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Industry 5.0 Revolution towards an Imminent Future Driven Society

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Abstract - *The Industry 5.0 system is analogous to a system in which machines provide services and communicate information with products in real-time. It offers numerous capabilities that aid in any system's automation, monitoring, and diagnostics. It is a process for transitioning from dominating machine production to digital manufacturing. The Industry 5.0 standard must be thoroughly understood to achieve a successful transformation, and a detailed road map must be developed and implemented. Several approaches and conversations are now underway to produce roadmaps, some of which are discussed in this paper. Evaluating Industry 5.0 components and features is critical for defining the fundamental pillars of a concrete future manufacturing environment as well as a specific ranking position in India. This study aims to describe, examine, and compare some of the most promising existing methodologies for calculating national Industry 5.0 readiness.*

Key Words: Augmented reality and simulation, IoT, CII, Cloud Computing, GCI.

1. INTRODUCTION

Every moment in the world is changing so quickly due to human activity. The entire manufacturing and production flora and fauna are through a tremendous change with current modifications in technical advancements (Bag et al., 2021). The necessity to recognize and use modern manufacturing mechanisms has become urgent. The phrase 'Industry 4.0' refers to a smart mechanism in which smart digital devices are networked and communicate with raw materials, work-in-process items, finished goods, machines, tools, techniques, automation, and robots (Chauhan et al., 2021; Esmaeilian et al., 2020). According to (Giovanni & Cariola, 2020), this industry is distinguished by its adaptability, efficient resource utilization, and integration of customers and business partners into the business process. Industry 5.0 has proven its importance and necessity in several fields of human endeavor in recent times. Automation, machine learning, and deep learning are essential drivers of numerous technological innovations gaining traction in every area. Furthermore, the Japanese have taken this ambition further by including Society 5.0 in the 5th Science and Technology Basic Plan. It is a human-centred civilization that combines economic growth with social problem solving through a system that blends online and physical space. The evolution of society has been classified as a hunting society, an agricultural society, an industrial society, an information society, and a super-smart society (Gupta et al., 2021; Kumar & Dadhich, 2014).

Small and medium-sized firms (SMEs) are the backbone of the economy in many nations since they generate jobs, convert goods and services, and ultimately contribute significantly to GDP (Dadhich, 2017a; Industry & What, 2016). The current industrial expansion has lasted many decades, and we are now living in the age of Industry 5.0. Germans first proposed the concept of Industry 5.0 in 2011 (see figure 1). (Giovanni & Cariola, 2020) discovered that the first industrial revolution began in the latter half of the 18th century. This reform was distinguished by the automation of stranded machinery and the use of steam power. The second phase, which began in the early twentieth century, is distinguished by group labor production based on electrical energy. The third stage of the revolution began in the 1970s, with the defining traits of scheduled production ashore in new internet-related technology. Eventually, Industry 5.0 will include characteristics such as Cyber-Physical System production, which is based on big data and knowledge transformation (Dadhich, 2017b; Gupta et al., 2021). In the recent past, Industry 5.0 has been associated with baskets of technologies and related patterns, such as real-time manufacturing, IoT, augmented reality, simulation, and social product advancement (Kamble et al., 2018).

The current study fills the gaps by thoroughly reviewing research publications from various journals and conferences on the issue of Industry 5.0, making it easier for enterprises to prepare for the future. Organizational structure and procedure strengthen the favorable association between Industry 5.0 and IT adoption. Several studies have shown that the expansion of sustainable corporate performance is dependent on innovation, and Industry 5.0 is one of them. Industry 5.0 elements are heavily influenced by modern concepts such as big data, automation, virtual reality, the AI-ML-DL, IoT and smart factories (Kannan, 2021).

