The future of Manufacturing Industry a Strategic roadmap Towards Industry 4.0

[1]Mr.Deependra Yadav, [2]Dr. Manish Gangil

M.Tech.Scholar[1], *Professor*[2]

Department of Mechanical Engineering, RKDF, University Bhopal, (M.P.) India.

[1]yadavdeependra36@gmail.com, [2]rkdfbhojpal@gmail.com,

Abstract

Academicians and practitioners recollect that the on - going disruptive transformation is yet some other commercial enterprise revolution which is symbolized as 'Fourth Industrial Revolution' or 'Industry 4.0'. Industry 4.0 develops virtual networks consisting of smart and self-optimized factories in which guy, tool, material and structures of manufacturing are absolutely included and art work autonomously with minimum guide intervention. Further, the organizations inside the deliver chain are digitally linked and horizontally incorporated with each unique that allow tremendous collaboration and partnership among stakeholders. The production structures want to be vertically included with enterprise techniques inside factories and Entire Corporation. However, organization wishes to make certain the cease-to-cease digital integration of automation hierarchy. The linking of Information Technology (IT) with Operation Technology (OT) will manual the employer to optimize choice making in real-time which in the end decorate the visualization, useful resource utilization and profitability. In addition, the self-optimized clever factories will produce noticeably custom designed products which might be embedded with clever sensors. These clever products may be identified and positioned always in their life cycle. They are sensible enough to control their production semi-autonomously and recognize their very own manufacturing methods. In one-of-a-type terms, the ones smarts products are self-conscious and augmented with digitalized features.

1. Introduction

Industry 4.0 (I 4.0) is ushering in the new era of industrial production which is finding its way in all industries. Being a comparatively young and emerging research field, I 4.0 observes an exponential growth in research articles. The explosive growth in publications makes the job of scholars difficult to regularly track this highly dynamic and multidisciplinary research area. Also, it imposes several challenges to identify and assimilate trends in the field.

The adopted technique extracts several latent factors that characterise the emerging pattern of research in I 4.0. The cross-loading analysis of high-loaded papers is performed to identify the semantic link between research areas and research themes. This chapter seeks to synthesise the literature in the form of taxonomy with an emphasis on potential topics for research and scope for future research regarding realisation of 14.0. Subsequently the chapter presents a systematic literature review of existing I 4.0 maturity models, emerging technologies, barriers to I 4.0 adoption and benefits to manufacturing organisations. The structured literature review also examines the outcomes of preceding I 4.0 related studies and activities in the perspective of India.[1]

2. Backdrop and Evolution of Fourth Industrial Revolution (I 4.0)

The rapid development in the field of science and technology is boosting the continuous growth in industrialisation. The first industrial revolution may be traced back to the end of the 18th century [2]. Ever since the first industrial revolution, every key technological triumph leveraged the industrialisation to the next step and experienced the shift in paradigm. [3] This reflects that technological developments have played a pivotal role in the evolution of the manufacturing sector.

[4], the four paradigm shifts observed in the technology; first one started with the use of

steam power (steam engines) for mechanical systems in the late 18th century; followed by the use of 'division of labour' principle for mass production and the use of electricity as a source of power; another technological leap led to third industrial revolution through the use of electronics and information technology. This helped to achieve further automation in the field of manufacturing that leads towards removal of high 'labour-work' as well as some portion of 'brain-work'. The innovative technological progress further leads towards another radical transformation which has been referred to as "Fourth Industrial Revolution". The technological leap in each revolution indicates that the pace of change is very fast and it is affecting manual and repetitive labour work. In fact, this current revolution is emphasising on the massive integration and co- operation among the factories and demands close linkages between various stakeholders.

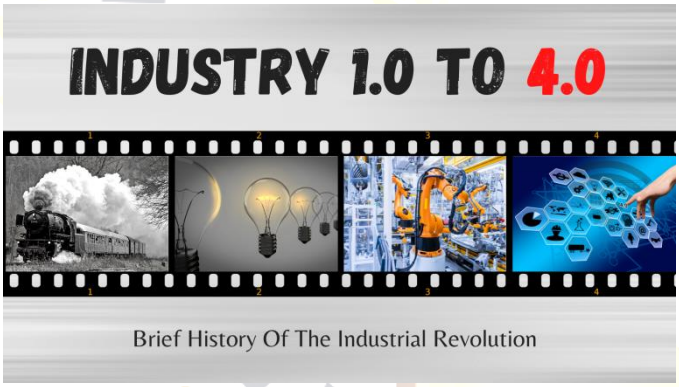


Fig.1 Industry 1.0 to 4.0 [1]

3. Disruptive Nature of I 4.0 and Manufacturing Organisations

The disruptive and destructive nature of 'Fourth Industrial Revolution' and its pace of change make this revolution different from earlier three revolutions. It is expected to bring about a substantial disruption in the field of manufacturing due to extensive technological advancement and its penetration in the manufacturing environment [5]. The existing manufacturing industries' approach of value creation is unable to handle this increasingly dynamic and complex business situation [6] preferred to see this as a gap between technological innovation and its proliferation at production environment and enterprise level.

