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# Research Action Fields at the Nexus of Digital Transformation and Supply Chain Management: Findings from Practitioner Focus Group Workshops

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***Abstract*—**Logistics and Supply Chain Management are of crucial importance for organisational success. In the era of Digitalization, several implications and improvement potentials for these domains arise, which at the same time could lead to decreased competitiveness and could endanger long-term company success if ignored or neglected. However, empirical research on the issue of Digitalization and benefits purported to it by practitioners is scarce and mainly focused on single technologies or separate, isolated Supply Chain blocks as e.g. distribution logistics or procurement only. The current paper applies a holistic focus group approach to elaborate practitioner use cases at the nexus of the concepts of Supply Chain Management (SCM) and Digitalization. In the course of three focus group workshops with over 45 participants from more than 20 organisations, a comprehensive set of benefit entitlements and areas for improvement in terms of applying digitalization to SCM is developed. The main results of the paper indicate the relevance of Digitalization being realized in practice. In the form of seventeen concrete research action fields, the benefit entitlements are aggregated and transformed into potential starting points for future research projects in this area. The main contribution of this paper is an empirically grounded basis for future research projects and an overview of actual research action fields from practitioners' point of view.

***Keywords*—**Digital transformation, supply chain management, digital supply chain, value networks.

## I. Introduction

DIGITAL Transformation is imperative for society, economy and politics. The ongoing process of digitalization and the technological developments driving it, equally affects individuals and organisations. From an organisational point of view, this change offers many potentials for improvement at different stages and in different areas, one of these being Supply Chain Management. Digital Transformation is often purported to have fundamental impacts on traditionally linear supply chains and to provide the basis for the creation of digital, transparent, anticipatory, real-time and open Value Networks. However, despite the variety and plethora of Supply Chain Management (SCM) research, little attention has been given to actual use cases and challenges as well as to concrete research opportunities and specific action fields arising at the nexus of Supply Chain Management and Digital Transformation from practitioners' point of view. Hence, the research question underlying this paper is as follows: What are the research action fields created by Digital Transformation in Supply Chain Management according to SCM experts and practitioners?

Due to the limited availability of comparable, empirically grounded material, a combination of practitioner interviews and focus group workshops is applied as the main research technique of this paper. Hereby, knowledge is constructed and empirically grounded insights are derived.

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## II. Literature Review

### *A. Logistics and Supply Chain Management*

The origin of the term logistics can be traced back to as early as 1898, when it was first mentioned in the context of French military applications as the process or the art of moving and quartering troops [1]. During both world wars, logistics received much attention and its description was extended to include "all the activities and methods connected with the supply of armed force organizations, including storage requirements, transport and distribution" [2]. Following its success in a military context, logisitcs soon became an acknowledged term in a business context as well. By introducing the notion of Supply Chain, the definition of logistics was further extended and adopted to the business context. The Council of Logistics Management (CLM) defined logistics as "part of the supply chain process that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements" [3]. As a response to this evolutionary development of logistics and the introduction of the Supply Chain concept, the term Supply Chain Management emerged as a theoretical construct defining the integration of all the activities along the Supply Chain into a seamless process on a strategic level. Logistics on the other hand can be placed within the rather tactical and operative realm of the supply chain and could be considered as part of the execution of Supply Chain Management activities [4].

To summarize this short introduction and to present our view of logistics and Supply Chain Management, the following distinction between these two concepts is defined as a basis for this proposal:

- Supply Chain Management (SCM) is defined as the management approach concerned with systemically dealing with strategic coordination of traditional business functions and the tactics across these within an

organisation and across partner organisations along the supply chain, with the aim of improving long-term performance not only of the individual organisation, but also of supply chain as a whole [5].

- Logistics includes the process of managing the physical flow and storage of goods and materials from its acquisition to its consumption or usage.

Despite this rather elaborate definition of SCM, there are several issues with the notion of "chain". Especially against the background of the current, highly dynamic, increasingly networked and growingly complex, economic environment, the next evolutionary step in the area of digitalization seems necessary.

### *B. Digital "Value Network Management"*

Mentzer's definition of SCM [5] clearly states the holistic claim of not only focussing on individual companies and chains but also of integrally considering network structures as a whole. The creation of a system-wide total optimum is defined as the aim of SCM. Nonetheless, current Supply Chain Management and logisitcs practices are often conducted in the form of isolated, functional activity blocks and the focus on supply, production and distribution logistics still seems to be the common practice. The traditional view of Supply Chain Management in economic practice is still characterized by the chain-paradigm and the predominant focus on integrating customers, suppliers, partners and OEMs in more or less isolated, sequentially lined up blocks of activities. This approach to SCM has worked more or less satisfactory in the past, but has increasingly led to problems and inefficiencies in current, increasingly complex economic environments [6]].