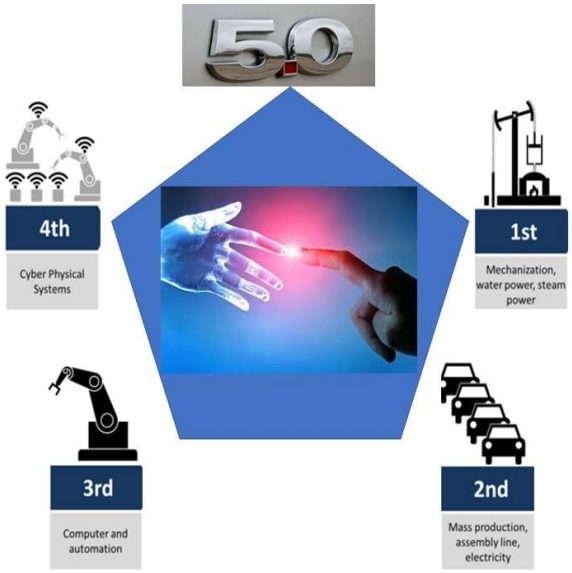

Fig -1: Phases of Industry 5.0 (Kannan, 2021)

2. RESEARCH METHODOLOGY

The current study is a theoretical modal based on substantial investigation using only secondary sources of knowledge. Journals, periodicals, annual reports, white papers, and novels are among the sources. The primary methodology employed in this essay is that of literary analysis.

3. RATIONALE OF THE STUDY

The economic ramifications of the epidemic are already having an enormous impact on the world. It is too early to predict how much worldwide economic damage Covid-19 will cause in the current setting. The momentum has begun in social distance, quarantine, lockdown, and working from home, but it will undoubtedly impede regular corporate growth on a vast scale (Kiraz et al., 2020; Kumar Naresh, Dadhich Manish, 2014). According to OECD estimates, the lockout will directly impact industries accounting for up to one-third of GDP in the main nations. Each month of containment will result in a 2% drop in the annual Gross Domestic Product. The tourism industry alone has seen a massive drop, and many economies are sensing the looming recession. This is unavoidable, and there is a need to continue fighting the pandemic as international organizations work to restore economic normalcy as quickly as possible. 'Coming events cast their shadow before them' appears to be true in the current global crises resulting from this pandemic occurrence. Every business will experience a severe breakdown, particularly retail and wholesale trade, real estate services, automobiles, airlines, service sectors, agriculture, and associated businesses (Chauhan et al., 2021; da Silva Rabêlo & de Azevedo Melo, 2019; Dadhich et al., 2020). As a result, an optimal solution must be found using well-defined problems and their repercussions. It is also important to consider the consequences of this epidemic by using new techniques and means of Industry 5.0 to deal with the global meltdown.

4. OBJECTIVES OF THE STUDY

The primary goal of this research is to investigate Industry 5.0 techniques to increase economic growth following a pandemic. The research report also dives into analyzing and summarizing readiness indices to reach a relevant conclusion with an important guideline for the development of further analyses, namely, how Industry 5.0 can alter the economic game plan. This work also seeks to integrate the available literature reviews on the topic and provide them in a way that researchers and academics may focus on, develop their expertise on the topic, and recommend opportunities for future research.

5. MAJOR COMPONENTS OF INDUSTRY 5.0

The primary goal of this research is to investigate Industry 5.0 techniques to increase economic growth following a pandemic. The research report also dives into analyzing and summarizing readiness indices to reach a relevant conclusion with an important guideline for the development of further analyses, namely, how Industry 5.0 can alter the economic game plan. This work also seeks to integrate the available literature reviews on the topic and provide them in a way that researchers and academics may focus on, develop their expertise on the topic, and recommend opportunities for future research.

5.1 Big Data

Big data is the data that is generated continually by everything in the current context. Every digital operation and social media interaction generates a massive amount of data. These data are transmitted by systems, sensors, and mobile devices over a cloud-based network infrastructure (Naresh Kumar, 2016). Big data is pouring in from all directions at breakneck speed, volume, and variety. To extract real value from big data, adequate processing capacity, analytics capabilities, and information management skills are required.

5.2 Smart Factories

Smart manufacturing aims to optimize production and product interactions by shifting from old methods to digitized and autonomous systems. When manufacturing is defined as the multi-phased process of making a product from raw materials, smart manufacturing is the subset that uses computer control and high levels of adaptability to do so. It intends to use modern information and manufacturing technologies to enable physical process flexibility to function in a highly dynamic and global market (Dadhich et al., 2019). The purpose of a Smart Factory is to develop fully flexible production at the fastest possible speed, which necessitates

a comprehensive transformation from traditional methods to innovative technologies.

