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IR 4.0 APPLICATIONS IN CONSTRUCTION INDUSTRY

The construction industry is moving towards the adoption of new techniques and technologies where the Industrial Revolution has been introduced as a digital transformation. Hence, this chapter covers the historic and current Industrial Revolution approaches, Building Information Modelling and digitalisation, and automated construction strategies in the construction industry.

11.1 IR 4.0 DEFINITION

Industrial Revolution (IR) 4.0 is the digital transformation of industries for value creation processes. The first IR emerged in the 1700s when mechanical equipment was driven by steam and waterpower because of mechanical looms. In the 1870s, the second IR occurred when a mass production system was used to generate electrical energy. These revolutions were achieved because of human capabilities. In the 1970s, a third IR occurred in the form of electronics rise. In recent times, IR has been built on the digital revolution known as IR 4.0, where people and technology are connected [103]. The industrial revolution's progress is shown in Figure 11.1. In 2011, during the Hannover Messe, the German Federal Government released a future vision of the manufacturing sector under the umbrella of INDUSTRIE (I) 4.0 and became the "High-Tech Strategy 2020" project part still grows. The concept was eye-catching, therefore, recognised globally as I4.0. This broad paradigm is also defined as smart production, smart manufacturing, smart factory, etc. Similar initiatives were taken by other countries, such as in 2014, "Advanced Manufacturing Partnership" was developed by the United States, which was updated in 2016, the UK launched "Future of Manufacturing", whereas China launched the "Made in China 2025" program as a part of IR 4.0 [104].

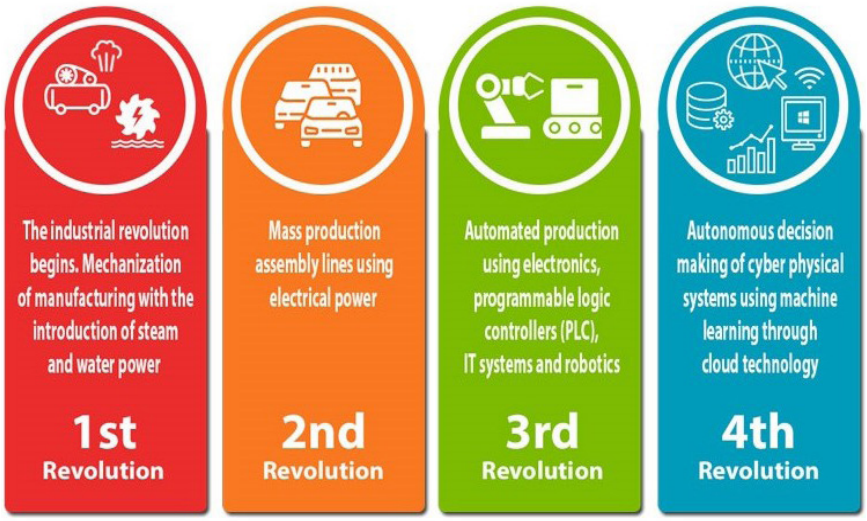

Figure 11.1 Industrial Revolution [110]

The IR4.0 not only focuses on the techniques but also on sustainability, where two central components are energy efficiency and renewable energy [105-107]. The aim of IR 4.0 is a sustainable and viable manufacturing process with a high level of integrating production. IR 4.0 focuses on all three aspects of sustainability, i.e., social, economic and environmental, where strategic, operational and tactical dimensions are important and require consideration [108],-[109].

IR 4.0 is also described by adopting Information and Communication Technology (ICT), the trend of digitisation and automation, cloud computing and cognitive computing, Internet of Things (IoT) and cyber-physical systems. Digitising industrial processes for a better service network is IR 4.0 concept where the construction industry can perform much better with its adoption. With IR 4.0 in the construction industry, the interconnectivity of operations and information with technological advancements can render human errors and improve efficiency. In the scenario, a concept of the smart factory has been introduced where the data is stored in cognitive and cloud computing, making decisions more effective. Cyber-physical system allows real-time monitoring without a physical presence, proving IR 4.0 magnificent [103]. IR 4.0 benefits are clear as it improves operational performance and decreases time-to-market. IR 4.0 can be achieved by several technologies which are described in Figure 11.2.