
Guest editorial: (Un)physicalization (digitalization) of supply chain management

Guest editorial

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1. Introduction

The new era of digitalization has brought up new challenges, concerns and opportunities. The present special issue entitled (Un)physicalization of Supply Chain Management provokes new reflection on the digitalization of supply chain management (SCM). The traditional meaning of the term SCM refers to the movement of goods and services from a producer to a final consumer (Cooper and Ellram, 1993; Lee *et al.*, 2020). SCM encompasses all information processed by this movement (Hvolby *et al.*, 2007; Lambert and Cooper, 2000). The unphysicalization of SCM means information is shared, costs are negotiated and goods are listed in a virtual environment (El Sawy *et al.*, 1999; Mital *et al.*, 2018; Malhotra *et al.*, 2005; Vendrell-Herrero *et al.*, 2017; Scuotto *et al.*, 2017). This has encouraged the development of intelligent infrastructures and dynamic systems built on adaptive supply chain relationships (Malhotra *et al.*, 2007). SCM can be shifted “from isolated, local and single-company applications to supply chain wide systematic smart implementations” (Wu *et al.*, 2016, p. 396). In this context, Wu *et al.* (2016) consider SCM “smart” being (1) instrumented, (2) interconnected, (3) intelligent, (4) automated, (5) integrated and (6) innovative and call for more studies on (1) information in supply chains, (2) IT, (3) process automation, (4) advanced analytics and (5) process integration and innovation.

To realize Smart SCM lots of unknown and new challenges must be addressed. According to McKinsey (2016) the unphysicalization (or digitalization) of SCM is characterized by three phases: starting from SCM 2.0, the digitization was commencing but it was still at its infancy with many processes carried out manually. Big data were not leveraged to support any decisions at this stage of digital transformation which is expected to come through in the SCM 3.0 and later moving toward the 4.0 digital tier, putting in place some digital devices such as the internet of things, drones and robots among others (see also Hofmann *et al.*, 2019). The first challenge is the development of digital technologies and infrastructure to digitalize SCM. Morenza-Cinos *et al.* (2019) show retailers are in an early phase allowing academic researchers to experiment with the use of IoTs (Internet of Things) for capturing inventory data. The “Just Walk Out Technology” used in Amazon Go and Amazon Fresh relies heavily on the integration of facial recognition, camera, mobile apps and mobile payment technologies. Even though Amazon aims to sell the technology, the technology is still expensive while Amazon’s rivals would prefer to engage with other start-ups.

Digitalization is not just about automation; the main benefit is in the data itself. As international suppliers offer their goods and/or services to a broad number of buyers through electronic platforms there is an opportunity to adopt predictive analytics (Handfield *et al.*, 2019). So, the main question supply chain managers ask when considering installing sensors or Internet of Things concerns the types of data that could support the vision to

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create smart SCM. Richey *et al.* (2016) reveal there is no consensus among supply chain managers regarding big data's definition and its characteristics as compared to the academic literature. Some managers recognize big data as costly though it may help integrate the supply chain. Handfield *et al.* (2019) point out that the "low usage of advanced procurement analytics" is partly caused by the lack of a "coherent approach to collection and storage of trusted organizational data" and they suggest that the use of "ad-hoc approaches to capturing unstructured data must be replaced by a systematic data governance strategy" (p. 972). The human ability of using new technologies generates big data exchange and a cross-supply chain model (Scotto and Mueller, 2020).

2. Smart SCM: micro perspective

Recently some practitioners have started to debate whether the traditional SCM is going to disappear in five or 10 years due to unphysicalization of SCM (Lyall *et al.*, 2018). This is thought to occur due to the pervasive digitization of all SCM functions which involves the adoption of sensor data to reduce downtime, blockchain to avoid asymmetric information, robots to optimize warehouse spaces and drones which may be used for delivery (Hald and Kinra, 2019; Gurtu and Johny, 2019). While some companies with traditional SCM view digital/smart SCM (e.g. Amazon) as new threats, they struggle with strategic uncertainty. The unphysicalization of SCM could potentially lead to new benefits for the business in terms of more options of suppliers' choices (Lepak *et al.*, 2007; Porter and Heppelmann, 2014), financial convenience (Kshetri, 2018) and even more transparency (Lechler *et al.*, 2019). However many chief SCM officers are still struggling to position their goals and choose whether to use digital technologies to gain efficiency (automation) or to embed those advanced new technologies into their business realities (as their new rivals do) to become a leader in smart or intelligent SCM.

The impacts of digitalization on human resources raise urgent concerns. Feng and Shanthikumar (2018) stress the need for sharing abilities and skills either for big corporates or small to medium sized enterprises. But small enterprises are not financially equipped to innovate. Lyall *et al.* (2018) also highlight the threat of losing jobs as digital technologies are gradually replacing human workforces. However Schniederjans *et al.* (2020) comment that the new technologies can digitize process and organizational learning but there is still a need for strategic thinking that, for now, only human beings can develop. Yet, new knowledge about how to gain relevant insights from big data is required (see also Ardito *et al.*, 2019). The conceptualization of intelligence capabilities requires further clarification (Wu *et al.*, 2016).

