Chapter 8
Smart Manufacturing:
Post-Pandemic and Future Trends

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ABSTRACT

In this chapter, the current state and future trends in smart manufacturing (SM) and its technologies are presented with the perspective of economic growth and evolution of policies and strategies that steer its growth. The long-term effect of the COVID-19 pandemic on manufacturing is investigated. As a result of the COVID-19 pandemic, a long-lasting effect on manufacturing is foreseen, particularly in the supply chain dependency. To overcome future supply chain disruptions, attention is expected to shift towards incorporating industrial and service robotics, additive manufacturing, and augmented and virtual reality. Additive manufacturing will continue to play an increased role in customized product manufacturing. More demand is expected in the long term of additive manufacturing to counter future supply chain interruption.

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INTRODUCTION

In 2011 the term "Industry 4.0" (Rüßmann, et al., 2015) (Erol, Schumacher, & Sihn, 2016) Came to define the 4th Generation of industry (Digitale Wirtschaft und Gesellschaft, n.d.) after the Hannover fair in Germany. In the years that follow, Germany and the European Union adopted policies and plans that rely on Smart Manufacturing (SM) technologies to increase their national manufacturing production. *The Wall Street Journal* calls it the "New Industrial Revolution", and the Huffington Post called it a "bullet train" that "propels the manufacturers that climb on board" (Kennell, 2015).

However, before the adoption of policies and plans for "Industry 4.0" in Europe, in the year 2010, China surpassed the United States, for the first time in modern history, as the world's largest manufacturer and it continues to widen its lead (see *Table 1*) (China Solidifies Its Position as the World's Largest Manufacturer, 2015). For the past four decades, China adopted strict and fruitful industrial policies, that resulted in the successful transformation of China's economy to a leading industrialized one.

The term "Intelligentization" was first introduced by the Chinese State Council in its National Artificial Intelligence Strategy (Webster, Creemers, Triolo, & Kania, 2017) translated as "Next Generation Artificial Intelligence Development Plan" to refer to the next generation of intelligent systems, in which decision making is a key capability of the AI machines.

Table 1. Top 10 countries that provide value-added manufacturing ranked by the percentage of the world's manufacturing services provided, 2015 data

Rank	Country	Percent		Rank	Country	Percent
1	China	23.2%		6	Italy	3.1%
2	United States	17.2%		7	France	2.4%
3	Japan	7.8%		8	Russia	2.4%
4	Germany	7.3%		9	Brazil	2.3%
5	Korea	6.3%		10	United Kingdom	2.1%

The spread of the Corona Virus Disease of 2019 (CoVid-19) caused a turning point in the manufacturing industry and intensified the need for "intelligentization" and "networkization" such as the use of augmented reality for remote troubleshooting and collaborative robots in both service and industrial applications. As of September 2021 the confirmed cases of the Corona Virus Disease of 2019 (CoVid-19) reported by the World Health Organization exceeded 220 million, including more than 4.5 million deaths (Coronavirus disease (COVID-19) pandemic, 2021).

The spread of the Coronavirus pandemic affected almost every aspect of the human civilization. By the end of April 2020, the pandemic resulted in a 52% decline in the automotive sales in the U.S. (Collie, et al., 2020) and a paralyzed aviation industry that shrunk at an unprecedented level of 94% (IATA, 2020) (Tantawi, Literature Review: Rethinking BioMEMS in the Aftermath of CoViD-19, 2020). Almost every manufacturing industry faced supply chain disruptions, however, on the long term, the automotive industry and other industries are expected to experience an increase in demand, with more individuals indicating that they will likely switch mode of transportation from public transportation to walking or private scooter or car (Bert, et al., 2020).