RESEARCH ARTICLE OPEN ACCESS

REVOLUTION OF INDUSTRY 4.0 IN THE MECHANICAL ENGINEERING MANUFACTURING SECTOR

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Abstract:

Since the human race was born, development has always been made. Until the end of the earth or the human species, this progress will not stop. In the information age of today, everyone is more connected and knowledgeable. More advancement for humanity will result from the idea of industry 4.0. This paper's goal is to examine how industry 4.0 and its constituent parts affect the manufacturing industry. It also examines how additive manufacturing supports industry 4.0 in real time.It is crucial to stress that the study for this specific issue is needed because the main work is case- or concept-based.After reading a number of research papers, this research study was put together to help readers have a better grasp of Industry 4.0 and its component technologies, such as IIoT, CPS, big data, and additive manufacturing.

Keywords **—CPS, IIoT, BIG DATA, INDUSTRY4.0, SMARTER MANUFACTURING.**

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I. INTRODUCTION

The productivity of both humans and robots is always increased by these improvements. Productivity has increased throughout each industrial revolution, from the first to the third. Industry 4.0 will be one of the most important items on this list. We shall have smart machines in this new era of industry 4.0. The self-awareness of this machine will allow it to make decisions based on the circumstances. There will be machine-to-machine, machine-to-human, and machine-to-system communication.

The German academy of sciences and engineering coined the phrase "industry 4.0," which was first used in this context. The fourth industrial revolution is known as "industry 4.0". The first industrial revolution was mostly driven by steam engines. The second was driven by electricity. The third was driven by IT and programmable logic controllers. Data, improved connection, and cyber-physical systems will power the fourth industrial revolution. Figure 1.0 depicts the progression of the industrial revolution. The methods of producing goods and services were altered by the fourth industrial revolution. Infrastructure will work along with the production system. The entire manufacturing process will be integrated, and full mass customization of the items is also a possibility. Industry 4.0 will have intelligent factories, intelligent services, and intelligent products.

In industry 4.0 we have lot of data which generated by machines, human, environmental. This data named as big data.The industry 4.0 will be data driven industry. We have lot of data with the help of this data we can take smart decision and also with the help of it we can operate predictivemaintenance. Our manufacturing system will be nearer to the customers. In industry 4.0, the entire system works together to boost the factory's productivity and efficiency. Industry 4.0 characteristics like CPS, IIoT, and big data have brought in a new era of innovation for the industrial sector. The machines will be intelligent and self-aware, and they will be connected to one another online.The business model will alter significantly as a result of industry 4.0. The optimal resource allocation will be made possible by industry 4.0.

We will allocate human resources more effectively and increase corporate profitability. Humans and machines will interact in industry 4.0. The entire landscape will soon shift due to the CPS and IIoT's rapid development. Industry 4.0 enables businesses to provide clients greater services and goods than they could have ever envisioned. It will be feasible to calculate the ever-changing product demand very well. The business environment has also changed the industry. Many new innovations will be brought to the industries by industry 4.0. With this new breakthrough, better products will be available at lower costs. The physical operation will be handled and controlled by a more effective algorithm. Everybody will have new opportunities thanks to industry 4.0.

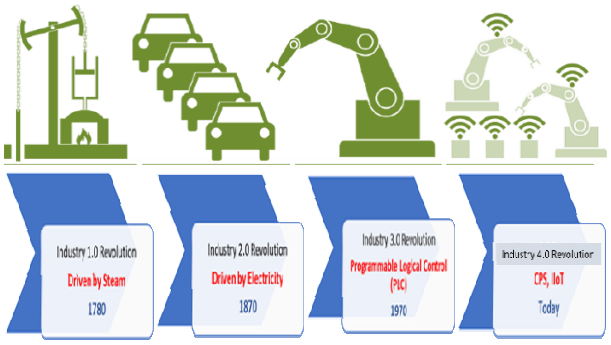

Fig.1 The overall industrial progress

II. SMARTER MANUFACTURING (SM)

Since the first industrial revolution, manufacturing techniques have undergone a significant change. Industries have been implementing new emerging technology regularly to improve their chances of surviving. Enhancing a manufacturer's ability to meet the specific needs of each client while simultaneously maintaining a very low production volume and making a profit has always been one of Industry 4.0's primary objectives. Many ideas, such as the factory-within-a-factory, have surfaced, greatly increasing production across a wide range of industries. Long-term objectives of smart manufacturinglarger global challenges, such as resource and energy efficiency, zero-waste production, and others are overcome, enabling firms to experience ongoing productivity and efficiency increases. In this smart manufacturing paradigm, the introduction of CPSs and Cyber-Physical Production Systems (CPPSs) is crucial. Today's engineers have access to a wide range of IT solutions, like CAx, Big Data, Cloud computing, and IoT, that can assist them in achieving these objectives. The technologies connected to SmarterManufacturing (SM) are split into five primary categories as shown in following fig. 2.

