Chapter 1
Digital Transformation and Future Impacts in Logistics and Value Chains

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ABSTRACT

This chapter discusses the opportunities and challenges as well as the effects and impacts on value creation processes, work organization, and corporate management caused by the digital transformation, particularly in the area of logistics. At its core, the chapter highlights the potential for change associated with the design of flexible, networked, and resilient value creation systems. An overview of technologies and innovations according to the 4.0 idea is given, with solution components from the categories 'Strategies and Principles,' 'Methods and Models,' and 'Technologies and Tools' being presented in a structured manner. The topics of 'Resilience Management,' 'Value Stream 4.0,' and 'Artificial Intelligence' receive special attention in this context. At this point, the reader is given impulses as well as central fields of action for the digitization of processes, products, and services in value networks.

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DIGITAL TRANSFORMATION AND INDUSTRY 4.0

In this view, the digital transformation and in particular the concept of Industry 4.0 are interpreted as an evolution rather than a new revolution, as it is not characterized by the introduction of a single, disruptive technology, such as electricity, but rather describes the constant development of intelligent networks (Schenk, 2014). In this context, Industry 4.0 not only includes technical integration of so called cyber-physical systems (CPS) in manufacturing and logistics, but also involves the application of the Internet of Things and Services (IoTS), i.e., the network of physical objects, in industrial, value-adding processes (Kagermann et al., 2021; Kagermann et al., 2013). The aim is to create a network of objects and services with the internet in order to be able to communicate independently with the environment in the industrial sphere. In the following chapter, we will use examples to illustrate effects of digital transformation in terms of value creation, business models and forms and processes of work organization. Detailed definitions of various technical terms are explained in particular in chapters 2.1, 2.2, and 2.3.

Digitization involves the targeted conversion of analogous information into digital information and its networking through the use of intelligent information systems. Enterprise resource planning (ERP) systems, software solutions for corporate resource planning, play an essential role here, acting as a central data hub in the enterprise and combining the domains of human resources, logistics and manufacturing as well as finance in a single system (Friedl & Pedell, 2020). The consideration of various medium- to long-term planning and control horizons and levels, which aggregates individual parts to product families, consolidates this role. According to the automation pyramid, the connection of additional systems and technologies via interfaces support the horizontal, i.e., the exchange of information between different functional areas along the supply chain, as well as the vertical integration, i.e., the exchange of information between different aggregation levels of data, in the process and system landscape of an enterprise. Further examples for the vertical integration may be sensors, manufacturing execution system (MES) and decision support systems (DSS)) (Meudt, Pohl et al., 2017). This allows manufacturing and logistics processes to be designed more flexibly and efficiently (Plattform Industrie 4.0, 2017). Through real-time capable information processing, resources can be better synchronized, utilized to capacity, and more customized products and services can be generated. In order to implement digitization technologies with elements such as CPS or cloud technologies, and to enable the self-organization and control of automated machinery, it is primarily necessary to guarantee the legal framework up to data sovereignty and the decentralized control of large amounts of data.

Society, and with it the manufacturing and logistics environment, is changing due to the increasing interconnection of employees, objects, and machinery. This has an impact on everyday human life and will change working, communication and consumption behavior at the producer and consumer level. (Federal Ministry for Economic Affairs and Energy, 2015). In order to sustain their existence in the long-term, value-creating companies must take into account the needs of target groups (e.g., customers in B2B or B2C business). These needs are changing at an increasingly rapid pace and are becoming more specific toward customized solutions and ‘batch size 1’. These demands are undergoing rapid changes, with a growing emphasis on customized solutions, e.g. regarding the product features and details, and the shift towards producing goods in small, personalized batches, commonly known as ‘batch size 1’ (Federal Ministry of Labour and Social Affairs, 2017). As a result, companies are facing major internal and external challenges in order to secure their own competitiveness in the long term.