It is expected that traditional manufacturing organisations need to change its approach from 'Product to Service orientation' that leads to the advent of a new type of business models so as to fulfil the requirements of the current competitive world [7]. Business processes demand greater flexibility, massive connectivity, increased stability and sustainability in order to cater to the demand of a volatile market, which could be difficult to predict in the future [8]. This may give I 4.0 a reason to flourish in the immediate future. The implementation of concepts and technologies of I 4.0 is likely to have far- reaching implications to the stakeholder of value network as well as to consumers and the environment [9]. The organisations which find it difficult to cope with the pace of adoption of innovative technologies may not able to retain its position in the near future.

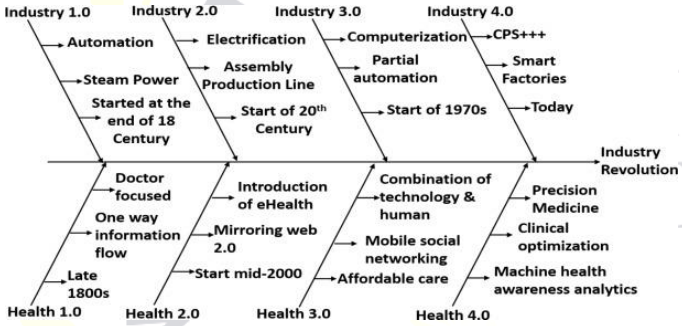
Fig.2 Disruptive Nature of I 4.0 and Manufacturing Organisations [2]

4. Industry 4.0 Design Principles and Features

It has mentioned six design principles of 14.0 and elaborated the important features of

I 4.0. The six design principles and three key features of I 4.0. For building digital vision these principles including interoperability, virtualisation, decentralisation, real-time capability, service orientation and modularity are important. In order to successfully realise I 4.0, IT systems of organisations should be vertically integrated across every engineering functions as well as horizontally connected with IT systems of value chain network companies.

Fig.3 Industry 4.0 Design Principles and Features [3]



5. Industry 4.0 and Indian Manufacturing Industry

The industries in India are witnessing another industrial revolution and its effect is inevitable. Therefore industries need to take concrete steps to revive its business structure and to realign their processes. The positive steps towards early adoption of technologies will ensure the survival of manufacturing organisation. Accordingly the organisations in the sectors like financial services, hospitality, energy and consumer have started using emerging technologies. Similarly, the manufacturing sector is also taking productive steps towards I 4.0. [10] Expectedly, Indian automotive sector is a front runner in adoption of I 4.0 technologies followed by electronics and aerospace sector.

The automotive sector is one of the crucial sectors for economic development of India. The automotive industry has implemented I 4.0 technologies like embedded systems (embedded sensors and **RFID** chips); advanced manufacturing technologies for example automation, Cobots, Additive Manufacturing and Big Data Analytics [11].

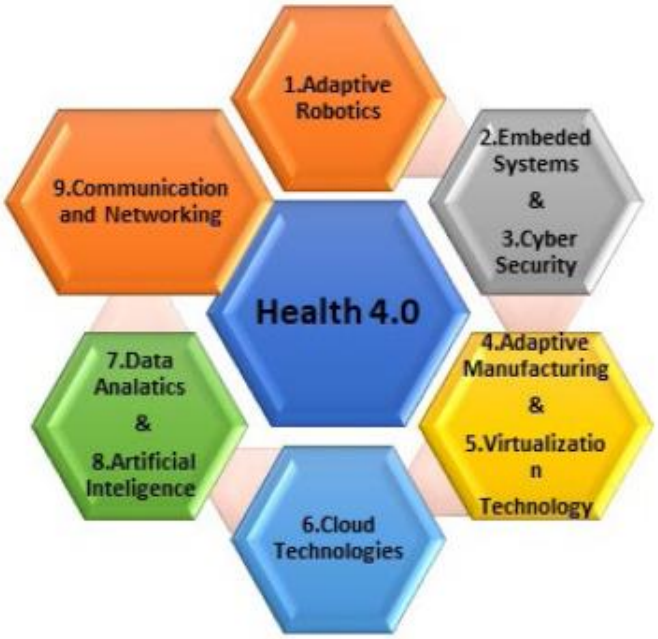
'Bajaj Auto' is using 100-120 'Cobots' in its manufacturing plants. 'Maruti Suzuki' is equipped with approximately 1700 robots in its process shop and assembly line. 'TATA Motors' has deployed around 100 robots in its 'TATA Nano' production line in the 'Sanand' plant. Another automotive OEM TVS Motor Company picks 14% stake in HoT platform firm Altizon Systems for $2.5 Million in the year 2019. Similarly Ford has adopted new strategy that involved local sourcing, platform sharing, and technology partnerships (EHR 2019). Mahindra manufacturing also implemented Cobots on their assembly lines which are basically used for sealant and tightening applications. The vision system which has camera fitted on the line that checks the quality and it gets continuously recorded. The company is monitoring the real-time performance of Cobots. The company believes that these Cobots are very safe and flexible and simple for teaching the operations.