i. Design and Visualisation
ii. Smart Machining and Control
iii. Monitoring and production
iv. Cyber security and traceability
v. Metrology

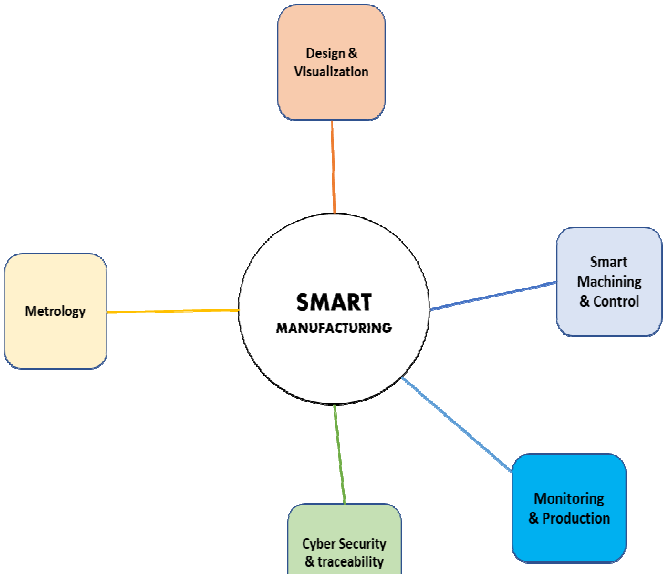

Fig. 2 Smarter Manufacturing Topology

III. CYBER PHYSICAL SYSTEM (CPS)

The United States National Science Foundation's Helen Gill first used the phrase "cyber-physical system" (CPS) in 2006. Key elements of industry 4.0 include cyber-physical systems. In a cyber-physical system, the cyber system will interact with the physical system to perform operations in the physical system while receiving data and

commands from the physical system. These days, CPSs are at the centre of industry 4.0. The integrations of physical, networking, and computational processes are known as CPSs. Physical processes are monitored and controlled by embedded computers and networks, with feedback loops affecting computations and vice versa.The cyber physical system is becoming more powerful and has more supercomputer power these days. A cyber-physical system collects data using sensors, and then uses an actuator to carry out an operation in a physical system.

There are currently some CPS gadgets available in our everyday environment, including smartphones. Every machine in the manufacturing sector will have a CPS system in the future. Only when we have better sensors and better actuators working together will the CPS system be practical. When CPS is present, the system becomes more intelligent, efficient, and productive. With the use of the CPS system, the product, machine, and staff can all be connected. High computational power plays a crucial role in CPS systems when completing actions through actuators.

IV. INDUSTRIAL INTERNETS OFTHINGS (IIoT)

The Industrial Internet of Things (IIoT), which ensures flexibility and adaptation of production systems and value chains in order to sustain the future global competitiveness of manufacturing firms, has received a lot of attention in practise and research during the past few years. IIoT will be crucial to the system. Every machine in an IIoT system will be connected to one another. The system will be integrated as a whole. Every equipment may communicate with the entire system through the internet and cloud systems with the aid of IIoT. With the aid of IIoT, a significant amount of machine-generated data can be transferred to thesystem.

The machine is controlled by the IIoT, which serves as a master.The production floor will be connected to the company's senior management through IIoT. the integration of system elements including clients, vendors, logistics, goods, and equipment. The IIoT interacts in real time. With the aid of IIoT, mass product customization is also a possibility. The industrial internet of things will assist us in lowering product costs. In the future, initiatives from all over the world emerged, such as the "HighTech Strategy 2020" in Germany or the "Industrial Internet Consortium" in the USA. These projects seek to create and implement the Industrial Internet of Things (IIoT), also known as "Industry 4.0" in the German-speaking world, in order to uphold and improve the individual industrial locations' competitiveness on a worldwide scale.

