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Sustainability in Industry 4.0

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Abstract

Industry 4.0 is considered the fourth industrial revolution. It is becoming a cutting-edge research topic among Academicians, industrialists, politicians and scientists. Researchers are focussing on the relationship between sustainability and industry 4.0 nowadays. The first part of this chapter will discuss how industry 4.0 can achieve sustainable development. The next part of this chapter concerns how green Labour markets can be digitised in industry 4.0. The smart technology of industry 4.0 helps in optimum utilisation of resources and reduction of waste. The social implication of industry 4.0 includes Employment generation and skill development. The main sustainability drivers of industry 4.0 are economic, environmental and social benefits. Transformation of industry 4.0 aimed towards achieving sustainable development, which is the need of the hour currently due to scarcity of resources. However, this transformation of industry 4.0 is a complicated and gradual process.

Keywords: Industry 4.0, Revolution, Sustainability, Green Labour, Digitisation

1. Introduction

Industry 4.0 is considered as "Fourth industrial revolution". It is becoming a cutting-edge research topic among Academicians, industrialists, politicians and scientists (Rosa et al., 2020; Beier et

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al., 2020). The first industrial revolution arose in the 18th century, which introduced mechanical production. The second industrial revolution spurred in the 19th century, indicated by factory electrification and production lines. The third Industrial Revolution was characterised by the use of digital technology in production during the 1960s and 1970s. And this Industrial Revolution 4.0 has been built upon the previous three revolutions (Culot et al., 2020). It is characterised by the greatest degree of automation, digitalisation, centralisation and virtualisation (Bordeleau et al., 2020). As per Kerin & Pham (2019) and Neal et al. (2019), industry 4.0 involved the implementation of Advanced Technologies of manufacturing such as modelling and simulation, 3D printing, virtualisation etc. Castelo-Branco et al. (2019) defined industry 4.0 as, " the set of technologies, devices and processes that allow for self-sufficient production models, capable of operating in an integrated way along the several phases of the production process and along the several levels of supply chain and able to make decentralised decisions with minimum human intervention".

Sustainability is a wide-ranging concept defined by different authors. The most popular definition is that of Brundtland (1987), “Sustainable development means development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”. Sustainability is maintaining a balance between three elements of the triple bottom line. Researchers are focusing on the relationship between sustainability and industry 4.0 nowadays. Green jobs and industry 4.0 are recent topics of researcher's interest. So, integration of green management and industry 4.0 results in green job Creations. It means investment should be made in those sectors which create economic, environmental and social profits (Kraeger et al., 2010). Industry 4.0 pointed out the new vital role of people in the industry and their way of working (Piatek, 2017). There are different categories of workers including white collars e.g., Lawyers, Entrepreneurs etc.; Blue collars e.g., administrative staff; Pink collars including Librarians, Beauticians, Flight attendants, Secretaries etc.; Gold collars e.g., Doctors, Accountants, Professors and so on and green collars (Rutkowska, 2016). Green collar workers include those who are involved in waste management and follow the principle of sustainable development. Green collar

employees are those who are involved in green jobs. Expectations of customers are changing. They are demanding customised products and environmental-friendly products. They also consider the environmental profile of the companies while purchasing the product. So, there is a requirement for qualified and environmentally aware employees to meet the customers' expectations. Green employees are highly required in industries to come up with the customers' expectations.

The first part of this chapter will discuss how industry 4.0 can achieve sustainable development. The second part of this chapter is related to how green Labour markets can be digitised in industry 4.0.

2. Industrial Revolution

Ways to handle supply chain sustainability were discussed by Bag et al. (2018) in industry 4.0. Governmental support, research Institutions and Universities support information on Exchange between actors of the supply chain, management commitment regarding sustainability and technological factor identified as key enabling factors in industry 4.0. This study provided the key to enabling factors affecting supply chain sustainability in industry 4.0.

The impact of industry 4.0 on the triple bottom line was assessed by a study conducted by Birkel & Muller (2020). Results of this study showed some direct relationship between technology and sustainability. Industrial Revolution was Defined by Malgozata Rutkowska et al. (2020) as follows:

- **Industry 1.0**

It was considered a mechanisation phase which was characterized by the "Invention and implementation of a steam engine to introduce repeatable production".

- **Industry 2.0**

It was the electrification phase characterised by "electricity displaced steam engines which could help in producing goods in the last series".

- **Industry 3.0**

It was the digitisation phase characterised by the "Invention of microprocessor, efficient computers and data processing system which have enabled machine control using the software".

- **Industry 4.0**

It is the artificial intelligence phase characterised by the "Integration of systems and creation of communication-based networks to develop artificial intelligence".

