence in Manufacturing Market by Offering, Technology, Application, End-user Industry | MarketsandMarkets™](https://www.marketsandmarkets.com/Market-Reports/artificial-intelligence-manufacturing-market-72679105.html)

[The Future of Artificial Intelligence in Manufacturing Industries (plantautomation-technology.com)](https://www.plantautomation-technology.com/articles/the-future-of-artificial-intelligence-in-manufacturing-industries)

### Areas where AI can improve productivity

Artificial intelligence is becoming more prevalent in the manufacturing industry for augmenting human to help them perform better and increase productivity. Idea here is to use artificial intelligence to give insights to human to take better decision. For Example, an operator can replace a HMI using HoloLens to see the line/station screen on the MR device where the physical and digital world come together. So, the operator can see the OEE of the machine and also see the internal representation of the line or station and impose real time sensor data to view the OEE in real time. Not only that predictive maintenance will provide insights on what parts are going to fail, how much production is going to happen within the shift, are they tracking the production goal.

The above are few examples, more to add like detecting PPE personal protective equipment to keep employee safe. Alert when nearing autonomous folk lifts and other moving equipment’s. There is also other use cases for manufacturing floor technicians to perform repair by collaborating with remote engineers to fix various line/station with SI. Also using artificial intelligence to identify waste in the manufacturing process and alert the supervisor or plant manager.

Quality is another area, can be manufactured products or even line and other equipment’s, by predicting what is going to fail we can avoid waste and reduce downtime and improve quality and productivity. Also detecting inventory near line or station and ability to fill inventory so that the line or factory keeps running and increase production.

Safety is a key important part in manufacturing to save humans working. Ability to detect fatigue, or tiredness, or wearing protecting equipment and creating compliance reporting or alert authorities to take action to save human.

Remote collaboration with engineers and design using MR devices to collaborate and design the product engineering. Increases productivity and creativity with remote work.

AI also helps manufacturing to be sustainable by trying to save waste and decrease energy consumption to save the plant and contribute to sustainability. Using energy efficient and forecasting how energy is used plant managers can rearrange the work. Also by recycling the waste also helps the earth and be sustainable.

Now to create AI for factory we also should be using responsible AI to make sure we know what AI algorithm is doing, industry calls opening the black box. Also bias and fairness is very important to make sure AI models dont have bias and be fairness. Also make sure there are enough feedback and controls to make AI is acting on the levels and guidelines provided and not producing negative effect.

Supply chain in manufacturing is a huge area where AI can help achieve efficiency and productivity. Ability to connect suppliers and buyers based on geography and materials or products type with availability and their capacity can help manufacturer to plan their manufacturing process. There are lots of opportunity here and combined with logistics can add more details to the end-to-end process and provide traceability as well.

Using Conversation agents to enable next generation of communication between human and computers can amplify getting information to the hands of users to make intelligent driven organization decision making process. Instead of apps and web site users can just chat and get their OEE information on their hands either by typing or talking, making it very productive not to wait information.

### Some reference:

[AI Business School Artificial Intelligence Courses - Microsoft AI](https://www.microsoft.com/en-us/ai/ai-business-school)

[AI business school for manufacturing - Learn | Microsoft Docs](https://docs.microsoft.com/en-us/learn/paths/ai-business-school-manufacturing/?WT.mc_id=sitertzn_homepage_mslearn-card-aibusinessschool)

[csitestbedai/fillstationai.md at main · balakreshnan/csitestbedai (github.com)](https://github.com/balakreshnan/csitestbedai/blob/main/fillstationai.md)

[azure-intelligent-edge-patterns/factory-ai-vision at master · Azure-Samples/azure-intelligent-edge-patterns (github.com)](https://github.com/Azure-Samples/azure-intelligent-edge-patterns/tree/master/factory-ai-vision)

[balakreshnan/WorkplaceSafety: AI based - Custom Vision Workplace Safety detection system. (github.com)](https://github.com/balakreshnan/WorkplaceSafety)

[PPE Compliance Detection using Artificial Intelligence in Learning Factories - ScienceDirect](https://www.sciencedirect.com/science/article/pii/S2351978920310556?via%3Dihub)

[sdd/covidproject.md at master · balakreshnan/sdd (github.com)](https://github.com/balakreshnan/sdd/blob/master/covidproject.md)

[A Collaboratively Developed Platform to Introduce Fundamentals of IoT and IIoT by Grant Richards, Ragu Athinarayanan, Balamurugan Balakreshnan, Jim Bennett, Andrea Weatherly, Joseph Zaccaria, Peter Zink, Jun Yamasaki, Brittany Newell, Gaurav Nanda, Huachao Mao :: SSRN](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3859672)

### Appendix

#### Major Use Case solution topics:

1. Intelligent supply chain
2. Robot process automation - Automate business process management
3. Predictive Maintenance - Predict outcomes
4. Vision and Audio based Quality detection
5. Automate machine action using reinforcement learning
6. Digital Twin
7. MR with AI and digital Twin
8. Remote monitoring
9. Knowledge mining - engineering and operations/mfg
10. Workplace safety