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AI Business Applications in Manufacturing - Executive Overview

Rajesh Hassija
raj@infosenseglobal.com
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1. Introduction

Machine learning (ML) and artificial intelligence (AI) are being touted as the next big thing across a variety of sectors. The technology signals an innovative shift with the capability to transform operations and usher in improved processes and automation. The manufacturing sector, in particular, is seeing some serious shifts as ML and AI systems are implemented.

However, before delving further, let's start with definitions. AI refers to the ability to program computers to perform tasks normally done by humans. ML is an application of artificial intelligence that gives systems the ability to learn and improve from its experience without the need for explicit programming. It learns from itself and continually improves its own algorithm.

Current industry giants such as Siemens, GE, Bosch, and Microsoft (to name a few) are all using some form of AI and ML in their manufacturing processes. As the industry evolves, it's clear that AI and ML are not some harbinger of disruption, but are ushering in a much-needed evolution in manufacturing

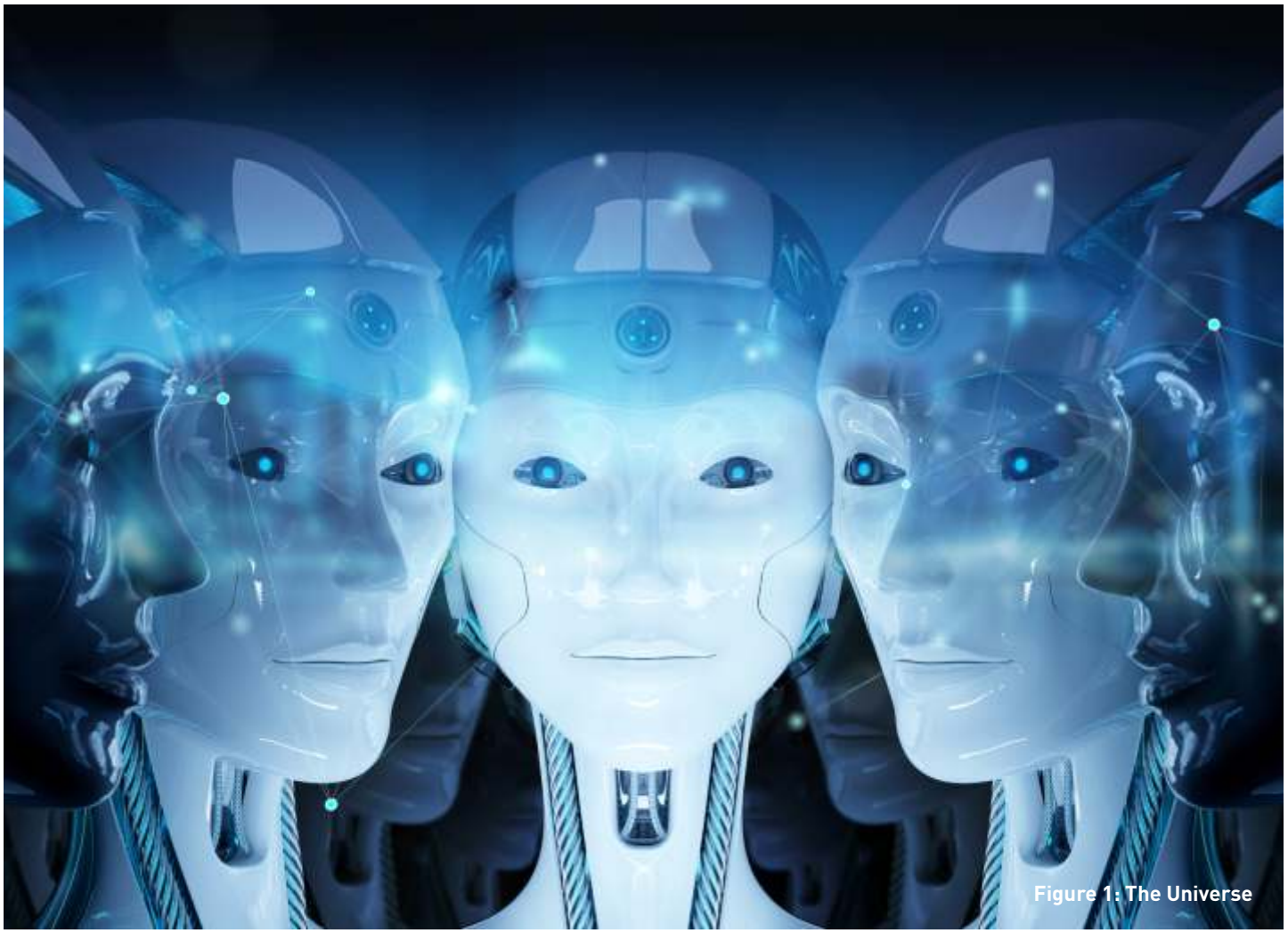

Figure 1: The Universe

2. Manufacturing in context

As leading manufacturers take notice, there's been a steady appetite for tech growth. For example, a recent Deloitte study found machine learning can improve product quality by up to 35 % within the manufacturing sector. Furthermore, it's projected that by 2021, 20 % of leading manufacturers will increase reliance on AI applications, improving execution times by up to 25 %

Supply chain, labor, inventory, and quality control are just some of the areas where manufacturing benefits from ML. In this context, it's clear that AI and ML have tremendous potential to push manufacturing towards entering a new age. Manufacturers have begun using the technology in different ways across a variety of functions, as explored below that demonstrate the breadth and versatility of how AI and ML are used in this sector.

3. Why it works

Within the day-to-day work of manufacturing, there's a considerable amount that ML can improve:

A. Detect defects early on

Quality control is one of the primary ways ML is utilized in manufacturing. Applications such as machine vision and data processing are essential for creating an automated quality assurance system and product defect detection. Once implemented, this leads to a massive uptick in productivity. In fact, AI and machine learning used in product defect detection is projected to show a 50% increase in productivity or more.