Significantly increased coordination effort and coordination intensity is just one effect of increased network complexity, which in turn results from higher environmental dynamics and network intricacy. A rising amount and variety of endogenous and exogenous logistics parameters as well as the heterogeneity of their interrelations lead to intricate systems, which e.g. manifest themselves in the form of highly individualized products and services or the growing importance of sustainability related issues. At the same time, higher environmental dynamics lead to shorter life cycles of nodes and edges in enterprise networks. Long proven network structures and relations are no longer stable and are subject to disruptive change and network dynamics [7].

Traditional logistics and current Supply Chain Management won't be able to tackle these challenging developments [8,9]. The shift from a chain- to a network-paradigm has already begun [10] and the need for a more responsive, anticipatory and network-oriented approach is recognized in industry and academia [11, 12]. Thinking in Supply Chains will shift towards a digital mindset of transparent, customer centric and holistic Value Networks. Such digital Value Networks require transparency across the different stages of the whole system, intensive collaboration, the willingness to share relevant information and data both upstream and downstream and the technology (i.e. hardware) and intelligence (i.e. software) needed to collect, analyse, evaluate and process Value Network events (i.e. data and information). In order to further evaluate this argumentation, the current paper aims an analyzing this issue also from practitioners' point view. The research methodology applied to reach this objective is described in the subsequent section.

## III. Research Methodology

The research methodology of the paper comprises a set of practitioner interviews and focus-group workshops to collect research needs at the nexus of SCM and digitalization from practitioners' point of view. Focus groups are an acknowledged research technique and have long been applied in various research settings [13]. Focus group studies aim at analysing clearly defined areas or set of issues (i.e. the focus) by means of group discussions [14, 15]. The interaction between members of a focus group is a central element and source to collect information, which would be difficult or impossible to be elaborated in classic one-to-one expert interviews [16]. Encouraged by a moderator, a small group of people shares ideas and thoughts on open ended predefined questions. A typical focus group, as defined in literature consists of three to twelve participants, depending on the source of literature [17,18].

In the current paper, three focus group workshops where conducted. The first workshop included 2 groups of 12 participants, the second one 11 participants and the third one 10 participants. Each time, different organisations where included, ranging from retail, metal industry, automotive sector and IT-sector to logistic service providers, waste management, fast moving consumer goods and infrastructure providers. Hence, a wide range of different industries and service sectors could be included in the focus group study. A senior researcher respectively a professor was responsible for focus group moderation. Additionally, collaborative notes where taken by the moderator and the group using flipcharts and whiteboards. Additionally, a second observer took notes.

## IV. Results and Discussion

The main result of the conducted focus group workshop is a set of seventeen research action fields at the nexus of SCM and digitalization. The aggregation of results was done based on the qualitative content analysis (QCA) approach proposed by Mayring [19]. The development of a structured coding scheme and the analytic procedure of QCA further increased the validity of research results and allowed for a category definition as near to the documented focus group results as possible. The research action fields were deduced tentatively, and the fields were step-by-step revised and where necessary reduced respectively combined. Additionally, the technique of peer debriefing was applied in the course of QCA, which also contributes to research validity [20].

The final list of research action fields is described in the following paragraphs. Each of these fields represents a potential starting point for adapting existing technologies and research results respectively for developing new solutions and deriving new research project and endeavors. Subsequently,

these research action fields are explained:

**Mapping and analysis of Supply Chain Network structures**: This includes e.g. the visualization of strategic and tactical network-level structures and partners, the relationships between these partners, the identification of central players and hubs or the identification of deviations between actual and target states based on control charts.

**Identification of criticalities in networks** (i.e. critical partners and the relationship to or between them): This includes e.g. the evaluation of supplier, customer or material criticality in comparison to other network parts or players, the analysis of network elements in regard to their vulnerability to e.g. supply restrictions or the analysis of susceptibility to environmental impacts.

**Creating transparency in critical network paths**: This includes e.g. the identification of blind spots in critical network paths and the resulting need for additional data integration and its realization or sensor based systems or the identification, development and provision of supporting data analysis methods and tools if existing data is not exploited sufficiently enough.

**Creating near real-time transparency of physical flows**: This includes e.g. the identification of conceptual requirements for sensor-based solution applicable to close blind spots in critical network paths, the technological development of prototypical sensor systems and their implementation in defined demonstrator settings or transport infrastructures.