We can measure the environment in which a product is located after it is connected to a system. We can use that information moving forward to improve even more. The production process will be more accurate, dependable, and self-aware. The IIoT offers constant contact with customers so that we may maintain, monetize, and monitor the good or service. We can still keep track of a product after it has been sold by a business for future use. The IIoT enables us to gather all created data and use it for future enterprise resource planning. Every equipment and product in the IIoThave a unique IP address. This IP address indicates the location or state of the computer or the product.

V. BIG DATA

When we can integrate the entire system, big data plays a significant role in industry 4.0. These days, data is produced at rates that have never been seen before, largely because of improvements in cloud computing, the internet, mobile technology, and embedded sensors. We are able to save this information and go forward in search of a better problem-solving strategy. There has been a lot of data generation on the manufacturing floor in the past, but this data cannot come before other business solutions. Raw data from several production sites can be seamlessly aggregated because to technological advancements in sensing and networking.Utilizing and collecting big data could help businesses create eco-friendly products, consume less raw resources, and recycle more products.

The entire data set can be used for business resource planning. Big data is produced on the factory floor by each and every piece of machinery

and equipment. The Big Data solutions enable high-performance processing of enormous amounts of big data with a variety of characteristics, including volume, speed, variability, or validity. Big data analytics, which is able to generate one of the most profound trends in management and industry, is created by combining big data technology and analytics. We can reduce production time using big data analytics thanks to the big data. We can monitor the performance of the products in real time thanks to big data analytics. Big data will be of more use to us. Big data is also produced in real time by consumers. We will have data from both side from manufacturing and customer. The company management try to match the customer requirements with product. Customer base production will be possible in industry 4.0.The big data will help us too to do predictive maintenance of the machine. In production house we have in past experience-based problem solving but now we have data, evidences base approach at all.

VI. ADDITIVE MANUFACUTURING

Industry 4.0 and additive manufacturing both have the potential to offer consumers the best possible solution. A layer-by-layer process known as additive manufacturing (AM), often known as 3D printing, creates three-dimensional (3D) items directly from a digital model. A large number of things can be customised thanks to additive manufacturing. When compared to traditional manufacturing (TM) procedures, additive manufacturing (AM) offers distinctive capabilities to build complex, customised parts faster, lighter, and with less material waste. As connection advances in industry 4.0, we will be able to develop products that are customised for each customer. Both the customer and the machine will be nearby. The customer can create their own product and make an order in real time for 3d printing through the IIoT and CPS.

Traditional methods need a lot of tooling, are pricy, and take a long time. Nothing is necessary for 3D printing; all that is needed is a product design and an order. Real-time placement of the order is planned. The use of 3D printing and industry 4.0 allows customers to design and customise their own products as well as choose the colour, size, and shape. The potential for additive manufacturing is enormous in this new corporate environment. The machine known as here 3D printer will be able to communicate with the entire world or be operated from anywhere you have internet access in the future thanks to IIoT and cyber physical systems. The FMS technology is a logical answer to how the global market has changed, with greater emphasis now being placed on the idea of customization. In order to operate more nimbly and satisfy various market segments, businesses must adapt to the environment in which they operate.

VII. CONCLUSION

Industry 4.0 will present us with new opportunities. Enterprises will benefit from new developments. New changes will be made to our entire way of life. The customer will receive cutting-edge services and clever goods. The importance of the IIoT, CPS, big data, and other elements that have an impact on our production system are highlighted in this article. The topic of additive manufacturing in industry 4.0 is also addressed here.

The IIoT and cyber physical system will have an impact on our machinery. This paper will aid readers in better understanding of industry 4.0. Industry 4.0 inculcates new energy in the manufacturing industry. The organisation can produce items very efficiently and economically, thanks to the convergence of the three essential components- CPS, IIoT, and big data. An industry 4.0 factory might see a 10 to 20% reduction in production costs.

VIII. ACKNOWLEDGMENT

I want to express my gratitude to the Mechanical Engineering Department of SSIET for helping and inspiring me to publish this paper.

I would like to thank Prof. R. C. Bhedasgaonkar for his helpful suggestions and for volunteering his time during this paper work.

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