There are a few different models that could work for quality assurance and product defect detection, so there's room for innovation. The ultimate goal is to use a system that detects issues early enough so that maintenance can be done. Otherwise, quality assurance opens up to human errors and risks very easily. Automating the process diminishes the risk though, and provides a lot of opportunities to increase time in other functions that can improve the business.

Another method could involve an AI-enabled visual quality inspection. Reference examples of both good and bad products from different angles are used to create a supervised learning algorithm. As the name suggests, its continuous learning ensures that quality assurance becomes proactive management rather than a defensive method. It's a clear advantage in production, and it yields benefits. Predictive modelling is also beneficial in this context since it inspects and tests constantly. It then predicts outcomes with higher efficiency and signals issues early.

B. Optimizes resource allocation and supply chain management

There are a myriad of ways machine learning is deployed in this area including asset tracking, accuracy, supply chain visibility, and inventory optimization. In each aspect, machine learning clears the way for automation and better resource allocation. Rather than getting bogged down in anticipating needs and optimizing operations, machine learning algorithms replace it all, freeing up time and energy.

This is especially salient when considering 20-30 % of total costs are swallowed up in storing inventory. Combined with supply chain optimization, and you start to see how easily resources become tied up. BCG found that AI usage led to higher conversion rates and significant cost reductions that resulted in higher workforce productivity.

These statistics demonstrate the immense amount of time being dedicated to tasks that just don't need that kind of manual oversight anymore with the emergence of ML. With algorithms in place, manufacturers can accurately and quickly predict product supply and demand, supply chain processes, identify efficient shipping routes, and predict complications.

For example, inventory optimization can be undertaken with regression models. The latter aims to forecast ahead and search for causal effect relationships amongst the variables to better understand where improvement should be made. As a decision-making engine, regression models can provide

insight on how to optimize processes, where resources are being used, and how much time is being spent on tasks.