Information can automatically be exchanged between people and machines which is required for effective production by using the Information Technology system (Roblek et al., 2016). Studies conducted by various researchers revealed that the implementation of industry 4.0 solutions can help in reducing the cost and flexible response to queries or enquiries of customers (Perechuda & Sobinska, 2015; Sanders et al., 2016). Industry 4.0 created many challenges as well as opportunities for companies.

3. Sustainability in Industry 4.0

Technological Trends of industry 4.0 was categorised into two clusters by Ghobakhloo et al. (2021) including core Technologies and facilitating Technology. The core technology of industry 4.0 includes IoT, cyber-physical systems, Cloud Computing, Industrial Robotics, Data Analytics, digital turn Technology, Augmented reality, simulation, big data, semantic and blockchain Technology (Ghobakhloo et al., 2021). Facilitating Technologies of industry 4.0 includes Industrial actuator and sensor, machine and process controller, automated guided vehicle, intelligent enterprise resource planning, communication interface, predictive Analytics and so on (Ghobakhloo et al., 2021).

3.1. Sustainability Drivers in Industry 4.0

It has become a growing research topic among researchers. However, sustainable manufacturing and green manufacturing are the main among them (Kamble et al., 2020; Yadav et al., 2020; Kamble et al., 2018). Research has been conducted on the benefits of industry 4.0. Technological innovation contributes to

environmental sustainability at the National level in industry 4.0 (Cheng et al., 2021). Nationwide waste management problems can be overcome by the biotechnological solutions and industry 4.0 (Fatimah et al., 2020). Several dimensions of implications of industry 4.0 exist such as cleaners and more innovative production technological Solutions in industry 4.0 (Jean et al., 2020), social sustainability implications (Farrell et al., 2020; Stock et al., 2018) and so on. The smart technology of industry 4.0 helps in optimum utilisation of resources and reduction of waste. The social implication of industry 4.0 includes Employment generation and skill development. The main sustainability drivers of industry 4.0 are economic, environmental and social benefits (Ghobakhloo et al., 2021).

3.1.1 Economic benefits

- **Manufacturing Productivity**

Industry 4.0 Technological Solutions results in enhanced production monitoring and control, increased Labour productivity, improved production planning, reduction in maintenance cost, reduced machine down time, reduced cost of quality and so on.

- **Strategic advantages**

Industry 4.0 provides opportunities to enhance the competitive advantage in business. It includes integration of supply chain, increased profitability and market share enhanced innovation capacity and corporate image. It also provides opportunities for the company to expand internationally.

3.1.2 Social benefits

As highlighted by the literature, new employment opportunities and improved working conditions are being provided which helps in boosting the standard of living of people. New technological solutions and industry 4.0 result in enhanced customer satisfaction and a decrease in the cost of customer goods.

3.1.3 Environmental benefits

Industry 4.0 helps in the reduction of waste and harmful gas emissions and increases resource and energy consumption efficiency. Sustainability in Industry 4.0 is directed toward the

production of Sustainable products. Opportunities for corporate profitability and social sustainability are being offered by industry 4.0 (Beier et al., 2020).

3.2 Digitisation of green labour market

Increasing speed of changes in technology force people to think about the world in future in which more high level of Technology will be used. For example, self-propelled cars (Malgorzata Rutkowsa et al., 2020) will reduce the demand for taxi drivers, Pilots, delivering vehicle drivers etc. Three-dimensional printers are available on small scale. It is used in the industry for weapon production and also in the medical field. Text creation software leads to a reduction in demand for work done by a journalist or lower-level officials. It is used in stock comments or match reports etc. It can also be used in compressing the hierarchical structure of employees for those who are involved in intellectual works. An increasing number of platforms are widely being used for sharing information. For example, Wikipedia, online courses and repositories run by Columbia University, Amazon and R. Analysis of big data is very complicated and will require efficient and skilled professionals. All of these result in the creation of green jobs and digitisation of the green Labour market.

4. Conclusion

In conclusion, we can say that concept of a green Labour market in industry 4.0 is more likely to be used in future. Productivity in manufacturing and profitability in corporate can be improved through digitisation in industry 4.0. Transformation of industry 4.0 aimed towards achieving sustainable development, which is the need of the hour currently due to scarcity of resources. However, this transformation of industry 4.0 is a complicated and gradual process. Several determinants such as financial capability, the readiness of HR for digitisation, expertise in information and digital technology of industry, support from management, data security, organisational culture and so on these affect the transformation process positively as well as negatively in industries. The first part of this discussion tries to explain the sustainability drivers in industry 4.0 and the second part explained

the digitisation of the Labour market triggered by green job creation.

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