

A Review on Industry 5.0: The Techno-Social Revolution

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Abstract

Industry 4.0 has brought great advancement in Industries. Productivity, quality and transparency in technologies was boosted appreciably. But with these there were few factors which were left behind and which have abrupt effect on human and environment. Due to this there is need of next revolution i.e., Industry 5.0. This revolution will deal with all such factors along with incorporating Industry 4.0. Industry 5.0 will be more value driven revolution rather than technology driven. This paper through literature survey deals with how Industry 4.0 and Industry 5.0 are different still co-related to each other. For every revolution, it is necessary to have awareness and understanding of the topic so we intend to put a light on industry 5.0 which will boost the new industrial revolution i.e., Industry 5.0.

Keywords: *Industry 4.0, Industry 5.0, human-centric, sustainability*

1. INTRODUCTION

Understanding Industry 5.0

Industry 3.0 was based on automating the system to accomplish the human job, which was solely concentrated on the automation of a single machine and process. However, the process required human inputs and there was need that machines will operate independently. And thus, revolution took place from Industry 3.0 to Industry 4.0. The fourth Industrial revolution has taken manufacturing process to the next level with the implementation of digitalized and flexible mass production. [1] [2]

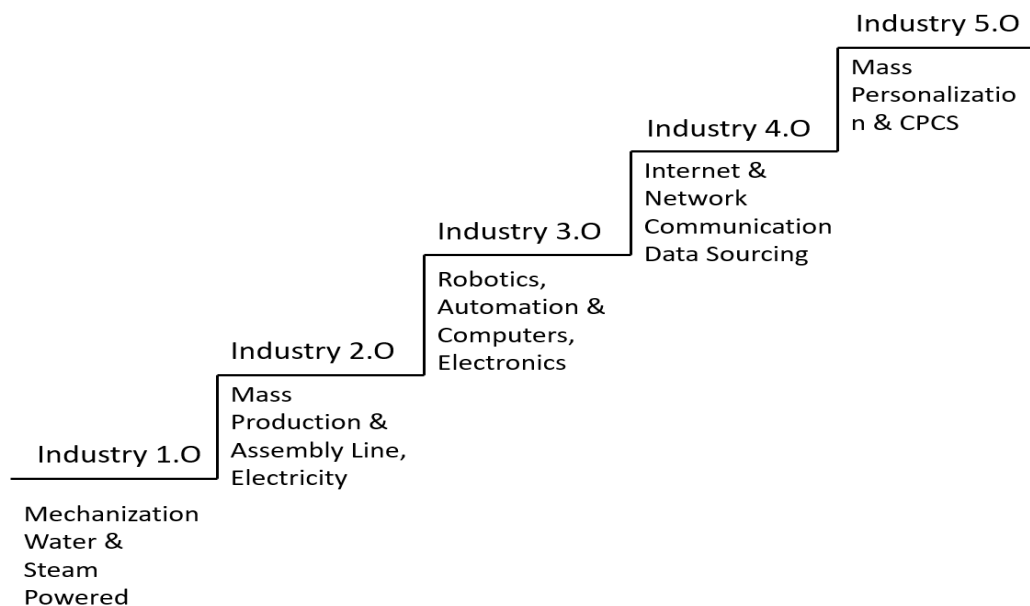


Figure 1: Roadmap of Industrial Revolution

Using technologies like Industrial Internet of Things (IIOT), Automation, Artificial Intelligence and Machine Learning and Simulations, the Industry 4.0 has brought smart factories into existence. This revolution brought great advancement in productivity, quality and transparency in technologies. Hence it was called the technology and profit-driven revolution. Along with such advancement there were few things which are supposed to be addressed. [3] It left behind social and environmental sustainability, the result of which there was unemployment, and limited natural resources depletion. Moreover, the technologies used in industries for production are not customized based and there is repeatability in production of particular products and if any error in process of production occurs it is rectified directly in Quality Check process, thus there is loss of time and material. Consequently, there is a

need for an industrial revolution that would conserve the values such as social and environmental sustainability in check. The industry 5.0 would be value driven instead of technology driven. It will focus on the social and environmental sustainability by keeping human at the core of process. Human will be adding significance in creative and innovative solutions rather than doing monotonous job. Industry 5.0 is the first revolution which would use the previous industries technological infrastructure as a base and adding its principal to core. [4] [5]