Likewise, several other manufacturing companies **III** India are on a track of digitalising its existing facilities. This reflects that, effect of I 4.0 is quite visible in Indian manufacturing industry. Furthermore, government needs to focus on manufacturing sector through major initiatives to boost manufacturing sector that is highlighted in next section.

Fig.4 Industry 4.0 and Indian Manufacturing Industry

6. Industry 4.0 and Indian Government

From Indian government perspective, government has taken substantial steps towards



fourth industrial revolution by executing the initiatives like 'Make in India', 'Digital India', 'Skill India', 'Cyber-Physical Systems Innovation Hub' and 'Centre of Excellence for loT'. In the year 2017, the ministry of commerce and industry has constituted [12] the task force on AI to explore the possibilities of using AI to transform India's economy. Recently task force has submitted their recommendations report pointing out specific challenges in adoption of AI based systems, key enablers needed for deployment of these technologies, ethical and social safety issues and strategies that the government can adopt to address these issues. [13] The report highlights the potential challenges posed on the route to advanced technologies.

Conclusion

The quantitative analysis of literature has provided an overall picture of prominent research areas and themes of 14.0. The themes exposed in the LSA have helped this study to locate a topic of interest for future research. The trends analysis showed a remarkable growth in the publication of articles since 2016 on topics like 'opportunities and challenges of I 4.0', 'standardisation', 'new business model' and 'applications of big data'. The analysis also revealed that there is great potential for future research on the topics like 'the empirical investigation of enablers and barriers in implementation of I 4.0', 'structured methodology to assess the readiness of the enterprises' and 'development of universal roadmap to I 4.0'.

Based on outcome of quantitative analysis, this study found that there is dearth of studies focused on I 4.0 realisation strategies, maturity models and I 4.0 readiness assessment of organisations from developing countries like India. Therefore, to determine the exact status of research of above-mentioned topics, further critical literature review was conducted concerning to I 4.0 realisation frameworks or roadmaps, I 4.0 maturity models, barriers to I 4.0 implementation and potential benefits of I 4.0 to manufacturing

Reference

1. Aceto, G., Persico, V., & Pescape, A (2018). The role of Information and Communication Technologies in healthcare: taxonomies, perspectives, and challenges. Journal of Network and Computer Applications, 107, 125-154.

2.Agca, 0., Gibson, J., Godsell, J., Ignatius, J., Wyn Davies, C., & Xu, O. (2018). An Industry 4 readiness assessment tool. WMG International Institute for Product and Service Innovation University of Warwick (2017).

3. Barata, J., Da Cunha, P. R, & Stal, J. (2018). Mobile supply chain management in the Industry 4.0 era. Journal of Enterprise Information Management. 31 (1), 173-192.

4. Castelo-Branco, I., Cruz-Jesus, F., & Oliveira, T (2019). Assessing Industry 4.0 readiness in manufacturing: Evidence for the European Union. Computers in Industry, 107,22-32.

5. Dalenogare, L. S., Benitez, G. B., Ayala, N. F., & Frank, A. G. (2018). The expected contribution

of Industry 4.0 technologies for industrial performance. International Journal of Production Economics, 204, 383-394.

6. Elhoseny, M., Abdelaziz, A, Salama, AS., Riad, A M., Muhammad, K, & Sangaiah, A K (2018). A hybrid model of internet of things and cloud computing to manage big data in health services applications. Future generation computer systems, 86, 1383-1394.

7. Feng, L., Zhang, X., & Zhou, K (2018). Current problems in China's manufacturing and countermeasures for industry 4.0. EURASIP Journal on Wireless Communications and Networking, 2018(1), 90.

8. Ghobakhloo, M. (2018). The future of manufacturing industry: a strategic roadmap toward Industry 4.0. Journal of Manufacturing Technology Management. 29 (6), 910-936.

10. Horvath, D., & Szab6, R Z. (2019). Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities? Technological Forecasting and Social Change, 146, 119-132.

11. Lin, D., Lee, C. K M., Lau, H., & Yang, Y (2018). Strategic response to Industry 4.0: an empirical investigation on the Chinese automotive industry. Industrial Management & Data Systems. 118 (3), 589-605.

12. Lu, H. P., & Weng, C. I. (2018). Smart manufacturing technology, market maturity analysis and technology roadmap in the computer and electronic product manufacturing industry. Technological Forecasting and Social Change, 133, 85-94.

13. Mehta, B. S., & Awasthi, I. C. (2019). Industry 4.0 and future of work in India. FUB Business Review, 8(1), 9-16.

14. Pisching, M. A, Pessoa, M. A, Junqueira, F., & Miyagi, P. E. (2018). An architecture based on RAMI 4.0 to discover equipment to process operations required by products. Computers & Industrial Engineering, 125,574-591.

15. Queiroz, M. M., & Wamba, S. F. (2019). Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA International Journal of Information Management, 46, 70-82.