Chapter 2
Industry 4.0: Design Principles,Technologies, and Applications

Sheetal Zalte
Shivaji University, India

Smita Deshmukh
Vishwakarma College of Arts, Commerce, and Science, Pune, India

Prajkta Patil
Vishwakarma College of Arts, Commerce, and Science, Pune, India

Minal Patil
Vishwakarma College of Arts, Commerce, and Science, Pune, India

Rajanish K. Kamat
Shivaji University, India

ABSTRACT

The fourth technological revolution, which is widely called Industry 4.0, works by incorporating the critical features like physical (object in existence), digital, and biological worlds. The attributes related to Industry 4.0 are more important as they change from producing a large amount of standardized products by using manual assembly, semi-automated assembly, or fully automated assembly with customization based on different product manufacturing. The fourth technological revolution is not progressing to modification; however, "it can modify us" and revolutionize societal life. The chapter elucidates the essential technologies behind Industry 4.0 and how they are shaping smart manufacturing and digital supply chain management. It also throws light on the policy frameworks required to be adopted to inculcate Industry 4.0 in the walks of societal life and reviews the upcoming trends.

DOI: 10.4018/978-1-6684-5250-9.ch002

INTRODUCTION

Over the past hundred years, Industrial Revolution has increased productivity by rapidly and significantly, especially in logistics organizations. The third industrial revolution is from the 1950s and 1970s and refers to the digital revolution that has arisen due to the shift from analog mechanical systems to digital ones. This is due to the impact of immense development in computer, information and communication technologies. The automation of manufacturing processes is shifted to the next level by introducing suitable and adaptable mass production technologies in this fourth industrial revolution.

Industry 4.0 involves Cyber-physical systems (CPS), hyperactive connections, the Industrial Internet of Things (IIoT) and the Internet of Services (IoS) that shape the way services and values are used across supply chains. Thus, Industry 4.0 is a concept or process in the current manufacturing and automation industry that focuses on digital data transformation. The main goal is to empower monitor assets, self-directed decision-making processes, processes in a real-time environment. Priorinvolvement of stake-holders and vertical-horizontal integrationcan create real value networks. In chronological order, the 3 most essential throughput factors are steam moving manufacture lines, industrial control-monitoring systems and automation.

As briefly, covered in this chapter, the 4thIndustrial Revolution which is essentially an orientation toward automation and data transfer or exchange across manufacturing processes and techniques, including cloud computing, cyber-physical systems (CPS), IIoT (Industrial Internet of Things), intellectual or simulative computing and artificial intelligence. Virtual, structured and intelligent factories governingand controlling the substantial activity, it creates an imaginary world that will be helpful to make decentralized decisions. This revolution is said to be behind the widespread dependence on technologies such as 3D printing technology.

Industry 4.0 provides six design principles to provide clear guiding principles for those companies or industries, who want to get knowledge, recognize, identify, and develop the projects or services.

It involves large data transfer and automation in the manufacturing work environment, including the systems as a cyber-physical system, cloud computing, Big-Data, IoT, IIoT, Smart Factory. All these systems aim at the integration of computation and physical processes (Kicińsk & Chaja, 2021).

The 4thIndustrial Revolution and Industry 4.0 is the progressive automation of old manufacturing and industrial processes through recent intelligent technologies. The term “Industry 4.0” itself is a broad term encompassing the range of modern automation or computerization, data transfer and exchange and manufacturing technologies.

This chapter presents current advances in design and technology in the phase of Industry 4.0. It is inspired by the tendency toward smart plants (workplace) and the forthcoming of the 4th Industrial Revolution, which will enable better use of people’s skills and resources, cyber and physical production environments. The evolving paradigms of the industry 5.0 present innovative system design issues or problems at the edge between intelligent manufacturing or processing, robust and adaptable automation, scattered and reconfigurable production systems, industrial IoT and supply chain integration.

DESIGN PRINCIPLES

As portrayed, with the previous section, Industry 4.0 refers to a next level of industrial evolution that emphasis on networked, computerization or automation, machine learning, and realworld data. It includes