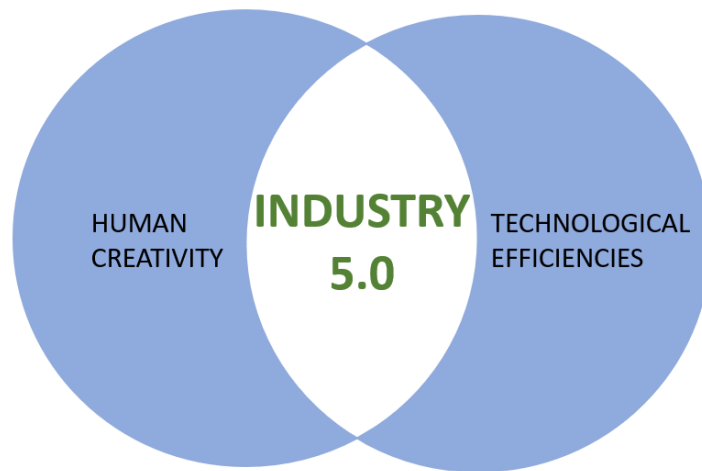


Figure 2: Foundations of INDUSTRY 5.0

2. NEED FOR A NEW REVOLUTION

Better, not cheaper, Industry 4.0's so-called motto strives for the socio-technical approach but the fact that smart factories have to be configured with complex, dynamic, and flexible systems was not achieved in Industry 4.0. [6] [7] So, in Industry 5.0 empowerment of employees to act as controllers and decision-makers. Industry 5.0's human-centric and resilient approach complements the existing industry 4.0 paradigm. This revolution will promote employees' diversity, talents, and innovation and lead to a sustainable environment and make technology more agile and adaptable. [8] [9]

3. TECHNOLOGICAL FOUNDATIONS

As the industry 5.0 is the enhanced version of industry 4.0, the added features of this revolution made the working environment smart. In industry 5.0 smart additive manufacturing approach will make the processes cost-effective by executing development plans and utilizing the resources throughout the lifecycle of development. [8]

3.1 Human-Robot correlation

In industry 5.0 the main focus was to bring back the human touch into production and development. This human-robot collaboration will help perform laborious tasks with much ease and introduce a high degree of control. This collaboration will create long-term and high-value careers. Ensuring consistency of flow, quality, and data collection is achieved due to this collaboration. [10] [11]

3.2 Artificial intelligence & Machine learning

Artificial intelligence and machine learning are the two technologies which are interdependent and being researched and developed since a long time. It has the capability to contribute in each and every aspect of industry that is supply-chain, production, research and design. Use of artificial intelligence can significantly improve the quality and standards of any industry. Industry 5.0 aims to make use of AI /ML to understand human needs and be able to predict impact on environment while adapting to the existing condition. [12] [13]

3.3 Internet of Everything

The Internet of Everything can be defined as the expansion or extension of the internet of things because it not only emphasizes on machine-to-machine communication but also includes a machine to people communication. It also focuses on people-to-people communication which be supported by the technology. The concept of the Internet of everything was first introduced by Cisco, which defines "The Internet of Everything (IoE) brings together people, process, data, and things to make networked connections more relevant and valuable than ever before-turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries" [14] [15].

3.4 Digital Twins

Digital Twin in simple terms is the twin virtual 3D model of the physical model, which collects the data from the actual physical model to examine, diagnose and prognostic which helps in the continual improvement of the model design. It also helps in finding

the issue in the physical model and further optimize the performance, quality and project the future measure damage, which will help in preventing it. [16]

3.5 Blockchain

Blockchain is one of the latest technologies which itself has the capacity to revolutionize the whole industry. Blockchain works on a distributed ledger dismissing the commonly used centralized database system. It can be used for creation of smart contracts which would lead transparency and will help in establishing trust within the industry. It could also help to promote distributed ownership through advancement in the technology. [17]

3.6 Bigdata

As we are advancing in time, we are entering a new era of industrialization with big data analytics techniques. Industry 5.0 is likely to harness big data and extreme automation with innovative, adaptable technology policy along with safe and responsibly implemented science. This will not only create a smart factory but also bring high-tech strategies in the sector. The Important 5 V's of Big Data variety, velocity, value, volume, and veracity had made it have great impact in present industry. [18] [19] [20]

