Chapter 7
Industry 4.0 and Sustainability

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ABSTRACT

Modern industry developed over several centuries and three industrial revolutions. Today, we experience the fourth era of the industrial revolution, Industry 4.0. The advance of industrialization brought along many problems, including environmental pollution, global warming, and depletion of natural resources. As a result, the concept of sustainability began to gain importance. Sustainability can be achieved through a balance between economic, social, and environmental processes. In order to establish such balance, businesses need new business models or insights. At this point, Industry 4.0 can be regarded as a new business mindset that will help businesses and communities move towards sustainable development. The technologies used by Industry 4.0 bear a strong promise to solve these problems, after all. Even though Industry 4.0 attracts a lot of attention lately, few works are available on its impact on sustainability. This chapter examines the impact of Industry 4.0 on sustainability.

INTRODUCTION

The first industrial revolution brought many dramatic changes in our world and our lives. As a result of industrialization, urban populations increased and living conditions improved. Industrial production, which expanded with increasing population, brought along some environmental issues over the centuries. The most important issues probably include the pollution of the natural environment, the depletion of natural resources, and global warming. As these issues deepened, the emerging concept of sustainability began to gain importance. Sustainability is defined "meeting today's needs without compromising the ability of future generations to meet theirs" (Brundtland, 1987). This definition has three dimensions: social, economic, and environmental.

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Sustainability in an enterprise requires sustainable processes throughout the value chain, from product design and processing of raw materials to recycling. As this does not entail a simple transformation, businesses need new business models or insights to implement this. At this point, Industry 4.0 can be considered a new business mindset that will help businesses and communities move towards a sustainable development (Luthra & Mangla, 2018).

Industry 4.0 refers to smart factories with machines and production modules capable of communicating with each other and a high degree of automation in the industry, changing the way things work. The aim of this revolution is to provide flexible, fast, and personalized production, as well as efficiency in resource use. With Industry 4.0, production time and cost are expected to decrease, while production quantity and quality are expected to increase.

Industry 4.0 recently started to attract a lot of attention and there are not many studies yet on its possible effects on sustainability. However, Industry 4.0 has tremendous potential for the creation of sustainable industries (Kamble, Gunasekaran, & Gawankar, 2018). With smart devices and a smart production system, Industry 4.0 can contribute to improved sustainability by reducing overproduction, material waste, and energy consumption (Branke, Farid, & Shah, 2016; Waibel, Steenkamp, Moloko, & Oosthuizen, 2017; Wagner, Herrmann, & Thiede, 2017). For example, energy consumption (water, electricity, gas, etc.) can be monitored and optimized thanks to new energy management techniques Industry 4.0 supports (Ding, 2018). However, enterprises have difficulties with the disposal of ever-increasing amounts of waste, especially when it comes to keeping control over dangerous chemical waste in developing countries, where accidents are not infrequent. The technologies of Industry 4.0 make waste control and monitoring more effective. Moreover, with automation Industry 4.0 minimizes human errors and maximizes efficiency and quality in production (Ding, 2018). It also helps reduce uncertainty by ensuring that accurate information is transmitted full-time among the members of a supply chain. This data transparency improves accuracy in delivery and reduces waiting time. With respect to Industry 4.0, the aforementioned energy savings, resource efficiency, waste control, and improved delivery are important for both economic and environmental sustainability. Regarding the social dimension of Industry 4.0, several benefits for employees can be listed, including enhanced human learning through intelligent assistance systems or human-machine interfaces. This may help increase employee satisfaction (Herrmann, Schmidt, Kurle, Blume, & Thiede, 2014). Moreover, assigning smart devices and robots to ergonomically unfavorable and physically demanding workstations can provide significant improvement in employee health (Hirsch-Kreinsen, 2014). However, the current literature cannot provide a common perspective on whether Industry 4.0 will increase or decrease the number of employees in industry. While simple tasks are expected to disappear with Industry 4.0, tasks such as monitoring, collaboration, and training are still considered necessary (Kiel, Müller, Arnold, & Voigt, 2017).

In short, Industry 4.0 is expected to transform industrial production, as well as the structure of society with its economic, ecological, and social achievements (Kiel et al., 2017; Herrmann et al., 2014). However, as mentioned before, studies in this field are yet few. Industry managers need to achieve a better comprehension of the possible effects of Industry 4.0 on sustainability, if they aim to gain a better edge. Therefore, this study discusses the effects of Industry 4.0 on sustainability. First, it explains on the concept of sustainability, then expands on the concept of Industry 4.0, and finally discusses the effects of Industry 4.0 on sustainability.