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Role Of Robots In Mass Production And The Associated Advantages And Disadvantages

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Abstract

Reconfigurable automation systems, such as robots, are becoming increasingly important as the manufacturing paradigm shifts away from mass production and toward mass customisation. To compete in global markets, manufacturers are converting to fully automated production lines, which include automation technology that can be easily modified or repurposed. Manufacturing is being transformed by robots. Robots are constructed and programmed to do a number of tasks, including moving materials, seam welding, lifting heavy objects, and assembly line operations.

The goal of this paper is to provide an overview of the advances and innovations that have occurred in the evolving field of rapid manufacturing over recent years. The work begins with an introduction section that defines the robotics technology and role of robotics in manufacturing, including their definition and scope. The main applications of robotics in industrial tasks, robotics integration in CAD/CAM systems, and the future of robots in mass production will be discussed next. This paper also addresses the issues of sustainability, covid impact & unemployment associated with robots.

Keywords- Robots, Mass Manufacturing, CAD/CAM, Covid'19, welding, programming

1. Introduction

The word "robot" is said to come from the Czech word "robotnik," which means serf. Machine tools are what industrial robots are. Surface machining, such as cutting or grinding, is where industrial robots are most commonly used in production processes. They are programmable manipulators that can move parts or tools in a predetermined sequence. Re-programmability refers to the ability to change the robot's actions without changing the hardware by changing control settings. The robot, like a machine tool, can repeat the same task with great precision for extended periods of time. It can be taught to do a new task and can use accessory tools to expand its physical capabilities, just like an operator.

Any effective workplace requires high levels of productivity and performance. Manufacturing is being transformed by robots. They're a perfect match. In the manufacturing industry, robotics increasingly plays a key role. Automated manufacturing solutions should be an integral component of every organisation that seeks to achieve maximum efficiency, safety, and competitive advantage.

Manufacturing robots automate repetitive procedures, lowering error margins to near-zero levels and freeing up workers to focus on more productive aspects of the operation. They are used to move goods and perform a range of pre-programmed actions in industrial and industrial situations. When robots are deployed to accomplish activities that people can't accomplish as effectively or with a better and more consistent degree of quality, productivity rises. Not only are robots cost-effective in the workplace, but they can also have an economic impact. Companies will no longer need to look for labour in other countries as a result of increased productivity. All labour can be done locally, in a manufacturer's own space, with the use of robots.

In India, industrial robots are experiencing a virtual population explosion. According to the report, India installed over 4,300 new industrial robots in 2019. In the last five years, the number

of industrial robots has doubled, with over 26.000 in total. As automation spreads throughout the world's industries, the number of such machines in India continues to rise. According to the latest World Robotics Report-2020, released by the International Robotics Federation (IRF), India has climbed one spot among the top 10 countries with the highest yearly robot installations in sectors. There will be 2.7M industrial robots in operation in industries throughout the world by the end of 2019, up 12 percent from 2018. In 2019, 3.7 lakh units were sold globally, down 12% from the previous year [1]. "However, it was still the third greatest sales volume ever recorded," the study noted. More than 3M industrial robots will be in use in companies throughout the world by 2020. The operating stock will have more than quadrupled in 7 years (2014-20) [2].

"Industrial robots are an important aspect of the industrial industry's progress," says junji tsuda, The International Federation of Robotics president. “Robots are built using a variety of cutting-edge technology. A few of the subjects discussed include vision recognition, skill development, AI-assisted failure prediction, a revolutionary approach of man-machine collaboration, and simple programming. They'll aid in increasing production productivity while also expanding the range of robot applications. According to the IFR prediction, the yearly number of robots deployed to industries throughout the world would reach around 630k units in 2021.” [3]