**Identification of patterns in Supply Chain Network and logistics data**: This includes e.g. identification and analysis of Demand Patterns, Usage Patterns, Order Patterns, Transport Patterns, Storage Patterns, Damage Patterns, Seasonal Patterns, System Patterns, Location Patterns, Service Patterns, Infrastructure Patterns, Supplier Patterns, Customer Patterns, pattern-triggering events, Similarities & Connections in data etc.

**Unveiling actual drivers of complexity in SC networks**: Based on pattern analysis, the actual triggering events, i.e. the actual drivers of network complexity resulting in e.g. out-of-stock situations or the need for express deliveries, have to be identified. This includes e.g. the evaluation of network partner performance based on deeper insight, the identification of critical and non-critical players (customers, suppliers, service providers etc.) adding high level complexity, the provision of data based decision basis for deriving network adaption requirements or the quantitative basis for justifying decisions made in the context e.g. supplier quality evaluation.

**Analysis and evaluation of alternative reactions to network events** based on data aggregation and analysis: This includes e.g. the simulation of possible reactions to e.g. abruptly changed customer demands or seasonal variance, unforeseeable critical events as e.g. earthquakes or terrorist attacks and to possible future scenarios on a strategic network level. In order to enable this, complex simulation-supporting network models have to be developed and possible measures have to be mapped in suitable optimization scenarios as input source for these models.

**Enabling predictive actions for future network events based on data aggregation and analysis**. This includes e.g. the prediction of customer demands, seasonal changes, future bottlenecks in terms of e.g. out of stock or out of transport resources. Based on identified triggering events, these predicted future events can either be alleviated by means of e.g. adapting stock levels, transportation resources or changed quantity structures, or they can be reinforced in terms of desired future situations. Possible future events to reinforce could e.g. be the possibility to decrease stock levels or transport kilometers based on e.g. alternative sourcing, warehousing or routing strategies.

**Evaluation and analysis of use-cases for applicant-distant future SC network technologies**: This includes the in-depth analysis of Blockchain technology and Deep Learning in regard to their specific application fields in SC network structures, the quantitative evaluation of their impact on SCM key figures and the definition of the specific value added along and across internal and external network stages. Based on clearly defined and evaluated use cases, further decisions whether and at which stages a technology is applicable and reasonable can be made.

**Definition of future SC network technology requirements**: This includes the analysis of technical requirements of e.g. Blockchain-based solutions and of Deep Learning algorithms in defined SC network use cases. This provides the basis for identifying weaknesses of status quo of these two approaches and allows for the definition of technology adaption and research needs arising out of this.

**Analysis of prerequisites for applying future SC network technologies in existing network structures**: This includes research work packages aiming at identifying the non-technical requirements for implementing Blockchain and Deep Learning SC network structures (e.g. legal, organisational, cultural and process-respectively network-related factors as e.g. trust or compliance levels).

**Assessment of feasibility and viability of future SC network technologies**: Based on the quantified use cases, the adaption effort due to technical weaknesses of existing Blockchain or Deep Learning solutions and the prerequisites to implement these technologies, a clear decision basis can provided to organisations. The result is a detailed cost / benefit analysis on the one hand and a set of technological and organisational requirements on the other hand.

**Strategic Roadmapping of future SC network technology implementation**: This includes the strategic roadmapping of concrete next steps and projects required to create the organisational basis for implementing e.g. Blockchain and Deep Learning in the specific use case settings. Depending on the individual maturity of the respective organisations, this may include the creation of interfaces at system levels, the adaption of specific process steps in accordance with aimed at improvements or the general organisational willingness to share data in distributed ledger systems.

**Prototypical development and demonstration of future SC network technology use cases**: This includes the

development and / or adaption of new / existing Blockchain and Deep Learning-based solutions to specific use cases where implementation requirements from an organisational point of view are already given. The aim of these demonstrator-elements should be to prove the practical feasibility and the economic viability of these still applicant-distant technologies.

**Identification and Evaluation of trend-based implications on SC network structures**: This includes 1) the identification of disruptive events (i.e. new key technologies (e.g. 3D-print, VR, etc), socio-demographic trends (e.g. workforce shortage, ageing society, etc.), changing customer demands and service requirements (e.g. product-service bundling, order behavior, lot sizes etc.) or political and environmental trends (e.g. e-mobility, sustainability, etc) and 2) the evaluation of the specific impact of these events in terms of their implications on SC network processes, value propositions, product-service combinations, future criticalities and structural network issues. The result of this should include e.g. quantitatively described scenarios of possible future events and trends with a long-term orientation and their potential, quantified impacts on value network design.

