

Industry 4.0 to Industry 5.0: A Paradigm Shift towards Sustainable and Human-Centric Production

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Abstract

During the period of the Industry 4.0 revolution which was started in 2011 with the aim of various benefits in the form of mass production and initiation of robot mechanization during the more than 10 years of life span. In spite of the benefits, there are many shortcomings in the Industry 4.0 revolution. Finally, the Industry 5.0 revolution has taken place for the development of industry life with the help of new developments in the industry revolution. The industrial fifth revolution is known as Industry 5.0. The term Industry 5.0 refers to people working with robots and smart machines. It involves robots assisting humans in working more efficiently by utilizing advancements in technology, such as big data analytics. This paper discusses the development of all industrial revolutions and differentiates between Industry 4.0 and Industry 5.0. The technologies adopted by Industry 5.0 are analytics of big data, the Internet of Things, Collaborative robots, Blockchain, digital twins, and future 6G systems are discussed in this article. Industry 5.0 outlined three primary pillars-human-centric, resilient, and sustainable. Every business strategy is anticipated to be impacted by all three of them. The creative applications Industry 5.0 involved are Disaster Recovery Management Plans, Smart Education, Supply Chain Management, Smart Hospital, Cloud Environment, and Production Management.

KEYWORDS: *Industry 5.0, Industry 4.0, Digitalisation, Artificial Intelligence, Cloud Environment, Smart Hospital*

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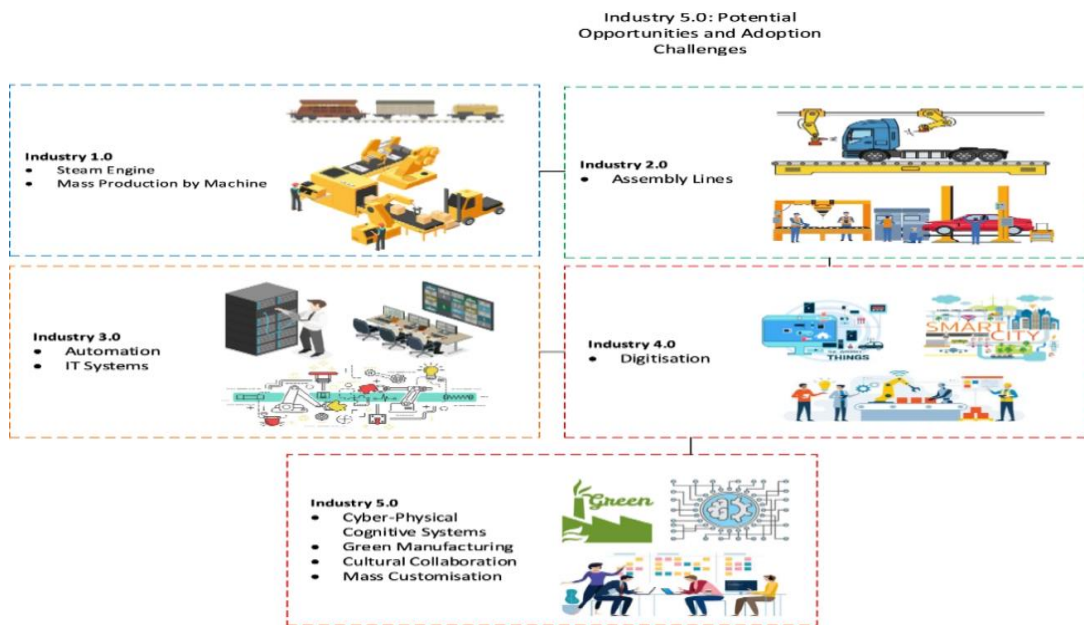
Introduction

The fifth industrial revolution is referred to as Industry 5.0. In this phase of industrialization, the workplace process is enhanced with the use of AI and advanced technology by the employees. This revolution is more human-centric than the previous one. Here the mainly focus is on the sustainability of the industry. Extending beyond manufacturing, this new phase builds on the fourth Industrial Revolution (Industry 4.0) and is driven by advancements in Information Technology (I.T), encompassing technologies such as big data analytics, artificial intelligence, the Internet of Things (IoT), automation, machine learning, robotics, smart systems, and virtualization. Industry 5.0 represents the next stage of industrial development, aiming to create a more collaborative and flexible manufacturing environment by integrating human creativity and intuition with advanced technologies.

