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

Alexander Pflaum
University of Bamberg
alexander.pflaum@uni-bamberg.de

Günter Prockl
Copenhagen Business School
gp.digi@cbs.dk

Freimut Bodendorf
University of Erlangen-Nuremberg
freimut.bodendorf@fau.de

Haozhe Chen
Iowa State University
hzchen@iastate.edu

Abstract

The following text sections provide an overview to the minitrack on the digital supply chain of the uture. The minitrack addresses research questions oncerning drivers and challenges of igital transformation, basic technologies, applications and services, digital platforms as well as cultural and organizational hange etc. After a short introduction the different papers of the mini-track are scribed and embedded into an overall context. Towards the nd of our ontribution, we add some r ommendations oncerning future r - search on digitalization o firms, business models and supply chains.

1. Introduction

The framework conditions for value creation in a globalized world are changing in many ways. Events such as the COVID-19 pandemic, the war in Ukraine and the recent armed conflicts in Israel and Palestine are symptomatic for the volatility of global supply chains. Limited planetary resources combined with uninterrupted growth in the world's population are forcing companies to become more sustainable. The digitalization of the economy is leading to new data-driven and platform-based business models and fundamentally changing established value creation architectures. Against the backdrop of these changes, there are calls in the scientific community for new ways of thinking about supply chain management (SCM). Christopher and Holweg (, 2017), for example, call for models that focus on the structural flexibility of supply chains. Wieland (2021) speaks of "circular, postfossil, servitized and degrowth" supply chains and of a new type of SCM that focuses on the transformation of supply chains following the occurrence of a disruption or phenomenon within the supply chain, in the social and political environment or even on a planetary level.

The question of the operational implementation of these new thinking models by the companies involved in global supply chains remains open. Data and information in conjunction with modern information and communication systems have always been an enabler, if not the main enabler, for the implementation of new SCM concepts. It therefore stands to reason that this will also be the case in the future. The potential of diverse technological developments must be considered here. The Internet of Things and the closely related concepts of smart products and cyber-physical systems enable maximum transparency and, in conjunction with lightweight artificial intelligence processes, create the prerequisites for fast, agile and decentralized decision-making on the shop floor. Blockchain technologies, semantic web and knowledge graphs help to integrate different data sources and support the creation of digital representations of supply chains. These digital twins contain data and information that can be analyzed and used with the help of mathematical, statistical and Artificial Intelligence (AI) methods. Supply chain analytics offers the potential to describe complex value-added structures, predict their behavior, generate recommendations for action and implement these in a partially or fully automated manner. Cloud computing and digital service platforms on the internet enable analytics-as-a-service architectures, relieve the burden on in-house IT service providers and enable the fast and agile "reprogramming" of physical supply chains in the long term. At the physical level, modern autonomous systems and modern manufacturing processes such as 3D printing technology support the automation and virtualization of supply chains.

Ultimately, it remains to be clarified how the different technologies must be combined with each other in order to operationally implement the new SCM thinking models mentioned above and what contribution the individual technologies can make to this. It is precisely this question that the following briefly characterized contributions of our mini-track deal with. The spectrum of contributions ranges from the identification and classification of phenomena relevant to the further development of the SCM concept, to the

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examination of digital platforms in the SCM context, the discussion of the sustainability of supply chains from a data perspective and the development of a future vision of data-driven and AI-based circular SCM.

2. Contributions

The first article (Fischer and Papert, 2024) focuses on the question of which specific phenomena have influenced the development of SCM in the past. The basic objective is to identify and cluster the phenomena described in the academic literature to date. On this basis, the authors review and further develop the level model proposed by Wieland (2021) for the classification of relevant phenomena. In doing so, they address an open research question from the literature. Methodologically, a bibliographic analysis of the literature between 1976 and 2022 is used. Using a co-occurrence analysis, the authors identify a total of seven different clusters. Wieland's level model (2021) is extended by two further levels on this basis. The authors thus make a relevant contribution to a better understanding of the influencing factors relevant to the development of the existing SCM concept. On this basis, further scientific work can search for potential phenomena that will determine the future development of SCM

The second article by Papert et al. (2024) first provides an overview of trends, concepts and basic technologies that are important for the further development of SCM, based on a comprehensive literature review. On this basis, an initial framework model is developed for a corresponding information system supporting the SCM of tomorrow. This, in turn, is examined and further detailed by means of a single case study using an action research approach. The authors draw a fundamentally new vision of a closed-loop supply chain embedded in a superordinate business ecosystem and managed with the help of a federated and AI-based data ecosystem. They also outline a roadmap consisting of four phases for the transformation of traditional linear supply chains into corresponding closed-loop systems, based on the different dimensions of the concept of responsiveness according to Richey (2022). Practitioners can use this roadmap to assess the maturity of their own SCM activities. However, in view of the fact that the results are based on one single case study, the results can only be generalized to a very limited extent. The empirical basis must be expanded in further scientific studies.

In the next article, Görtler et al. (2024) deal with digital platforms for SCM. Based on a bibliographic analysis of articles on this topic published to date in highly ranked SCM journals, they identify eight different thematic clusters. A separate research agenda is developed for each of these clusters. The results of the analysis emphasize that the connections between digital platforms and SCM have so far only been researched superficially and in a comparatively unstructured manner. A consistent stream of research does not exist. More structured research on digital platforms and SCM first requires a typification of existing platforms. In a further step, the effects of the different platform types on existing global supply chains and their significance for individual economic sectors can be investigated.

The fourth article by Guennoun et al. (2024) deals with the question which data and information already available in logistics systems can contribute to more sustainable supply chains. Methodologically, a structured literature analysis is used. As a result, the authors provide a series of relevant data objects, a description of key attributes of the individual objects and a mapping to the dimensions of the triple bottom line on the one hand and to the sustainability goals of the United Nations on the other. They thus demonstrate the potential of data-driven services for the realization of sustainable logistics systems and supply chains, but also point out that there are still gaps with regard to the various sustainability goals of the United Nations that need to be closed with the help of data-driven services. This applies, among other things, to the goal of responsible consumption and production and thus also to the realization of closed-loop supply chains.

3. Conclusion

Overall, the contributions to the mini-track address highly relevant issues within SCM research The first article clearly shows that digitalization on the one hand and the demand for more sustainability and greater resilience on the other are key drivers for the further development of the SCM concept. The second article shows what contributions the realization of data- and AI-based supply chain control tools, the use of digital service platforms along the value chain and the transformation of linear supply chains into closed-loop systems can make to resilience and sustainability. It also provides a more detailed vision for the SCM of the future, which can be used as a guide for science and practice. The third contribution creates more transparency with regard to the research work carried out to date by the SCM community on the topic of digital platforms. It shows that the effects of such platforms on supply chains have only been researched to some extent at best and that there is a lack of a structured research stream within the SCM literature. The last article takes up the topic of sustainability again and points out the largely untapped potential of data-driven services for the realization of sustainable supply structures.

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. (2019).

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