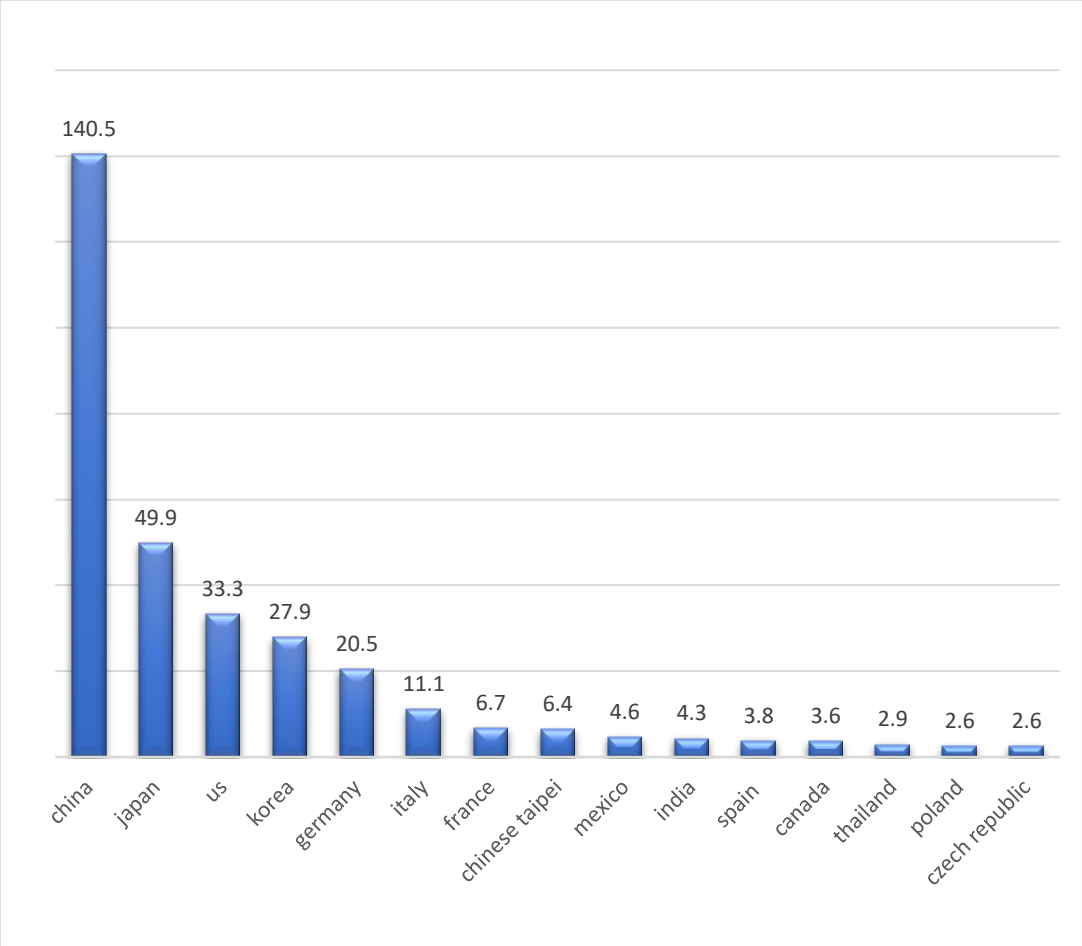

Figure 1 Above figure shows the yearly installations of industrial robots TOP 15 countries. The world robotics 2020 industrial robots reports a new high of 2.7M industrial robots in factories all over the world, a 12% increase. Asia accounted for around two-thirds of the worldwide supply of newly deployed robots. The largest number of new robots sold in China is around 140,500 [1].

1.1 Advances and innovations

Technology is a constantly changing field, with innovations constantly being introduced to provide exciting new opportunities for today's manufacturers to reimagine their operations. In some cases, new technologies allow progressive manufacturers to introduce truly innovative products of their own. Manufacturing is one of the most realistic examples of the inevitability of industrial breakthroughs and innovations. Manufacturers mostly use 3D printers for prototyping, and 3D printing has been around for around 40 years in the manufacturing industry. It's a low-cost way for designers to try out new products. It also allows them to create products on demand rather than having to manufacture and store them.

