**Case Study:**

**Advantages of Using AI in Manufacturing Industry**

**R.Y – ITAI 2372**

**Introduction**

Similar to how machines and advancements of technology led to easier and more efficient manufacturing for companies, and individual crafts, AI has also begun to evolve and change the manufacturing process. The evolution of technology in history has easily shown a big influence when it comes to manufacturing, as machines and tools have gotten to a point where human labor is less needed. Assembly lines in factories have made the creation and distribution of goods more efficient and faster than ever before, and entire spaces and factories are now dedicated to processing raw materials like wood into planks. Technology is getting to a point where humans don’t even have to actively operate machines, making production faster and easier than ever.

AI has made this process even more apparent, since models are able to make lines more efficient than ever. Not only can AI improve the manufacturing process of goods but also identify faults and errors in entire production lines to prevent breakdowns and save resources. Although machinery and AI have improved the workplace, many workers are concerned about their jobs being taken over by a machine, and AI makes that problem more apparent than ever. Not only are the machines now doing manual labor, they may now be able to identify their own faults and manage entire lines better than a human could.

**Use Cases/Tools Used**

AI’s implementation into the manufacturing process has mainly been focused on optimization, made to improve or manage various systems already in place.

**Quality/Manufacturing Optimization**

AI Models can manage and better optimize manufacturing lines through computer vision imaging and identify any product not meeting their standards. These models can identify any faults or objects that do not meet their standards and remove them from the line. These models give more accurate quality-assurance based on guidelines and also identify what may be causing the quality control issues.

**Supply Distribution/Management**

Analytic models are able to gather large amounts of data, using these to predict demand based on generated sales, referencing inventory stock for needed resources or overstocked items, and automatically manage orders based on these needs. These models can also schedule deliveries ahead of time and actively cancel or update them based on price changes, market trends, and even recent events that may impact the business.

**Custom/Generative Manufacturing**

AI can also allow the implementation of customized products into an assembly line, by updating what designs or changes are needed, and instantly making them to a batch. Orders can be instantly processed without the need of stopping or manually updating an assembly line to make each customer’s demand. Not only can AI make the manufacturing easier, but it can also recommend possible changes or designs to customers based off popular options or choices.

**Predictive Maintenance/DT Technology**

Digital Twin Technology, or DT technology are able to digitalize an entire factory’s schedule, including supply chains and production lines. These can be used for instant simulations, or changes to be seen and tested to further optimize and improve production lines and either finalize plans or optimize entire supply chains without needing to directly be there. These are also used to give models a greater understanding, and access to entire lines to instantly identify where machines run into errors or even predict them breaking down ahead of time.

A diagram of a car

AI-generated content may be incorrect.

**(**[**How Digital Twins and IoT Work Together [With Example]**](https://www.toobler.com/blog/digital-twin-iot)**)**

**Cobots**

Cobots or “Collaborative Robots” have begun appearing in the manufacturing industry ever since robotics and technology have been implemented. These bots are meant to work with employees, rather than replace or work separately for specific tasks. AI have further improved cobots by not only replacing manual and precise tasks, but also smarter choices that can assist in management and recommendations for managers overseeing a factory.

**Smart Factories/Manufacturing**

All of these can be combined to make a smart factory, which can be entirely ran and automated through AI. Machine workers assembling parts, identifying and stopping errors automatically, ordering needed supplies and changing pricing based on demand, and even keeping themselves functional by ordering and performing automated maintenance.

A diagram of smart factory ecosystem

AI-generated content may be incorrect.

([What is a Smart Factory? A Guide to Smart Manufacturing](https://www.lightguidesys.com/resource-center/blog/your-guide-to-smart-factories-and-industry-4-0/))

**Outcome/Benefits**

**Improved Productivity**

AI improves productivity by cutting out much of the manual aspects of management and time wasted adjusting to unexpected events. DT Technology saves time in making changes to production lines by instantly simulating and making necessary changes to improve productivity. Supply can automatically be ordered ahead of time, making sure factories aren’t missing or accidentally get an overabundance of resources and parts. Broken machinery can either be identified instantly, or even predicted failures based on workload, age, and other aspects and improve longevity through smart maintenance.

**Quality Assurance/Satisfaction**

With increased error detection, most products coming out of an assembly line can be guaranteed to come out at a certain standard level. AI models are able to find these issues faster and more often than a human worker and even identify the source of the error as a one-time issue or with the production line itself. With each product coming out at a consistent quality, customers are able to rely better on a chosen manufacturer. Increased control and customization options also improve satisfaction, since AI-managed lines can handle custom orders and personalized changes without slowing down or altering the rest of the lines.