Table 1 shows the Revolution of industries from Industry 1.0 to Industry 5.0. Industry 1.0 was started in 1784 with the objective of steam and water power which was the initial source of power generated to pull down/ functioning any type of machines existing in the industry premises during that period. There was the priority of research in the revolution of Industry 1.0 and advised time to time go further research for modernization of power systems and alternative source of power for operation of different kinds of machines and their various capacities. The second Industry Revolution was initiated in 1870 year after 86

years of industry 1.0. During the 2nd Industrial Revolution, electricity power took the place of water and steam power. During the 2nd Industrial Revolution most of the machines manufactured which were operating with the help of electricity power without any types of problems and produced more than targeted production with the smooth-running machinery by electricity power in this period and produced a higher quantity of production. Industry 3.0 was started in 1969 and automatization has taken place as an innovation that helped in the machine operating system and most of the machines connected with computer automatic controlling system which was a new era in Industrial development. It is also interesting to mention here that the formation of robots was initiated during the era of Industry 3.0. Industry 4.0 innovation was initiated in 2011 and digitalization has taken place for operating machines and manufacturing different types of tools, machines, and technologies. The Industry 5.0 renovation is a new development that will take place in the Industry with the establishment of a major field of customization and cyber-physical cognitive systems of revolution and auto-recoding data for further studies and future research.

Figure 1: Evaluation of the Industrial Revolution



Source: www.twi.global.com

Table 2 shows the difference between Industry 4.0 and Industry 5.0 phases taken place in the Industrial Revolution at different points. The major five points differentiate the above table i.e. motto, motivation, power source, involved technologies, and involved research area among Industry 4.0 and Industry 5.0. The motto of Industry 5.0 is to introduce bio-economy which is directly related to environmental concern which was not in Industry 4.0. The second motivational point is understanding the level of production would be maintained during Industry 5.0 while it was not in Industry 4.0. Under the point of source of power, there is not much difference between Industry 4.0 and Industry 5.0. The technologies involved are also one of the major points in which the sustainability of agricultural production bionics, renewable resources, and human-robot coordination are new areas that taken place in Industry 5.0 which was absent

in Industry 4.0. It is interesting to mention here that the research area in Industry Phase 5.0 revolution was extended to agriculture, biology and waste prevention, process innovation and improvement, and business administration were the fields of research in Industry 4.0 renovation. It is also included in Industry 5.0.

Table 1: Industrial Revolution and their Area of Research and Innovation

Industrial Revolution	Year	Innovation	Research area involved
Industry 1.0	1784	Water and steam	Modernization and the introduction of steam and water power
Industry 2.0	1870	Electricity	Mass Production Assembly lines using Electricity
Industry 3.0	1969	Automation	Automated production, computer IT systems, and robotics
Industry 4.0	2011(Today)	Digitalization	The smart factory, autonomous system, IoT, machine
Industry 5.0	Tomorrow	Societal	Man, customization, and cyber-physical cognitive systems

Source: Research Nester

Table 2: Comparison of Industry 4.0 and Industry 5.0

Point of Difference	Industry 4.0	Industry 5.0
Motto	Smart Factory	Bio-economy
Motivation	Mass Production	Sustainability
Power source	Electric Power -Fossil-based Fuel -Renewable power source	Electric power -Renewable power sources
Involved Technologies	-Internet of Things (IoT) -Cloud Computing -Big Data -Robotics and Artificial Intelligence (AI)	-Sustainability of Agricultural Production -Bionics -Renewable Resources -Human-Robot Coordination
Involved Research Area	-Organisational Research -Process Innovation and Improvement -Business Administrative	-Agriculture -Biology -Waste Prevention -Organisational Research -Process Innovation and Improvement -Business Administrative

Research Questions

1. Is there further scope for the development of industry research in the field of source of power and implementation in another field of mechanization which may help the man kinds in different directions?

Research Objectives

1. To see the technology of Industry 5.0 Revolution and their applications.
2. To study the changes in the adoption of technologies Industry 5.0 over Industry 4.0.
3. To find out the challenges faced by the Industry chain revolution (Industry 1.0 to Industry 5.0) and the adoption of new technologies and techniques of Industry 5.0

Research Methodology

The present study is based on secondary data collected from different internet websites related to different phases of the revolution taking place in the field of industry development and in the renovation in light of innovation coming out in industry development at national and international levels. The information/data are classified based on different industry eras that took place in the different phases of the industry revolution. The fifth revolution represents the next generation of the Industrial Revolution. The revolution and development focus on three strategies, Human-centric, Resilience, and Sustainability.