On July 14, 2010, the German cabinet launched the High-Tech Strategy 2020 initiative, which would concentrate the country's research and innovation strategy on ten to fifteen years of forward-looking initiatives tied to scientific and technical advances. Industry 4.0 is a concept of a networked industry that uses computers, software, and Internet technologies to meet mass production goals [4]. In order to encourage smart factory innovation, Industry 4.0 advocates for the integration of industrial automation and data interchange. Such factories will be run by a virtual production line that runs systems, monitors, and completes physical processes. Physical production will be run automatically by connected software systems that communicate in real time and ensure the quality of their operations. As a result, it's only logical that manufacturing innovation be led by smaller, more agile enterprises. Industry 4.0 automates manufacturing using water and steam power, mass manufacturing, and the digital revolution by utilising cyber-physical systems, embedded computing, and the Internet of Things (IoT) (e.g., machine tool NC etc.)

Traditionally, industrial robots were programmed by a skilled programmer travelling from point to point, capturing and replaying actions and functions. This method is inflexible, despite its reliability; adjustments can be made, but it is a difficult effort. CAD (Computer Aided Design) As processing power has increased and production requirements have changed, CAM manufacturing has become the standard for numerous processes, including CNC machining. Computer Aided Manufacturing, or CAM, is a software-assisted manufacturing approach. In the robotics sector, CAD has been reluctant to catch on, and for most robotic systems, it is still a pricey option rather than the norm. With nearly 50 years of research and 30 years of popular use, Computer Aided Design, or CAD, has been around for nearly as long as robotics. With CAD, you can perform analysis, be more flexible, and make quick modifications. It offers the benefit of allowing us to make design modifications that are immediately reflected in production. In today's flexible industrial environment, this is a considerable benefit over traditional robotic solutions.

1.2 Impact of robotics

Employees in the manufacturing industry frequently express concern that robots will eliminate their jobs. This is not the case, however. Robots have the ability to eliminate jobs that are either boring or dangerous and replace them with more appealing jobs, such as engineering or programming. Oxford Economics stated that, up to 20 million manufacturing jobs worldwide could be replaced by robots by the end of this decade. According to the company, each new industrial robot eliminates 1.6 manufacturing jobs, with the least-skilled regions bearing the brunt of the losses. According to Oxford Economics, areas with a higher number of people with lower skills, as well as weaker economic structures and higher rates of unemployment were more vulnerable to job loss as a result of adding robots in manufacturing lines. Each extra robot deployed in those lower-skilled parts of the country might result in about double the amount of job losses as those deployed in higher-skilled parts of the country, exacerbating the ever-increasing economic disparities and political polarisation. Approximately 1.7M industrial jobs have been lost to robots

since the beginning of this century, according to the research, including 400k in Europe, 260k in the United States, and 550k in China. However, it was calculated that a 30.0% increase in world robot installation would result in an additional $5 trillion in global GDP. [5]

