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The Digital Supply Chain of the Future: From Drivers to Technologies and Applications

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Abstract

The following text sections provide an overview to the minitrack on the digital supply chain of the future. The minitrack addresses research questions concerning drivers and challenges of digital transformation, basic technologies, applications and services, digital platforms as well as cultural and organizational change etc. After a short introduction the different papers of the mini track are described and embedded into an overall context. Towards the end of our contribution, we added some recommendations concerning future research on digitalization of firms, business models and supply chains.

1. Introduction

The side-effects of the Covid 19 pandemic, which are still affecting the economies, and the current crises such as the war in Ukraine have on the one hand impressively demonstrated the vulnerability of global supply chains. On the other hand, this has also brought the physical processes back into focus. Supply chains are based on physical structures and resources. Their management is complex and, due to decentralization and the variety of stakeholders involved, requires a high degree of visibility, e.g. with regard to available capacities, alternative routes and possibilities for consolidation and bundling. In addition to the constant striving for the most efficient possible utilization of these physical resources, which are always scarce because they are expensive, the last two years in particular have made us anew aware of how important it is not to forget the robustness and resilience of the supply chains. In addition to efficiency, this also affects properties such as flexibility, speed and agility in planning and controlling the chains. All of this is embedded in an environment that is increasingly being questioned in terms of its ecological and social sustainability.

In order to cope with this complex management task, there has always been a need for solid and timely available data that can be used to provide targeted information for the effective control and better reconfiguration of supply chains. Although many processes today, especially in transport logistics, for example, are still based on analog paper, the digitization of data is progressing and today provides data in abundance that was only accessible to a very limited extent in the past, even in the best ERP systems. New digital technologies such as the IoT, cyber-physical systems, embedded systems in autonomous and collaborative robots, automated guided vehicles and drones, cloud and mobile computing, digital cloud platforms and blockchain provide even more data that was not at all available before in an analog world, leading in total to a digital supply chain of the future. There seems to be consensus that digitalization with new technologies and digital initiatives can help optimizing traditional supply chains, improve control, and build greater resiliency and preparedness for future disruptions.

The mentioned digitization of the supply chains that may show different levels of progress across industries such as automotive, food or the logistics industry is a precondition for a digital supply chain. But it also creates new opportunities for digitalization in terms of value creation through new business models or even a redesign of supply chains or their key characteristics such as governance. All this now available pools of data have to be understood as sources of value creation. From our point of view, the technologies mentioned above in combination with data-driven services pave the way for a paradigm shift in supply chain management (SCM), leading to more self-organizing and self-optimizing ecosystems.

In our minitrack we intend accordingly to support the understanding of how digital transformation effects traditional product-oriented supply chains and the corresponding management activities and thus leads to the digital supply chain of tomorrow.

Digitalization in general is expected to play an increasingly important role for global supply chains. The reasons for this include: the shift in values from the physical artefact to the data created by smart products, the emerging importance of digital platforms, services and business ecosystems, the displacement of industry boundaries, the radical change of competitive structures and power distribution, the transformation of business models and, at the end of the day, the symptomatic creative destruction of established structures and behavioral patterns.

The four contributions that we can welcome to our minitrack this year are located precisely in this topical complex of digitalization. Illustrated within various industries such as the automotive industry, the logistics industry or the food sector, the authors investigate: how digital technologies can help simplifying complex optimization tasks or how the planning of physical processes can be supported by digital twins, or which components are addressed in the innovation of new business models or how the increased use of digital technologies can lead to a transformation of a classic supply chain towards an ecosystem. In the next section, these four individual presentations of the minitrack on the digital supply chain of the future are briefly outlined. At the end of this contribution, we provide some additional recommendations concerning future research topics.

2. Contributions

The first paper shows how complex optimization tasks can be better supported through the systematic use of digital technologies, in this case from the field of artificial intelligence. The authors focus on the business function of procurement, which, in contrast to marketing, for example, is often said to have less potential with regard to the use of AI. The concrete problem of optimization relates to possible cost savings through the bundling of purchasing requisitions. Based on an information processing theory and with the help of a design science research approach, the authors are developing a support tool for making better decisions regarding this complex task and present, in addition to their basic approach, also specific content regarding the underlying technical aspects such as the algorithms. A prototypical implementation of this AI-based bundling generator is illustrated and discussed by using a case from the automotive industry. [1]

The second paper deals with the technology of so-called digital twins. The starting point of the considerations is the postulated finding that traditional enterprise IS, especially in interaction with external

actors, have several blind spots that can be closed with modern digital technologies. In particular, the authors address the differences between these traditional enterprise IS and digital twins, which are based on the technology and architecture of an Industrial Internet of Things or the principles of cyber-physical systems. The presentation and discussion is based on a case study on the control of internal transport logistics in a large German production company. Since this internal transport is outsourced to a logistics service provider, the case study promises interesting insights into the interaction of different actors in a supply chain with the help of digital twins and the associated basic technologies [2].

The third paper deals with the development of business models based on digital technologies. The focus here is on digital platforms. The authors provide a primarily conceptual contribution that deals in particular with the question of which design topics are seen as relevant for the development of digital platforms in the context of supply chain management. A systematic literature review provides the basis for this. The findings are structured and presented along the building blocks of the business model canvas. [3].

The fourth contribution deals again with digital technology from the field of artificial intelligence. Here, the authors use an application in the food industry as a case study. In this specific case, it is about how animal products, especially dairy products, can be replaced by plant-based alternatives. In particular, this promises potential with regard to greater sustainability in the production of food. However, mimicking the texture or flavor is complex and requires new skills and cooperation that cannot be found in classic supply chain. AI is supporting here by calculating potential combinations of ingredients for plant-based products that are better capable of such a mimicking. The focus of the paper is less on the presentation of this concrete AI application. Rather, the authors refer to an observation, e.g. formulated in [5] that the increased use of digital technologies stands in certain contrast to the focal actor view in traditional supply chains. This potentially implies an uneasy transformation from supply chains to ecosystems [6]. In their paper, the authors show such an emerging ecosystem and discuss the implications [4].

3. Conclusion

In summary, the different contributions address important research topics that altogether span a nice range from new potential for optimization of known problems in established supply chains towards the transformation of supply chains into new ecosystems. The contributions refer to different supply chains and

are addressing technical, methodological and transformational topics in the field.

In addition, there are more topics that have to be addressed in future research on data-driven companies and supply chains. The following list contains some of these, in our view, highly important topics: Analysis of drivers of digital transformation of supply chains; supply structures for smart products and services; visibility and transparency through the Internet of Things; improved planning and forecasting through data analytics; decision making based on artificial intelligence; virtualization of supply structures; robots, cobots and other technology drivers for process automation; the impact of digitalization on business performance and industries; changes in the understanding of the terms Supply Chain, SCM, ecosystem; effects of digitalization on the target system of SCM; models, methods, tools and legal frameworks for the digitalization of companies and supply chains; barriers and challenges for the digitalization of supply chains; relationship between data security and digitalization of supply chains; requirements for the digitization of supply chains in the extended enterprise. A more structured research agenda on the digital supply chain of the future can also be found in Hofmann et al. [7].

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