Chapter 3
Opportunities, Challenges, and Solutions for Industry 4.0

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ABSTRACT

Industry 4.0 (I4.0) is the fourth industrial revolution sweeping through the world of manufacturing. This revolution integrates the current trend of intelligent automation with internet of things (IoT), big data, and artificial intelligence to bring about extraordinary technological innovation, economic growth, and tremendous progress to organizations of all shapes and sizes, on a magnitude beyond the current imagination. The disruptive technologies introduced by I4.0 represent a leap forward from more traditional automation to next generation industrial production based on fully web-based cyber-physical systems (CPS)s. To full understand the I4.0 concept and implementation, this chapter makes an in-depth analysis on the issues and controversies of I4.0, recent technological advancement, management and organizational concerns in terms of opportunities and threats, capital investment and skillsets, cybersecurity threat, ethics consideration, current challenges facing organizations and industry in terms of geopolitical domination, economic and social disenfranchisement, job destruction and job creation, the roles of multinational corporations, lack of technologies capabilities, lack of skillset, and skill mismatches. This chapter also makes suggestions for solutions and recommendations in terms of the role of government and incentives and grants; assessment tools; collaboration; the development of local companies and small and medium-sized enterprises (SMEs); upskilling, reskilling, and lifelong learning; education; universities and students; skilled graduates; and future research and directions.

INTRODUCTION

Industry 4.0 (I4.0) is the common term referring to the use of cyber-physical systems (CPS) which comprise numerous major innovations in digital technology such as artificial intelligence (AI), Internet of Things (IoT), machine-to-machine link, data capture and data analytics, cloud computing, advanced robotics and smart production facilities. Such systems are capable of independently exchanging informa-

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tion, triggering actions, controlling each other independently and making autonomous decisions. In fact, CPSs are driven by cutting-edge software, computational power, programmable logic controllers, and sophisticated sensors and cameras to process vast amount of data using advanced predictive algorithms, monitor real-time transactions at every monitor real-time transactions at every stage of a process in the value chain right from customer ordering, marketing, suppliers, procurement, design and development (R&D), manufacturing, logistics and customer services, finally make large-scale centralised decisions without human intervention (Brettel, Friederichsen, Keller, & Rosenberg, 2014). In another example, such systems can use Internet Protocol (IP) addresses, Quick Response (QR) codes and Radio Frequency Identification (RFID) tracking tags to keep track of the manufacturing of every product and process using by online computer and smart-phones apps with the ease of a button and on-the-go.

The development of I4.0 technologies is fast changing the landscape of global supply chain at a breakneck pace. In this regard, digitalisation of the supply chain is underway to achieve operational efficiency and cost competitiveness. MNCs can leverage on digital global economy which are driven by information, ideas and innovation. Most leading companies are deploying such I4.0 technologies to share market intelligence and organizing their orders by divisionalsing their product lines according to the cost-base structures, economies of scales and tariff-free, and full market access with a view to realising high-flexible, individualised and resource-friendly mass production. In other word, I4.0 technologies will make such smart factories work easier, safer, leaner and more productive through I4.0 digital sphere. In today's competitive environment, most MNCs certainly cannot afford to look nervously over their shoulders at rivals taking command of the technology revolution, instead quickly jump on the bandwagon of adopting I4.0 cutting-edge technologies to stay competitive, connect more closely with customers and finally propel organisations towards for more sustainable growth (Ghobakhloo, 2018; Pandiyan, 2017).

Taking a quick look back in time the at these first three industrial revolutions, it is worth mentioning that Industry 1.0 refers to use of the mechanical production harnessing the power of water mills and coal-fired steam turbines in Britain in the late 1765, Industry 2.0 refers to the introduction of division of labour and electrically powered assembly lines especially pioneered by Henry Ford and Frederick Taylor in the manufacture of cars in 1870, and finally Industry 3.0 refers to the use of electronics and telecommunications and computers that further automate production in 1969. Over the course of history, mankind has perfected its industry by creating and striking innovations all throughout their revolutions. Indeed, previous three industrial revolutions have liberated humankind from animal power, made mass production possible and brought digital capabilities to billions of people (Sentryo, 2017).

COUNTRIES AND INDUSTRIES BACKGROUND

The concept of I4.0, also known as Industrie 4.0, was originally coined by the Germany government in 2012 to drive its High-Tech Strategy under the 2020 initiatives. As I4.0 holds promises of scientific and technology development, industrial optimalisation and upgrading, and finally major productivity improvement, major developing and developed countries have scrambled to join the bandwagon with different variants to play catch-ups with I4.0 but maintain their competitive edge beyond traditional industrialisation pathways for wealth creation and prosperity. For examples, Made in China 2025 (by China); Smart Manufacturing (by USA); Revitalisation Robotics Strategy (by Japan), Manufacturing Innovation 3.0 (by South Korea), Smart Nation Programme (by Singapore), Future of Manufacturing 2050 (by UK), and Productivity 4.0 (by Taiwan) are some of the variants. At the organisational level,

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