**Definition of strategic scenarios as input for Value Network Simulation and Optimization**: Based on the trends and disruptive events identified and evaluated in the form of quantitatively described scenarios, this block includes the preparation of optimization scenarios for simulation models of strategic Value Networks structures. The goal should be to identify the actual, predicted implications of specific trends on complex network systems by taking into consideration critical paths and network key players. The results of simulation could enable organisations to e.g. evaluate the relevance of certain partnerships (customers/suppliers/service providers), the rentability and reasonability of different e.g. hub locations or warehousing infrastructures or the impact of product-service bundles on strategic and tactical network levels.

**Identification and conceptualization of potential Value Network adaptions** as basis for long-term, network strategy planning: This includes e.g. the identification of strategic action fields based on the scenarios evaluated and tested. Possible results should include e.g. product-service bundling, strategic approaches to customer segmentation based on their network relevance, redesign of supplier network structures, the identification of possible joint-ventures respectively of mergers & acquisitions activities or the simulation-based identification and evaluation of possibilities for outsourcing and integrating third-party logistic service providers.

Based on the argumentation presented in the literature review chapter and building on the results of the conducted focus group workshops and interviews with practitioners, the next evolutionary step of Supply Chain Management in the form of Value Network Management has to consider the following benefit entitlements and abilities

1) Transparency and decision support by generating and exchanging data and by collecting and visualizing critical Supply Chain events and paths
2) Anticipatory network optimization as response to foreseeable events by means of intelligent, network-oriented data analysis and pattern recognition
3) Rapid responses to unforeseeable network events and changing network conditions in terms of increased network resilience
4) Ability to proactively and pre-emptively act from a holistic and strategic network-perspective instead of passively reacting in isolated Supply Chain silos
5) Analysis of application-distant solution approaches (e.g. Blockchain, Deep Learning, etc.) in regard to their potential to recast Value Network Management and their implementation in prototypical and evolutionary demonstrator-settings
6) Strategic Value Network design and (re)configuration based on early signals of disruption & change and integration of the implications in strategic Value Network planning

Against this background, we define "Value Network Management" as the next evolutionary step of SCM as an approach to overcome the crucial challenges introduced above and to address the research action fields identified.

Value Network management is defined in our present context as a management approach focussing on tactical and strategic network levels and putting into use software and hardware technology enabling organisations to 1) understand, depict and analyse their logistics and Supply Chain networks, 2) identify, evaluate and weight the influence of criticalities in Value Network systems, 3) acquire the ability to focus and provide selective transparency where necessary and appropriate, and to 4) develop, design and implement responsive Value Networks on strategic, tactical and in case of need on operational level.

The main challenges respectively prerequisites of VNM are:

1) the creation data- and event-based transparency of goods-, information and financial flows in critical network paths and the enabling of monitorability of value networks,
2) the establishment of intelligent analysis and predictive evaluation of collected events and event patterns as basis for pro-active network optimization and
3) the implementation of the ability to allow for early identification and evaluation of future demands and trends and the analysis of their implications on value networks in the form of potential future scenarios as the basis for strategic measures.

## V. Conclusion

The findings of this paper indicate that proactively driving the digital transformation of existing Supply Chains into digital Value Networks instead of just reacting passively to it is amongst the top priorities of Supply Chain Management experts and practitioners. The traditional view of Supply Chain Management with its predominant focus on integrating customers, suppliers, partners and Original Equipment Manufacturers (OEMs) in more or less sequentially lined up Supply or Value Chains will shift towards a more future oriented, digital mindset with customer centric, demand driven and holistic Value Networks in its core. Based on the results of three expert focus group workshops, three main areas were

found to influence the future of Supply Chain Management: 1.) hardware technologies (e.g. sensor systems, microelectronics etc.); 2.) software solutions (e.g. Artifical Intelligence, Simulation and Optimization, Pattern Recognition, Blockchains & Distributed Ledgers, Prediction Algorithms, Deep Learning etc.); and most important 3.) the Logistics and Supply Chain Management domain expertise to apply area 1 and 2 in Supply Chain Management application fields and to actually transform the supply chain by applying a "problem-2-solution" approach (e.g. in the form of Value Network Mapping & Monitoring, Preemptive Supply Chain Management, Logistics 4.0, Physical Internet, Supply Chain Network Simulation, Dynamic Supply Chain Data Clouds etc.). The results of this paper confirm that being able to combine these three areas, to focus on the problem domain of complex SC networks and provide insights into these complex structures as a basis for technology adaption and development (i.e. problem-2-solution) will be a fundamental capability and a critical success factor for future research projects and endeavors in Supply Chain Management. We introduce the term Value Network Management as one possible approach to enable organisations to master future SC networks. The substantial contribution of the papers is the described set of action fields, which were aggregated based on practitioners' needs. These fields and their descriptions represent the basis for deriving specific future research projects from a scientific and for developing a strategic (project) roadmap from practitioners' point of view.

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