In transitional phase from Industry 4.0 to Industry 5.0, Big Data has been gaining a huge attraction in academia as well as industry. [8] [19] Big data is representing a diverse and large set of information collected from various sources. Artificial Intelligence, Machine Learning, Data Fusion, data mining and many other data analysis techniques include big data technology. In industry 5.0 to optimize product prices, increase productivity and reduce overall cost many industries make use of big data analytics as it helps to known consumer behavior easily. With the available resources Big Data Analytics helps in creating mass customization processes. Continuous Improvement in process is a critical challenge as it requires a detailed information of that manufacturing cycle. Big Data Analytics techniques are easily able to recognize and remove unnecessary things to maximize predictability and explore new opportunities. [19] [8]

3.7 Cloud computing

Along with all above mentioned technologies cloud computing plays an important role in creating an advance and a smart working environment in Industry 5.0. Cloud computing is providing new opportunities to create smart manufacturing vision by creating new openings in infrastructural, system and connectivity. This technology will together not only connect a limited area but connect a large network and make a flexible and sustainable environment. [21] [22]

4. PILLARS FOR THE FIFTH REVOLUTION

The fourth industrial revolution majorly focused on the creation of setups that are interconnected and capable of complete automation. In short, the core value of Industry 4.0 was to make use of technology to increase production and profits. However, the fifth revolution still focuses on the same, but the principle or pillars are flipped over their heads to focus more on achieving sustainability, resilience, and putting humans at the core by taking the aid of technologies. The idea of the industries should be value-driven and profits are the byproduct. Industry 5.0 does not wish to be the next chronological revolution but to co-exist with 4.0

4.1 Human-centric

With the digitalization and automation of setup in the industry, the loss of human touch was observed. However, with industry 5.0 the idea is to bring back human intelligence to the forefront. It wishes to make use of human creativity, innovation, and judgment to even out the drawbacks of technology-driven industries. It is seen that the industry driven by human technology collaboration performs better than the industry driven by either commodity. With Industry 5.0 it is time to see employees as assets rather than an expense. [23] [11]

4.2 Environmental sustainability

Industry 5.0 wishes to promote techniques that lessen the hazardous impacts on nature. The revolutions preceding the fifth revolution never put working on a sustainable environment as their goal. Industries could be set up in such a way that they produce minimal waste. Circular manufacturing and the use of renewable energy sources are also viable options. Along with this use of Smart materials and bio-inspired technologies must also be promoted.

4.3 Social Sustainability

Society saw the adverse effect of the pandemic when the world came to a standstill. There was a lot of strain on the pockets of the common man as certain businesses stopped which led to the belief for needing a sustainable society that could thrive through the difficult times. Industry 5.0 aims at completely eradicating the 9-5 work culture. With the help of technology, the idea is to reduce tedious and repetitive tasks carried out by people so that they can work for the betterment of society. People should have a chance to explore their creativity and innovation to start a side hustle that could contribute to the growth and prosperity of society.

4.4 Resilience

As the technologies are helping to interconnect and make the setups more accessible so it is often prone to various threat. The idea is to develop setups which will be able to resist the drastic effect on the system and if needed be able to adapt to sudden changes. [24]

5. RESEARCH GAP

The further research is required in the following aspects to enable industry 5.0

5.1 Society Sustainability

As industry 5.0 is value driven there are still some gaps that are yet to be fulfilled. The man power which is required is needed to be highly skilled in terms of technological advances, because their role is to create and innovate the unique product for customized personalized experience.

5.2 Environmental Sustainability

There is lack of research and development in the innovation of smart materials which would help us reduce the use of non-biodegradable materials which has adverse effect on the environment.

Use of conventional sources of energy has its own limitation and their effects on environment which are proven to be hazardous. Hence, we need to use non-conventional source of renewable energy. But the technology and the infrastructure required is not up to the mark as a result we can't enable the use of these energy on the large scale effectively and efficiently. [25]

5.3 Technological Development.

Even though Industry 5.0 will be using the technology of Industry 4.0, still there are some gaps that are need to be filled of technologies such Block Chain, Internet of Everything and Big Data Analytics to achieve the goal of personalized mass production. Technologies such as Blockchain and internet of everything is relatively new and there is an extensive research required for its implementation. [25]

6. CONCLUSION

- Industry 5.0 is a new enhanced version of the industry 4.0
- The modern and advanced technology of Industry 5.0 has brought the research frontier to a new era of human and society-driven paradigms
- These changes in the industry will have a great impact in many industries hence ensuring sustainable, flexible, and agile development in the socio-economical dimension has been the main focus of the industrial revolution.
- A personalized custom manufacturing vision in industry5.0 is deeply benefited and rooted in the technical breakthroughs of Industry 4.0.
- As the human touch has been given the main focus in this revolution a smart human-machine environment with increasing research will make work more optimized and flexible.

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