5.3 Cloud Computing

The cloud is utilized for various purposes, including remote services, color management, and performance evaluation. It has captured the attention of the information technology community, and its influence in other business areas will only rise. As technology advances, machines, data management, and functionality will continue to migrate from traditional ways to cloud-based solutions (Bortolini et al., 2016; Dadhich, 2017a; Esmaeilian et al., 2020). The cloud enables considerably faster than standalone system delivery, quick updates, up-to-date performance models, and other delivery choices. The sector has experienced a significant shift toward using cloud solutions, which will continue to increase and challenge existing data storage methods. Cloud technology is the most basic online storage service, offering operational simplicity through web-based apps that do not require installation (Industry & What, 2016). Cloud computing lowers costs, decreases infrastructure complexity, expands the work area, safeguards data, and enables instant access to information. The system primarily uses four types of clouds: public cloud, private cloud, hybrid cloud, and community cloud (Dadhich et al., 2022).

5.4 Machine to machine (M2M) Communication

It refers to continuous communication between devices via any channel, wired or wireless. Machine-to-machine communication can include industrial instrumentation, which allows a sensor to exchange data with application software (Esmaeilian et al., 2020; Rakesh Kumar Birda & Manish Dadhich, 2019). This type of communication was performed by having a distributed network of equipment transmit data back to an innermost hub for analysis, which was then diverted to a personal computer. M2M is a technology that enables businesses to establish wireless connectivity between data centres and equipment.

5.5 Internet of things (IoT)

The network is made up of physical devices, vehicles, and structures embedded with electronics, software, sensors, actuators, and network connectivity, allowing these items to facilitate and transform data. It has four key layers: Perception Layer, Network Layer, Support Layer, and Application Layer (Chaâri et al., 2016; Dadhich et al., 2021). IoT and Industry 5.0 are concepts that are closely related. More effective working environments are generated because IoT-enabled manufacturing systems are linked to web-based technologies. This also encourages major standards to play a role in creating new optimizations and tactics. Manufacturing systems based on IoT produce quicker, more optimistic, and faster decisions than those of competitors.

5.6 Autonomous Robots

They are utilized to automate production procedures in various industries and are powered by the concept of the Internet of Things. This allows gadgets and computers to communicate with one another. The autonomous mobile machine can transfer resources across the production floor while avoiding obstacles, sharing with fleet mates, and identifying pickups and drop-offs in real-time (Kannan, 2021). Robot actions can be coordinated and automated by connecting to a central server or database, distinguishing it from the human interface. They can complete jobs quickly and intelligently with little human intervention (Kiraz et al., 2020).

5.7 Augmented Reality and Simulation

AR is a type of reality in which live direct or indirect views of actual real-world environments are augmented with computer-generated pictures. This technology underpins Industry 5.0 applications. The actual operations and simulation industries collaborated to create this new technology, which is critical to the industrial civilization. These strategies are extremely useful, particularly for designing products and manufacturing systems. Augmented reality is one of the cutting-edge technologies included in the Industry 5.0 movement, particularly in developing smart manufacturing functions. There have been some AR applications, primarily in the following fields.

5.8 Cyber-physical systems (CPS)

Integrating digital and physical processes is a critical component of Industry 5.0 implementations. They include imaging and control capabilities in appropriate systems. The ability of these systems to respond to any feedback generated is critical. They provide fast control and verification of process feedback to produce predicted results (Gupta et al., 2021). In general, a typical CPS in manufacturing may fulfil the following duties.

- Process control.
- Useful in various disciplines, contributing to developing a large-scale system.
- Integrating several disciplines in various fields.
- Dealing with effective reliability.