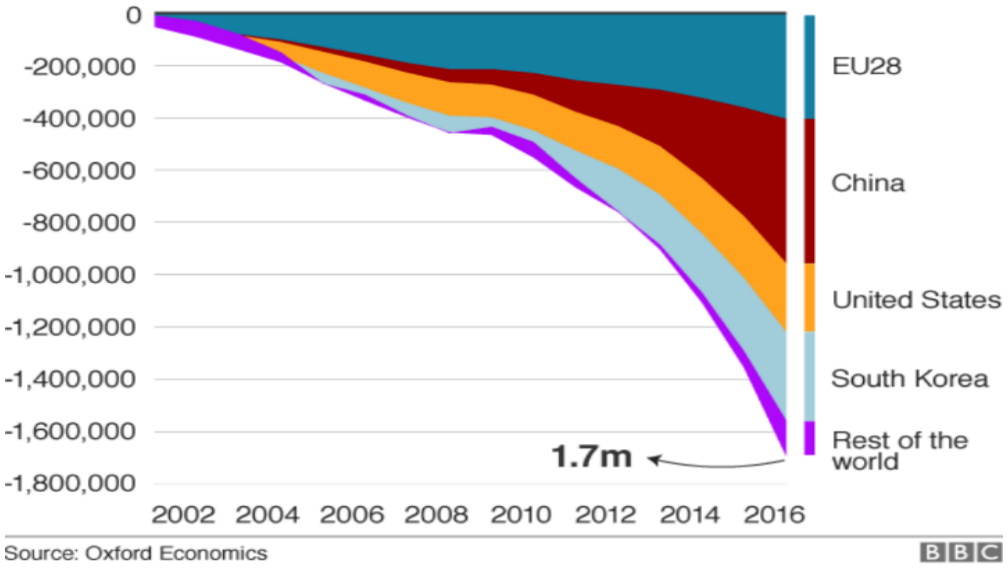

Figure 2 cumulative job losses attributed to auto-motion since 2020 & 1.7M industrial jobs have been lost to robots [5].

2. CASE STUDY

2.1 Voodoo manufacturing

Robots can help with speedy integrations, lights-out operations, and even reshoring production, as demonstrated by Voodoo Manufacturing in Brooklyn, N.Y. Voodoo Manufacturing has a fast expanding 3D printing facility capable of handling huge production runs and competing with injection moulding. They used a Universal Robotics UR10 Robotic arm to automate their system. This is assisting Voodoo Manufacturing in transforming 3D Printing from a technology mostly utilised for prototyping and high-value components into a viable alternative to injection moulding for mass production of plastic parts.

The UR10's work assignment of loading and unloading took up 10% of all labor hours. The ability of these heavy duty robotic arms to work overnight with minimal supervision required enabled the factory to run 24/7 hence increasing productivity. This tripled the production rate of the factory hereby increasing the overall profit margins. Voodoo Manufacturing's three-year goal is to reduce the costs of its products by 90%, they plan to achieve this goal by deploying more number of UR10 robotic manipulators in their workspace. They plan to increase their output ten-fold over the next couple of years, without increasing their costs.

2.2 Made in india robot in automobile sector

The automobile sector is one of India's most important drivers of economic growth, with a high level of global value chain engagement. With 3.49 million passenger and commercial vehicles sales in 2020, India was the fifth-largest car market. In 2019, it ranked sixth among commercial vehicle manufacturers. As a result, robots are rapidly being deployed in a variety of industries to do monotonous and/or risky activities.

Tal brabo Robot is a robotics machine made by an tata automobile company [6][7]. Tata Auto-Comp manufactured some of the robot's most critical components, which were designed in-house at Tata-Elxsi & TAL-Manufacturing. This robot was designed in-house to meet the needs of micro, small, medium, and even large businesses.

Figure 3 MADE IN INDIA TAL BRABO ROBOT

Source- Analytics India Magazine [7]

The robot has been found to enhance yield by 15.0-30.0% with a retribution period of 16-18 months, according to the business.

2.3 Covid'19 impact on manufacturing

The main focus in the industries are on stiff and improved production processes to achieve efficiency in the mass production industries such as autos, electronics, and aeronautics. Industries strive at rectifying the supply chain so that the production processes can be further redesigned in order to meet the consumer's uncertain demand environment. There is large investment into the cost-efficient supply chain and production efficiency with the incorporation in the present COVID-19 experience of fully automated technologies. Changing collective thinking will generate opportunities and greater flexibility in the collaborative framework. The change in the collective perspective should create opportunities and more flexibility to adapt the design, manufacturing and distribution processes for collaboration frameworks. According to Hella India Lighting Ltd. During COVID-19 and following COVID-19, production standards and processes are transformed in particular, making them flexible to adapt production to fear among changes so that consumers is employees and minimised.