Having this information allows for a better real-time picture of the production process and future decision-making. The regression model is able to provide a clearer picture of how shifts need to be staffed, the number of resources actually needed versus the time taken in production, and other areas. This enables factory and plant owners to design team schedules and processes that will actually work, rather than expending energy trying to manually tracking this work.

C. System Maintenance

Current statistics demonstrate that unplanned downtime tends to be a costly and time-intensive problem for manufacturers. Unplanned downtime can cost plants and factories up to $50 billion dollars and the main culprit tends to be asset failure.

Why is this? Because system maintenance has traditionally been a manual and labor-intensive process. Maintaining and fixing equipment takes time, and machines are non-operational while repairs are being made. With the number of assessments that occur on machinery, it can take much longer than expected to have the system running again smoothly.

However, predictive modelling can help avoid these issues altogether. Machine failures can be detected through the algorithm's continuous learning. Alerts can be set up so that system maintenance becomes automated. It can detect failures and schedule maintenance in advance, making system maintenance far less of a headache to manage.

Deemed smart maintenance, these proactive measures provide some respite from maintenance by creating a data-driven deep learning system that improves on its own. Rather than having to put out fires, predictive modelling is instrumental in bringing order to a chaotic system and giving manufacturers the opportunity to be proactive.

D. Process Improvement and Automation

A big challenge across manufacturing is process improvement and automation. Without process improvement, manufacturing can't really evolve. Without adapting to new changes quickly, factories and plants are often left fumbling in the dark, undertaking time-consuming processes that don't really contribute much to the overall production time.

According to recent studies, US businesses lose an average of over $170,000 in doing repetitive and mundane tasks. That's a lot of revenue that can be recouped through deploying AI and ML applications.

As an example, neural networks are perfect for process improvement and create a smoother working process. Siemens uses neural networks for monitoring machinery, as well as monitoring, recording, and analyzing every step of the manufacturing process.

Rather than assign an employee to record and track processes, deep learning algorithms allow Siemens to have real-time information around process improvement. It gives Siemens an advantage, it's a faster, clearer picture of where the gaps in production are, enabling faster decision-making.

E. A tool for innovation

Lastly, another reason why machine learning thrives in manufacturing is that it gives companies a chance to innovate. Using deep learning algorithms, AI and ML applications are able to process, and more importantly analyze, data faster than ever before and provide a level of insight that just isn't possible otherwise.

As an example, Coca Cola's Cherry Sprite wasn't exactly a human invention - it was a product of ML! Using the data from the deep learning models, Coca-Cola created a product that consumers wanted, without needing intensive product development and market research resources usually involved. Using data gathered from self-serve vending machines, the company looked at what kinds of drink combinations customers chose. From there, Cherry Sprite was created, a truly unique product designed solely through data.

This suggests the importance of AI and ML as it evolves. Deep learning models are important because they provide a window into what's missing and what needs improvement. It gives manufacturing a chance to innovate, to change, and create authentically, backed up with real-time data.

4. Conclusion

Put simply, manufacturing needs AI and ML to evolve. The technology has allowed the sector to see the deep problems that existed within operations. Alongside this, hidden issues and failed production efforts have also been exposed through these models, showing some of the deeper chasms the sector continues to deal with.

AI and ML have a way of upending the current status quo of operations but that isn't necessarily a bad thing. It doesn't signal doom and gloom, it's just the opposite. AI and ML are opening up new doors, creating new opportunities that the manufacturing industry needs to thrive. The development and deployment of these technologies highlight the investments companies are willing to make on their long-term efficacy and success.

This is a big digital transformation that could catapult the industry into a new wave of technology and efficiency, and create opportunities like never before for both established veterans of the industry and the newcomers.

1001 Texas Avenue, Suite 1400, Houston, Texas 77002, United States of America | Phone No: +(888) 510-2552
Fax: 844-205-6705 **| eMail:** sales@infosenseglobal.com **| URL:** www.infosenseglobal.com