Preface

As we completed this book in March 2021, we were living through the COVID-19 pandemic. This pandemic can be conceptualized as a cultural inflection point that rippled across all socio-economies, challenging established practices, expectations and routines. Overcoming COVID-19 required immediate solutions to the sudden increase in demand for personal protection equipment (PPE), hand sanitizer and medical equipment, combined with developments in new therapies, and the race to develop effective vaccines. It also included adjustments to homeworking for those employed to undertake tasks that could be delivered from home. Homeworking required developments in software and new working, teaching and learning routines. During the pandemic, businesses failed, jobs were created and destroyed, and new businesses were established. For some people and firms, the pandemic has represented a moment of creative destruction as existing business routines were displaced by online alternatives.

The pandemic should also be conceptualized as a discontinuity, in which policy and practice shifted towards tackling the pandemic and away from trying to develop solutions, or mitigation and adaptation strategies, to ongoing global societal challenges; including the 17 Sustainable Development Goals (SDGs) identified by the United Nations in 2015, climate change and the race to decarbonize socio-economies. Once the pandemic is under control, then the policy agenda must return to decarbonization, in the context of the SDGs, combined with post-pandemic recovery. This requires the decarbonization of manufacturing in the context of a production ecosystem approach that includes logistics.

The next decade will be one of revolutionary and extremely disruptive innovations across production ecosystems that will transform the existing manufacturing research agenda. There are three important disruptions to consider.

The first must be the decarbonization of production ecosystems. This is a complex process involving technological innovation, redesigning products and their production processes, new approaches to reconfiguring global production networks (GPNs) that minimize carbon and environmental pollutants, and alterations in consumer behaviour. There must be a focus on maximizing recyclability, and this requires ensuring that all consumers participate in minimizing non-recyclable waste. This shift in emphasis towards decarbonization will alter the current geographical configuration of production ecosystems, but also transform product design and fabrication with an emphasis on recyclability. This includes the selection of raw materials to reduce pollutants and enhance recycling and/or alterations in the location of manufacturing plants to reduce the overall environmental impacts of production processes.

Second, technological sovereignty has recently become a major concern as one response to resisting economic coercion imposed by one nation-state on another. In 1997, the United States (US) published the Entity List of foreign organizations that were engaged in activities that were counter to US national security and/or foreign policy interests. This initially focused on military-related activities but has expanded into other areas. In her November 2019 inauguration speech, Ursula von der Leyen, the President of the European Commission, stated that the EU's top priorities for the next five years were technology and climate change. She noted that Europe 'must have *mastery and ownership of key technologies in Europe*. These include quantum computing, artificial intelligence, blockchain, and critical chip technologies' (von der Leyen, 2019). This strategy includes identifying areas where the European Union is dependent on other countries. The focus is on limiting the reach of US and Chinese technology across Europe, with a focus on ensuring security of access to key technologies. Similar strategies have been developed by other countries, including the US and China. The COVID-19 pandemic highlighted both the fragility and the agility of GPNs. Concerns over technological sovereignty will intensify as products become more data-intensive, combined with technological convergence. Technological convergence is linked to digital transformation. One consequence is that more production processes and infrastructure systems are increasingly exposed to cyberattacks. One consequence of technological convergence could be technological divergence, as major economies adopt their own standards to enhance economic and national security. Technological sovereignty will reconfigure GPNs, altering the balance between localized versus globalized production. Technological sovereignty is a complex issue involving strategic autonomy of critical technologies, regulatory sovereignty and digital sovereignty. All this suggests that there will be an intensification of the role governments play in economic activity.

Third, the ongoing digitalization of manufacturing will continue to transform production ecosystems. This includes additive, rapid manufacturing, and rapid prototyping. It also includes innovations in artificial intelligence (AI) and robotics, and the emergence of ‘hyper factories’ that would be able to create many different types of products. Developments in AI will transform the interface between workers and machines. This includes continued innovation in collaborative robots, or ‘cobots’, that are designed to share a workspace with humans. Developments in robots are making the adoption of automation by businesses of all sizes much simpler and more cost-effective. The introduction of universal robots has transformed the time required to set up a cobot from weeks to hours. Universal cobots can be redeployed to undertake multiple applications without altering production layouts. Development in cobotics, combined with other types of digital manufacturing, will continue to contribute to rebalancing the relationship between local and global production networks. GPNs may become more orientated towards producing 3D printers and their powders required to facilitate close-to-market production systems that will be increasingly designed around a circular economy.

All these changes mean that existing approaches to understanding manufacturing, production ecosystems and GPNs will need to be replaced by new approaches to understanding the changing nature of capitalist production systems. This book sets out an agenda for manufacturing research at the start of what will be a decade of rapid and extremely disruptive and destructive change that will transform consumption and production.

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Reference

Von der Leyen, U. (2019), Speech by President-elect von der Leyen in the European Parliament Plenary on the occasion of the presentation of her College of Commissioners and their programme, accessed 1 March 2021, available at https://ec.europa.eu/commission/presscorner/detail/es/speech_19_6408.