5.9 Intelligent robotics

Robots can now execute any work, navigate any terrain, and make decisions in the face of uncertainty. Recent advancements have resulted in strategies that allow robots to manage their surroundings. Artificial intelligence will contribute to the advancement of robot teams working and collaborating to complete certain tasks assigned for a

specific destination. Some research is being conducted to promote robots, which can be useful in assisting with effective digital transformation (Kamble et al., 2018). Industry 5.0 is predicted to provide numerous benefits, some of which are as follows:

• Increased ability to innovate.

• Simple system multifunction diagnostic monitoring.

• High productivity using ecologically friendly products.

• Increased flexibility at a lower cost.

• Accelerated product development with new business and service models.

• Decision making that is unbiased, real-time, and knowledge-based.

• National involvement in contributing to the economy.

6. STEPS TO MAKE INDIA A LEADING MANUFACTURING HUB

India is on the verge of massive reforms and is on track to become the world's third-largest economy by 2030. With a tech-savvy and educated population, skilled workforce, a strong legal and intellectual property environment, and a strong commitment to controlled liberalization, India is a location that global investors cannot afford to neglect. From initial industrialization and the license system to liberalization and the current phase of global competitiveness, India's manufacturing segment has gone through various stages. Today, Indian manufacturing enterprises in various areas are expanding into global markets and becoming formidable global competitors (Sharma & Dadhich, 2014). Many are already among the most competitive in their respective industries. When it comes to the automobile sector, the equipment makers, the government, and the customer all play important roles in defining the industry. The following are a few opportunities for India in the Fourth Industrial Revolution:

6.1 Manufacturing Sector

The manufacturing sector comprises all areas of production and human resource management. The revolution focuses primarily on productivity, producing with high accuracy using advanced machinery, and reducing production damage, time consumption, and human labor to a larger extent. Manufacturing processes are given priority in India due to their greater contribution to GDP (Manish Dadhich, Manvinder Singh Pahwa, Vipin Jain, 2021).

6.2 Health-Medical Sector

In today's world, the medical profession is equipped with cutting-edge technology that is utilized to treat a wide range of life-threatening ailments. Damaged tissue, for example, can be replicated using nanotechnology (Costa & Peixoto, 2020). Artificial Stimulated Cells, 3D printed Artificial Organs, Smart Inhalers, Precision Medicines, Health Wearables, and other recent medical advances include Robotic Surgeries, Wireless Brain Sensors, and more.

6.3 Transportation Sector

In emerging countries such as India, transportation is poorly structured and unsafe. There is a significant possibility of improving the transportation system using Al and IoT, such as optimal traffic, where the AI analyses traffic patterns to optimize and design routes based on peak traffic hours, maintenance, and constructions (Dadhich et al., 2020). Using self-driving cars to avoid accidents and the use of Al and IoT can contribute to cost savings while encouraging greater safety and a better customer experience (Singh, 2021).

6.4 Agriculture

Agriculture is regarded as the backbone of the Indian economy. However, the agriculture sector is given the least emphasis in the current context due to a lack of sufficient understanding and advice about adopting Industry 5.0 methods. As a result, the incorporation of technology has led to a limited area of agriculture. Already, automated equipment is being employed in agriculture, saving both time and labor (Rakesh Kumar Birda & Manish Dadhich, 2019). Scientists and industry experts are developing and putting technical measures in place in the agri-sector.

7. CONCERNS FOR INDUSTRY 5.0

• Humans are expected to contribute high-value tasks to manufacturing policies in the next industrial revolution. Standardization and legalization will aid in the prevention of major problems between technology, society, and enterprises.

• Senior members of society and stakeholders will find adjusting to the new industrial revolution considerably more difficult.

• Rapid and extremely efficient manufacturing may result in overproduction.

Transparency in implementation should also be considered.

• We must investigate how ethical standards can be included in autonomous systems.

• In autonomous systems, there should be explainable ethical behavior solutions.

• Ethical behavior in autonomous systems must be verified and validated.

• Critical skill gaps in future management and executive jobs, such as CROs, must be addressed.