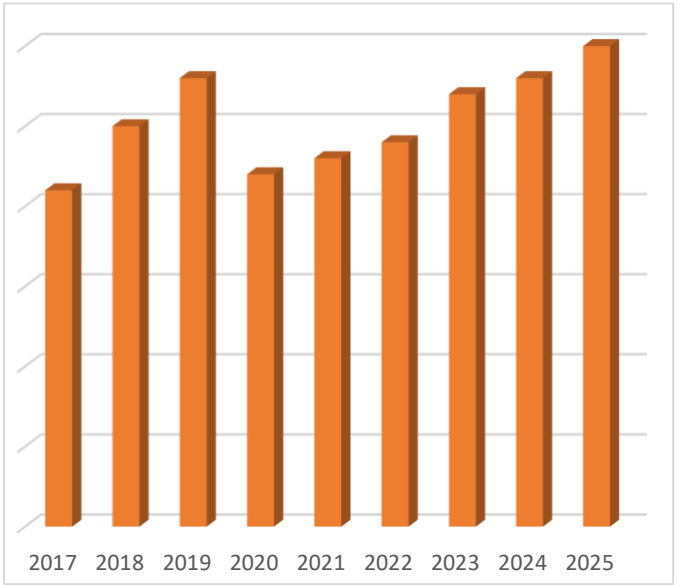

Figure 4- Post Covid 19 impact on manufacturing using robots

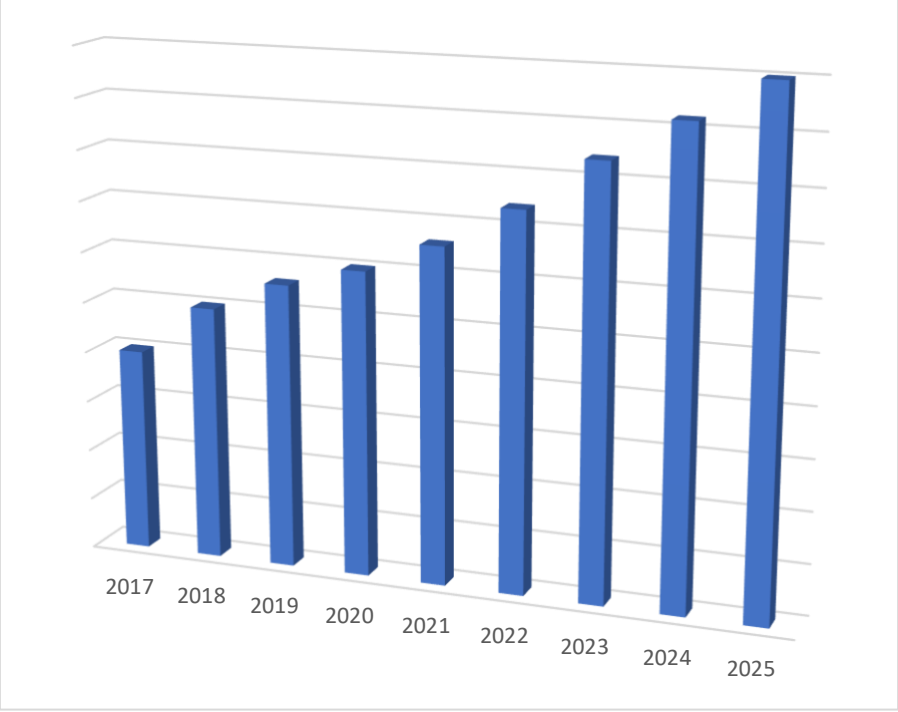

Figure 5 - (Pre covid'19 analysis)

Source- markets and markets analysis, investor relation ppt, yearly report, professional interview, press release. [8]

Flexible manufacturing is a system designed to respond to variations in the type and amount of the product being created [9]. It is a highly categorised collection of machines and computerised systems that make a range of parts and handle varying levels of production. The system's work machines are mostly fully automated Computer Numeric Control (CNC) machines coupled to a material handling system that optimises component flow at the workline and the central computer that regulates robotic motions. A group of automated processing equipment coupled to material handling systems and conveyors serves as the strategic function of flexible production. It provides

a system of workstations with automated technologies that are then inspected by an automated inspection unit. This approach is less costly than traditional manufacturing and provides for full flexibility across the formulation zone, allowing for fast response to changes.