Figure 2: Strategies of Industry 5.0



Source: <https://www.twi.global.com>

1) Human-Centric: In Industry 5.0 involves strategy in which the employees are considered as real assets of the organization. In return, the employees work for the organization and the organization works for the employees. Thus, employee talent is leveraged to gain a competitive edge and provide value to customers. Industry 5.0 also enhances value for workers, helping to attract and retain top talent within the organization.

2) Resilience: Over the years, the entire world has become interconnected, and we have seen the effects of global issues, such as during the COVID-19 pandemic and international supply shortages. While some businesses aimed to improve efficiencies and optimize profits, these efforts did not necessarily enhance resilience. It is believed that focusing on agility and flexibility can make companies less resilient, not more. Instead of prioritizing growth, profit, and efficiency, a more resilient organization would strive to anticipate and respond to crises, ensuring stability during challenging times.

3) Sustainability: Industry 5.0 shifts from merely reducing, minimizing, or mitigating climate damage to actively pursuing positive change. Often called "net positive," this goal aims to improve conditions by providing solutions rather than contributing to problems, and by achieving sustainability goals without resorting to greenwashing.

Figure 3: Industry 5.0 Creative Application



Source: <https://www.twi.global.com>

1) Disaster Recovery Management Plan: A disaster recovery plan involves the process of resuming normal business operations, recovering or salvaging essential and other important records and instruments, and guiding managers and employees during and after a disaster. The plan's key elements fall into three categories: those common to all sections, those primarily focused on business resumption, and those mainly concerned with reconstruction.

2) Smart Education: The essential elements in smart education -are smart environment, smart pedagogy, and smart learner. Smart education emphasizes the ideology of pursuing better education and thus had better be renamed as smarter education, which addresses the need for smart pedagogies as a methodological issue and smart learning environment as a technological issue, and advances the educational goals to cultivate smart learners as a result. [Zhu et al. Smart Learning Environment (2016)]

3) Supply Chain Management: Implementing Industry 5.0 in manufacturing and supply chain can be a challenging process, but it can also be highly beneficial for companies that are looking to innovate become more sustainable, and remain competitive. Industry 5.0 will require a greater emphasis on creativity in supply chain planning. Supply Chain planners will need to be able to think of new ideas and approaches to optimize manufacturing and supply chain processes. This will require a shift in mindset from traditional planning methods to more innovative and agile approaches.

4) Smart Hospital: A smart hospital deploys AI, IoT, 5G Network and other technologies advances from edge to cloud to seamlessly coordinate and align operations for accelerated and enhanced patient care. Smart hospitals are built upon innovative technologies to improve the care quality of patients. It includes

Ultra-modern hospital design and the latest visual care technology, support for AI-based decision-making, IoT-connected sensors, and robots to recreate how to deliver care across digitally connected devices and platforms. At a smart hospital, people, the environment, and the system are connected in real time. In smart hospitals, digital clinical staff will be able to provide better outcomes and more integrated patient experience while continuously innovating in the delivery of care.

5) Cloud Environment: A Cloud Environment is a set of systems and processes acting together to provide services in a manner that is disassociated with the underlying specific hardware or software used for such purpose and includes Hybrid clouds, private clouds, public clouds, and community clouds, as defined by NISP (*National Innovation and Start-up Policy*) special publication 800-145.

6) Production Management: Industry 5.0 represents the future of manufacturing. It has the potential to revolutionize the industry once again by creating a more efficient, flexible, and sustainable manufacturing process. However, it is important for manufacturing facilities to address the challenges and risks associated with Industry 5.0. Proper training, cyber security measures, and regulatory framework will be crucial to ensure the success of Industry 5.0

Figure 4: Industry 5.0 Technologies



Source: Future of Industry 5.0 in society: human-centric solutions, challenges and prospective research areas

Opportunities

1. Industry 5.0 generates a new kind of job opportunities such as innovative and creative thinking technology involvement, managing COBOTs, creating artificial algorithms, and many more.
2. Opportunities faced by adopted technology 5.0 -Binaural Beats, smart infrastructure, smart clothing, clean energy, and Intelligent transport.