8. CONCLUSION

Industry 5.0 is currently a new concept that depicts an evolution of a new set of systems, bringing together digital, biological, and physical technology in a fresh and powerful blend. These new systems are being created on the digital revolution's architecture. Governments will simultaneously acquire new technological capabilities to expand their control over populations based on pervasive surveillance systems and the ability to manipulate digital infrastructure. Many parallels and differences exist across the methodologies provided and studied in the Industry 5.0 readiness evaluation study. They share the use of relatively simple clustering approaches based on the stand-by index and production share. The discrepancies are in the indicators used and the evaluation methodologies used. The collected results and analysis of the concealed, not obvious information are of significant help to stakeholders in developing plans and policies to increase the readiness index. Their in-depth comparison and analysis will highlight the merits and shortcomings of each option under consideration. India is rising to new heights, with the greatest development in technical elements and a stronger position in practically every area. The preceding review provides insight into Industry 5.0 implementation and generates credible road maps to meet future difficulties, such as Covid-19 or other ad hoc measures. Industry 5.0 is a collaboration between man and machine that may continue to grow in all industries while allowing for more creativity for a better society.

REFERENCES

[1] Bag, S., Yadav, G., Dhamija, P., & Kumar, K. (2021). Key resources for industry 4.0 adoption and its effect on sustainable production and circular economy : An empirical study. *Journal of Cleaner Production*, *281*, 125233. https://doi.org/10.1016/j.jclepro.2020.125233

[2] Chaâri, R., Ellouze, F., Koubâa, A., Qureshi, B., Pereira, N., Youssef, H., & Tovar, E. (2016). Cyber-physical systems clouds: A survey. *Computer Networks*, *108*, 260–278. https://doi.org/10.1016/j.comnet.2016.08.017

[3] Chauhan, C., Singh, A., & Luthra, S. (2021). Barriers to industry 4.0 adoption and its performance implications : An empirical investigation of emerging economy. *Journal of Cleaner Production*, *285*, 1–15. https://doi.org/10.1016/j.jclepro.2020.124809

[4] Costa, D. G., & Peixoto, J. P. J. (2020). COVID-19 pandemic: a review of smart cities initiatives to face new outbreaks. *IET Smart Cities*, *2*(2), 64–73. https://doi.org/10.1049/iet-smc.2020.0044

[5] Da Silva Rabêlo, O., & de Azevedo Melo, A. S. S. (2019). Drivers of multidimensional eco-innovation: empirical evidence from the Brazilian industry. *Environmental Technology (United Kingdom)*, *40*(19), 2556–2566. https://doi.org/10.1080/09593330.2018.1447022

[6] Dadhich, M. (2017a). An analysis of factors affecting on online shopping behavior of customers. *ZENITH International Journal of Business Economics & Management Research*, *7*(1), 20–30.

[7] Dadhich, M. (2017b). An Analysis of Volatility of Macro Economic Variables on Gold Price. *Pacific Business Review International*, *9*(12), 21–25.

[8] Dadhich, M., Chouhan, V., & Adholiya, A. (2019). Stochastic pattern of major indices of Bombay stock exchange. *International Journal of Recent Technology and Engineering*, *8*(3), 6774–6779. https://doi.org/10.35940/ijrte.C6068.098319

[9] Dadhich, M., Chouhan, V., Gautam, S. K., & Mwinga, R. (2020). Profitability and Capital Adequacy Approach for Measuring Impact of Global Financial Crisis Vis-À-Vis Indian Banks. *International Journal of Advanced Science and Technology*, *29*(4), 2344–2365.

[10] Dadhich, M., Hiran, K. K., Rao, S. S., & Sharma, R. (2022). Impact of Covid-19 on Teaching-Learning Perception of Faculties and Students of Higher Education in Indian Purview. *Journal of Mobile Multimedia*, *18*(4), 957–980. https://doi.org/10.13052/jmm1550-4646.1841

[11] Dadhich, M., Purohit, H., & Bhasker, A. A. (2021). Determinants of green initiatives and operational performance for manufacturing SMEs. *Materials Today: Proceedings*, *46*(20), 10870–10874. https://doi.org/10.1016/j.matpr.2021.01.889

[12] Esmaeilian, B., Sarkis, J., Lewis, K., & Behdad, S. (2020). Resources, Conservation & Recycling Blockchain for the future of sustainable supply chain management in Industry 4.0. *Resources, Conservation & Recycling*, *163*(December 2019), 105064. https://doi.org/10.1016/j.resconrec.2020.105064