To fulfil the next generation's need for sophisticated manufacturing and worker monitoring assistance, manufacturers are looking to modernise their equipment, technology, and processes. The bulk of mass-production firms in the automotive, aerospace, and other industries are expected to have already deployed flexible manufacturing to mitigate the impact of COVID-19 fear on workers and customer behaviour. Furthermore, these companies are putting a strong emphasis on digital infrastructure to help them extend their capabilities and improve their production efficiency. Flexible manufacturing allows organisations to get the most out of their production processes, allowing them to rapidly recover from a deadly viral outbreak and expand faster and stronger than before.

3. Literature review

Robotics are becoming more common in businesses all over the world. Over the next decade, artificial intelligence and other advancements in robotics will likely result in dramatically improved prices and performance (Robert D. Atkinson, 2019). The use of robot kinematics to move the robot's end-effector with tools in the workspace is the concept behind robot application in manufacturing. The most common applications for robots are in manufacturing, where they are equipped with specialised tools. The kinematic structure of the robot determines the operating space.

Companies that used robotics showed increased growth with passage of time in their business KPIs in terms of firm performance and labour productivity, according to a study conducted by Mara Teresa Ballestar et al. [10] using a longitudinal machine learning model. Robotic enterprises grew their productivity and labour share for each employee at a faster rate than non-robotic enterprises. In robotic enterprises, the productivity over employee chained index was 1.54, compared to 1.20 in non-robotic enterprises.

Assessing the consequences of one of these kinds of digital transformation, the implementation of industrial robots, in the current setting of the new industrial revolution is becoming increasingly important. Despite the fact that many organisations are eager to adopt new technology to boost productivity, others have raised concerns about the cost of change and its impact on employees. (for example, Acemoglu et al., 2019). [11]

Robotic automation can help to increase support for environmentally friendly production practises. According to Robotic, robot-assisted handling processes (moulding machine tending, palletizing, and machine tending) account for 38% of manufacturing activities. Robotic welding, robotic assembly (disassembling, inserting and press-fitting), robotic dispensing (spraying, glueing and painting), and robotic processing (water jet and laser cutting) account for 29%, 10%, and 4% of the market, respectively. Industrial robots and automation can assist boost production and keep industrial systems running smoothly.

Industrial robots and automation now play a quantifiable role in enhancing human worker productivity, which has the potential to destabilise the economy. Robots also contribute to the quality of production. Robots regularly outperform humans in areas such as strength, precision, and sensing. These abilities enable the creation of beneficial products or services. Furthermore, robots can be redesigned to make better use of renewable energy and materials. [Guido Bugmann et al]

The heavy-duty industrial robot industry is anticipated to rise by $3.78 bn between 2021-2025, according to a research. The low cost of components and the ease with which heavy-duty industrial robots may be adapted to construct smart assembly lines are driving the market. The Asia-Pacific region continues to dominate worldwide industrial robotics markets, with revenues anticipated to reach $25.08 bn, thanks to countries like China, Japan, and South Korea. Because of their usability, ease of installation, and continually falling price, collaborative robots are becoming an inexpensive and feasible choice for a wide range of applications. It is one of the most rapidly expanding-segments, with a compound yearly growth rate (CAGR) of more than 32%.

4. Conclusion

Through this paper we presented an overview of the advances and innovations that have occurred in the evolving field of rapid manufacturing over recent years. Our goal was to shed some light on the ever increasing role of robotics in the manufacturing industry. With reducing prices of robots and increasing ease of integration along with enhanced adaptability the industry is now witnessing a growing role of robots working in the production lines. As shown by the case studies the robots not only increase the productivity but also lower the cost of the final product. Furthermore, robotization helps organisations become more resilient to bad or adverse economic worldwide catastrophes like the COVID-19 pandemic. Providing organisations with the skills they need to be competitive in such difficult conditions and so avoid undesirable consequences.

This technological revolution has the potential to create a virtuous cycle of increased investment and productivity, with nations benefiting from production systems that are more suited to localised manufacturing. Despite the fact that some studies suggest that this could lead to higher structural unemployment and lower wages, the evidence suggests that as more low-wage jobs are automated and the prices of manufactured goods fall, consumers across the income spectrum will spend more on other goods and services, resulting in a demand for more middle and higher-wage jobs.

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