**Reduced Costs/Waste**

Since AI is able to oversee the entire manufacturing process, models stop the waste of additional resources through various methods. Supplies and inventory aren’t wasted or at risk since predictive models taking demand, or price changes into account to make changes to what is needed in their inventory and avoid unnecessary spending. Since quality is being held to a certain standard, products not meeting that standard can instantly cease production, rather than wasting more resources incase a machine is no longer working properly. With optimized inventory, and less resources being wasted this also leads to better environmental impact as there’s less emissions, or just trash generated from wasted material.

**Challenges/Problems**

**Job Displacement**

One of the biggest and most common problems when it comes to technological advancements is job displacement. As machines become better at automating a process that once needed human workers, the need for manual labor, and job availability becomes reduced. Not only are manual processes at risk now, but management positions such as supply managers are also at risk. Predictive models are not only able to manage supply chains better than a human worker, but even manage entire factories and workers better, and potentially cheaper. With company heads mainly only benefiting from implementing AI, common workers are put more at risk.

**Overreliance**

Another issue is the overreliance of these models and their ease of use, leaving factories potentially understaffed/underprepared for issues related to AI models. If a model stops working, it could potentially put the entire workplace at threat, especially if they’re put in management positions and there’s no human supervision or experienced workers able to fill in for the AI.

**Integration Cost/Complexity**

One of the last issues, is that the implementation of AI in these factories is very expensive, and requires plenty of time. Investing all these resources into overhauling a workplace can be very complex and expensive based on what they need, especially if trying to set up an entire smart factory.

**Innovative Proposal**

**Issue:**

One of the biggest issues related to the manufacturing industry is the creation, and management of waste, and emissions generated from factories and assembly lines. Over almost 9 billion tons of waste is made worldwide yearly from industrial manufacturing alone, and plenty of the issues come from improper management of the waste leading to heavy pollution, and destruction of the environment.

My proposal for an AI innovation is to implement systems based around proper waste management, including proper disposal, less waste creation, and better use of resource alternatives. Depending on the type of products being produced in a factory, different types of waste is generated and need to be handled in different ways. Some waste can be more useful recycled, and others may be dangerous and need to be secured and removed in a safe way, although this can be expensive to set up especially for large-scale factories that don’t produce one type of waste. AI systems can automatically identify, and route deliveries to the proper facilities this waste needs to go to. Not only can it handle the proper disposal, AI can also recommend and find alternatives for production, whether it be more eco-friendly resources, energy usage, or production methods to save on un-needed pollution.

A graph of different colored bars

AI-generated content may be incorrect.

([Global Waste Management Outlook 2024 | UNEP - UN Environment Programme](https://www.unep.org/resources/global-waste-management-outlook-2024))

**Reasoning:**

The biggest reason for this innovation is how common improper handling of waste actually is. According to statistics, over a third of the 9 billion tons of waste yearly are improperly disposed and this can be seen directly with how around 50% of lakes in the US are affected by industrial waste. With how common this issue is, we need more secure and better ways of managing our waste that can help preserve the longevity of the planet. AI resources can help guarantee that this waste is sent to where it properly needs to go, so it either doesn’t end up negatively impacting the environment, or end up saving us vital resources in the long run.

**Expected Outcome:**

The expected outcome from the proper implementation of the waste monitoring, management, and alternatives is that pollution rates will begin to decrease. Recycled materials and alternatives can reduce the overall amount of waste in the world, leading production lines to use less newly processed materials and instead re-use what could’ve been considered trash at one point. Factories may need to implement new distribution or centers for handling their waste but will save costs with AI models reducing the amount of waste they generated through alternative production methods and times. Larger factories may reduce the risk of illegal or dangerous dumping as the types of waste they’re producing can be better identified, and automatically grouped for proper disposal.

**Potential Challenges:**

One of the biggest challenges I see for this is the actual proper implementation of these models in a factory. Many lower-end businesses may not be able to afford the expensive infrastructure needed, and alternative resources that might be more eco-friendly, aren’t always the most inexpensive. This also requires entire new systems of waste-tagging, storage, and disposal routes which could vary on cost depending on various factors like location. Although I don’t think the use of this AI would cause any major issues itself, the cost of it all and additional resources needed may not be worth it for many major manufacturers.

**Conclusion**

In conclusion, the impact and importance of AI in manufacturing industries can be seen with the evolution of automated labor, and production to automated management, and optimization. While machines and innovations reduced the workload of human workers on repetitive and manual tasks, AI has reduced the workload of managers, and planning within the industry. Productivity is improved as AI is able to instantly make adjustments and needed changes to production lines, which allows more customizability, and is even able to prevent demand and market trends to save costs and have smarter resource management.

Although it’s not perfect, as it threatens job security, creates an overreliance on technology, and can be difficult or expensive to even implement in the first place. For proper security, and reduced risk of the mis-use of AI I think these industries need to consider some of the downsides, even if the benefits seem great.

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**A01 – A08 Canvas Notes**

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**Image Credits:**

***How Digital Twins and IOT Work Together [with Example]*, www.toobler.com/blog/digital-twin-iot. Accessed 11 Apr. 2025.**

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