[13] Giovanni, P. De, & Cariola, A. (2020). Research in Transportation Economics Process innovation through industry 4.0 technologies, lean practices and green supply chains. *Research in Transportation Economics*, *April*, 100869. https://doi.org/10.1016/j.retrec.2020.100869

[14] Gupta, H., Kumar, A., & Wasan, P. (2021). Industry 4.0, cleaner production and circular economy : An integrative framework for evaluating ethical and sustainable business performance of manufacturing organizations. *Journal of Cleaner Production*, *295*, 1–18. https://doi.org/10.1016/j.jclepro.2021.126253

[15] Industry, G., & What, S. (2016). *Industry 4.0 : Building the digital enterprise*.

[16] Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2018). Sustainable Industry 4 . 0 framework : A systematic literature review identifying the current trends and future perspectives. *Process Safety and Environmental Protection*, *117*, 408–425. https://doi.org/10.1016/j.psep.2018.05.009

[17] Kannan, K. S. P. N. (2021). Competencies of quality professionals in the era of industry 4.0 : a case study of electronics manufacturer from Malaysia. *International Journal of Quality & Reliability Management, Emerald Publishing Limited*, *38*(3), 839–871. https://doi.org/10.1108/IJQRM-04-2019-0124

[18] Kiraz, A., Canpolat, O., Ozkurt, C., & Tas, H. (2020). Computers & Industrial Engineering Analysis of the factors affecting the Industry 4.0 tendency with the structural equation model and an application. *Computers & Industrial Engineering*, *150*(10), 1–10. https://doi.org/10.1016/j.cie.2020.106911

[19] Kumar, N., & Dadhich, M. (2014). Risk Management for Investors in Stock Market. *EXCEL International Journal of Multidisciplinary Management Studies*, *4*(3), 103–108.

[20] Kumar Naresh, Dadhich Manish, R. S. S. (2014). Determinant of Customers' Perception towards RTGS and NEFT Services. *Asian Journal of Research in Banking and Finance*, *4*(9), 253–260. https://doi.org/10.5958/2249-7323.2014.00960.2

[21] Manish Dadhich, Manvinder Singh Pahwa, Vipin Jain, R. D. (2021). Predictive Models for Stock Market Index Using Stochastic Time Series ARIMA Modeling in Emerging Economy. *Advances in Mechanical Engineering*, 281–290. https://doi.org/10.1007/978-981-16-0942-8_26.

[22] Naresh Kumar, M. D. (2016). An analytical study of life insurance facilities provided by life insurance companies. *SAARJ Journal on Banking & Insurance Research*, *5*(1), 82–92.

[23] Rakesh Kumar Birda & Manish Dadhich. (2019). Study of ICT and E-Governance Facilities in Tribal District of Rajasthan. *ZENITH International Journal of Multidisciplinary Research*, *9*(7), 39–49.

[24] Sharma, N., & Dadhich, M. (2014). Predictive Business Analytics: The Way Ahead. *Journal of Commerce and Management Thought*, *5*(4), 652. https://doi.org/10.5958/0976-478x.2014.00012.3

[25] Singh, G. K. (2021). Impact Execution of Total Quality Management (TQM) on Operational Performance of Indian Cement Manufacturing Industry : A Comprehensive SEM Approach. *Design Engineering*, *8*, 13538–13562. https://doi.org/http://thedesignengineering.com/index.php/DE/article/view/6476

[26] Dadhich, M. et al. (2021) 'Determining the Factors Influencing Cloud Computing Implementation in Library Management System (LMS): A High Order PLS-ANN Approach', Library Philosophy and Practice, p. 6281. doi: https://digitalcommons.unl.edu/libphilprac/6281.

[27] Bortolini, M., Faccio, M., Gamberi, M., & Pilati, F. (2016). Multi-objective design of multi-modal fresh food distribution networks. *International Journal of Logistics Systems and Management*, *24*(2), 155–177. https://doi.org/10.1504/IJLSM.2016.076470