2.1 SCM and organizational performance of digital technologies

Despite the ambiguity surrounding ways to (un)physicalize SCM, the literature is still largely focused on testing and speculating on the organizational performance of digital technologies. In fact, there are still many unanswered questions about the ways to achieve smart SCM (Wu *et al.*, 2016), what big data means (Richey *et al.*, 2016), how to build data and cognitive analytics (Handfield *et al.*, 2019), the dilemma of real time data (Lechler *et al.*, 2019) and how to move forward from experimental technology such as RFID robot to real implementation (Morenza-Cinos *et al.*, 2019) while academia has only started to explore research opportunities related to industry 4.0 and SCM 4.0 (Hofmann *et al.*, 2019).

It would be beneficial to complement such research in logistics and SCM management journals using insights from operations and production management fields to information fields. For instance Boehmer *et al.* (2020) offers an "operational service model" that involves an efficient mode of information exchange by IoT technology between buyers and suppliers. Whereas Haddud and Khare (2020) stress the improvement of operation practices by

digitalizing supply chains. This is also enforced by [Scuotto et al. \(2017\)](#) who highlight the use of new advanced technologies to share knowledge in the context of supply chain management. Studies on the information field have also demonstrated that the greater the flexibility of the information system the smarter is the supply chain ([Gupta et al., 2019](#)). In turn it strengthens the bonds with supply chain partners by integrating customer knowledge in the e-business environment ([El Sawy et al., 2015](#)).

[Malhotra et al. \(2005\)](#) state that supply chain partners are “building information technology infrastructures that allow them to process information obtained from their partner to create new knowledge” (145). In fact exploring SCM from a knowledge management perspective in the context of digital SCM ([Schniederjans et al., 2020](#)) can lead to many new research arenas. In this sense the present special issue offers six interesting and insightful research. [Rasool et al. \(2023\)](#) adopt a knowledge-based view to analyze the impact of reverse logistics adoption on firms’ digitalization and collaboration activities. This article entitled ‘What is next? The effect of reverse logistics adoption on digitalization and inter-organizational collaboration’ explores how embracing sustainable logistic practices (reverse logistics) gets firms ready to implement digitalization within their organization and adopt a collaborative approach. Empirically they have employed a longitudinal survey using data from two different periods: 2017 and 2019 from the Mannheim Centre for European Economic Research. As the authors state “the knowledge generated by reverse logistics adoption can be an essential pillar and enabler toward achieving firms’ digitalization and collaboration goals”.

Keeping in mind the knowledge perspective, the article by [Pizzichini et al. \(2023\)](#) entitled ‘The role of digital knowledge servitization in supply chain management’ investigates the relationship between digital servitization and knowledge management. As emerged digital knowledge servitization shifts the supply chain business model toward an open innovation framework. The authors examine such a shift using a case study analysis of Volvo Group. They have also adopted a knowledge base view to explain how digital knowledge servitization is affected by the inbound and outbound open innovation process ([Bogers et al., 2018](#)). In the same view, [Gagliardi et al. \(2023\)](#) discuss the concept of digital supply chain. By employing a knowledge management perspective the authors conduct a literature review to explore past and recent studies on governance and management in the digital supply chain domain. They have highlighted two research main streams: (1) digital supply chain and knowledge management in the business culture development and (2) digital supply chain and knowledge management in the business technological evolution.

Staying on a conceptual perspective, [Perano et al. \(2023\)](#) explain how digitalization can improve supply chain performance. In the article entitled ‘Embracing supply chain digitalization and unphysicalization to enhance supply chain performance: a conceptual framework’, the authors provide a framework based on three dimensions namely; (1) digital technologies; (2) business processes; and (3) SC performance. Again through systematic literature review it has emerged that the combination of these dimensions allow the generation of best practices which call for big data management.

The special issue also presents an empirical study entitled ‘Agility and digitalization: why strategic agility is a success factor for mastering digitalization – evidence from Industry 4.0 implementations across a supply chain by Yuko Melanie Pfaff (2023)’. This article offers an interesting microfoundation perspective analyzing the dynamic capabilities related to digitalization of supply chains. It explores this scenario adopting a multiple case study methodology which employs in-depth interviews aimed at managers working in the manufacturing industry. The results show a synergistic combination of inter-firm resources to facilitate the digitalization of the supply chain. It was found that strategic agility is a relevant capability which enables a company to be adaptive to market changes. Again, by offering a micro view, [Karttunen et al. \(2023\)](#) identify interventions and mechanisms for

purchasing and supply chain management (PCM) processes in the digital transformation context. Considering the previous work of [Lorentz et al. \(2021\)](#) it has emerged that data infrastructure is crucial for PCM processes. As stated “the data infrastructure needs firm-wide global governance and open standards that allow interoperable, generic data sets that are located on platforms” (p. 14). Furthermore applications are useful to integrate data and overcome organizational limits. In the conclusion they retain that “transforming the data infrastructure is the primary intervention because it will enable performance improvements in supplier measurement due to integrated, generic supplier data” (p. 14). New insights are provided with practitioners to implement I4.0 technologies and embrace new skills within the business. Overall digitalization has been revolutionizing the way companies develop a supply chain and manage their intangible assets like knowledge. Digitalization can facilitate all forms of information sharing, communication and management of interfirm relationships and strategic alliances, etc. ([Yang and Lirn, 2017](#)) involving both big corporates and small to medium enterprises (see [Lucia et al., 2023](#); [Lee et al., 2020](#)).

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