Limitations

It is difficult to see the limitation of Industry 5.0, but the challenges will be how the organization are able to adopt new information concept that able to become more human-centric i.e. human-machine collaboration and it requires highly skilled worker have complete digital knowledge to adapt and able to adjustable in new technology.

1. Due to a lack of financial support at the government level, the new technologies that would be available in Industry 5.0 may not be adopted by the users' companies or industries.
2. Costly new technologies may also not be adoptable by the companies or firms.
3. The lack of experienced manpower will be the major limitation of the new innovations developed Industry 5.0 revolutions.
4. Only low-cost, new innovations may be more feasible /adoptable at small-scale industries level which is not suitable to the large industries.

Findings

Industry is a key parameter of the development of any country because there are many types of work which is totally impossible by a human being but it is possible to complete that hard work with the help of machines, tools, and other accessories small machines. That is why Industrial development plays a vital role in the development of any country as well as the global world. Fortunately, the Industry 1.0 revolution was initiated during 1784 for development in the field of different types of machinery which help in various kinds of works in the field as well as in the industry where many kinds of production and innovations are going on.

The Industrial Revolution passes through Industry 1.0 to 4.0 with the development of different types of power forces, new innovations and also new research outcomes. However, the current, Industry Revolution reached up to Industry 5.0 revolution era with the aim to introduce /develop different fields in mechanization, electrification, electronics, computerization, digitalization and so on. The primary focus of the current manuscript is to examine the similarities and emerging research areas in the Industry 5.0 revolution compared to Industry 4.0. It aims to address the shortcomings of the previous industrial revolution by exploring new research challenges and solutions through the development of advanced techniques and machinery in the Industry 5.0 era. The main research work is initiated and takes place with the major research field- Man, customization, and cyber-physical cognitive systems.

Conclusions

Industry 5.0 marks the next stage of the industrial revolution, striving to merge human intelligence with cutting-edge technology to develop highly efficient and sustainable manufacturing processes. Leveraging advanced technologies like artificial intelligence, robotics, and the Internet of Things, it opens up new opportunities for growth and innovation in the coming years.

References

- Adel, A. (2022). Future of Industry 5.0 in society: human-centric solutions, challenges, and prospective research areas. *Journal of Cloud Computing*, 11(1), 40.
- Akundi, A., Euresti, D., Luna, S., Ankobiah, W., Lopes, A., Edinbarough, I. (2022). State of Industry 5.0-Analysis and Identification of Current Research Trends. *Applied System Innovation*, 5(1), DOI: 10.3390/asi5010027.
- Bakir, A., Dahlan, M. (2022). Higher education leadership and curricular design in industry5.0 environment: a cursory glance. *Development and Learning in Organizations*.
- Cillo, V., Gregori, G.L., Daniele, L.M., Caputo, F., Bitbol-Saba, N. (2022). Rethinking companies' culture through a knowledge management lens during the Industry 5.0 transition. *Journal of Knowledge Management*, 26(10), 2485-2498.
- Di Marino, C., Rega, A., Vitolo, F., Patalano, S. (2023). Enhancing Human-Robot Collaboration in the Industry 5.0 Context: Workplace Layout Prototyping. *Lecture Notes in Mechanical Engineering*, 454-465.
- Drozd, R., Wolniak, R. (2021). Systematic assessment of product quality. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(4), 1-12.
- Gajdzik, B., Grebski, M., Grebski, W., Wolniak, R. (2022). Human factor activity in lean management and quality management. Toruń: Towarzystwo Naukowe Organizacji Kierownictwa. Dom Organizatora.
- <https://journalofcloudcomputing.springeropen.com/articles/10.1186/s13677-022-00314-5>
- <https://www.twi.global.com>
- <https://www.intel.com/content/www/us/en/healthcare-it/smart-hospital.html>
- https://www.linkedin.com/signup/coldjoin?session_redirect=%2Fpulse%2Fimplementing-industry-50-its-impacts-supply-chain-badulescu-ph-d&trk=article-ssr-frontend-pulse_x-social-details_like-toggle_like-cta
- <https://www.umsystem.edu/ums/fa/management/records/disaster-prepare/>