EXPLORING THE KEY FACTOR CATEGORIES FOR THE DIGITAL SUPPLY CHAIN

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ABSTRACT

The Digital Supply Chain (DSC) phenomenon has recently emerged as a result of the advancement in technology, complexity, and dynamics of today's competitive market. Researchers have explored the competitive advantage of moving from the traditional supply chain to the digital supply chain. Some of the most apparent benefits include the integration of the physical supply chain with digital technology, in real time, to optimize organizational performance through the improvement of supply chain visibility, responsiveness, robustness, and resilience. On the other hand, this transformation of the supply chain brings with it a host of challenges and issues that might make organizations "more vulnerable" and a "source of chaos." The digital supply chain phenomenon is still in the preliminary stages of academic research, and the literature review is "fragmented." In this research, we explored the existing digital supply chain literature to identify and classify factors for organizations to migrate from the traditional supply chain to the digital supply chain. We used a systematic literature review method to analyze papers matching our research criteria. Structured content analysis was used to review 106 English articles published in peer-reviewed and accredited journals from 2002 to 2019. The result showed that supply chain integration, collaboration, coordination, strategy, technology & worker skills, and adaptability are among the significant factor categories that should be addressed to assess the readiness of an organization to adopt a digital supply chain.

Keywords: Supply Chain, Digitalization, Industry 4.0

1. INTRODUCTION

Supply Chain Management (SCM) entails the management and value creation of goods and services in the flow of the supply chain (Aamer 2018b, 2004). The Supply chain comprises all activities from product development to logistics, including production and manufacturing, resources, transportation, and inventory (Birker & Hartmann, 2019). The field of SCM has evolved from being a mere cost center to a strategic initiative for organizations. Different products and services require different supply chain strategies, which must be aligned with market demand

(Aamer 2019, 2018a, 2017). The Digital Supply Chain (DSC) phenomenon has recently emerged as a result of the advancement in technology, complexity, and dynamics of today's competitive market. Researchers have explored the competitive advantage of moving from the traditional supply chain to the digital supply chain. Some of the most apparent benefits include the integration of the physical supply chain with digital technology, in real-time, to optimize organizational performance through the improvement of supply chain visibility, responsiveness, robustness, and resilience (Gunasekaran et al, 2017). On the other hand, this transformation of the supply chain brings with it a host of challenges and issues that might make organizations "more vulnerable" and a "source of chaos." According to Büyüközkan and Göçer (2018), the digital supply chain phenomenon is still in the preliminary stages of academic research, and the literature review is "fragmented."

Improving the supply chain should increase efficiency to reach organization goals. Some technologies are significantly impacting the supply chain, which are big data, cloud computing, robotics, 3D printing, and mobile technology (Farahani et al, 2015). To meet the dynamics of customer demands in a highly competitive environment, the supply chain must be efficient, and cost-effective to improve operations (Fatorachian & Kazemi, 2018). This is a high level of digitization and automation within and outside the organization's supply chain (Rashid & Tjahjono, 2016). In this paper we tried to answer the following research question: What are the key factors for assessing an organization's readiness for supply chain digitalization? To address this question, we conducted an integrative and systematic literature review through content analysis. The following sections present the background, methodology, results and discussion, and conclusion.

2. BACKGROUND

Several researchers have addressed the digital supply chain (supply chain 4.0 or supply chain in industry 4.0). However, most publications only cover the application of the digital supply chain in different sectors. Therefore, the justification of the digital supply chain still needs to be pursued to deeply comprehend and to adjust the complexity and condition of the chain, as well as the evolution of supply chain threats and challenges. The readiness factor of the digital supply chain in an organization should have been identified in the first place, as it happens to be the determination gate for whether the organization can implement it well or not. An organization should have known what they need to have according to the critical factor readiness of the digital supply chain. Sony & Naik (2019); Akyus & Reyhan (2009) agreed that there is a need to identify the key factor (an organization's readiness) in a holistic view to transform into Industry 4.0. A digital supply chain is one of the scopes, to analyze the readiness factor and to assess the adoption of critical factors. Queirozet al., (2018) also stated that talent insufficiency, visibility lacking, inefficient models, obstinate technologies and poor response times can be solved by adopting digitalization of the supply chain. Iddris F (2018) stated that there is a lack of digital supply chain study. This evidence is supported by the study of Kakhki & Gargeya (2019) that addressed the intersection between supply chain management and information system topics. The digitization of the supply chain and the key factor is assumed to be clustered in supply chain technologies and technology transfer studies, in which it doesn't have the highest co-appearance among all published papers meant to be discussed. As a result, an investigation into the big picture of conceptualization and theoretical progress, that can be presented in a literature review or qualitative case, should be undertaken.

According to Queiroz et al (2018) supply chain planning accuracy and distribution operations can be leveraged by the digital supply network as it forms network visibility all over the value chain. For that to happen, a connection between digital technology and supply chain function must be built. As it goes, the adoption of the digital business model in the beginning will have a consideration for supply chain management modification (Makris et al, 2019). In adopting a digital transformation, an

organization must be aware of the requirement for the benefit to be optimized and that the risk of loss can be mitigated.

A key driver to Industry 4.0 is digitalization which has different methods for each organization to deal with (Bienhaus & Haddud, 2017). According to Makris et al (2019) supply chain 4.0 is related to three main emerging trends which are big data, cloud computing and 3D printing. In each emerging trend, there are different levels of adaptability for different industry sectors. For example, the chemical industry with the least possibility of SC transformation; food & beverages, transforming with slow speed; high tech, the fastest growing sector in digitalization; pharmaceuticals, struggling to determine a strategy to transform; retail, digitalizing marketing but not yet the supply chain.

3. METHODOLOGY

In this research we used the systematic literature review. The most recent publications in the area of supply chain digitization were utilized as a guideline for our research and to retrieve important and related citations; Burgers et al (2019), Rodero et al (2018), Gupta et al (2018), Fortin et al (2012), Bearman et al (2012), Seuring & Gold (2012) and Ganann et al (2010). We followed a three-step systematic review methodology as depicted in Figure 1(Rodero et al, 2018). The first step involved the preparation of our literature review, the second step involved the literature search itself, and the last step was the analysis of the collected literature.

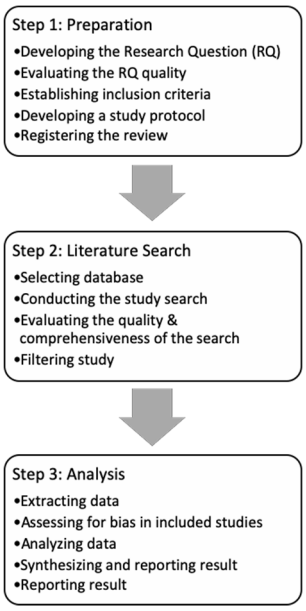

Figure 1. Systematic review methodology

The selected publications were sourced from accredited peer-reviewed journals. The authors screened and read several articles that were selected as the key factor of the digital supply chain. The reading was conducted independently to get a personal understanding of the content of the article. Then, the articles were discussed jointly to have a better perspective and interpretation of the key factor categories of the supply chain digitization.

4. RESULTS AND DISCUSSION

The categorization of supply chain digitization factors was based on the reviewed publications' themes and the content analysis. As a result, we weighted main factor categories for

supply chain digitalization based on the review of 106 digital supply chain related articles. Only 41, out of the reviewed 106 articles, discussed the digital supply chain factors. Hence, we devised six categories included supply chain integration, collaboration, coordination, strategy, technology & worker skills, and adaptability. It is worth mentioning that we derived the six main categories based on several publications as depicted in Figure 2.

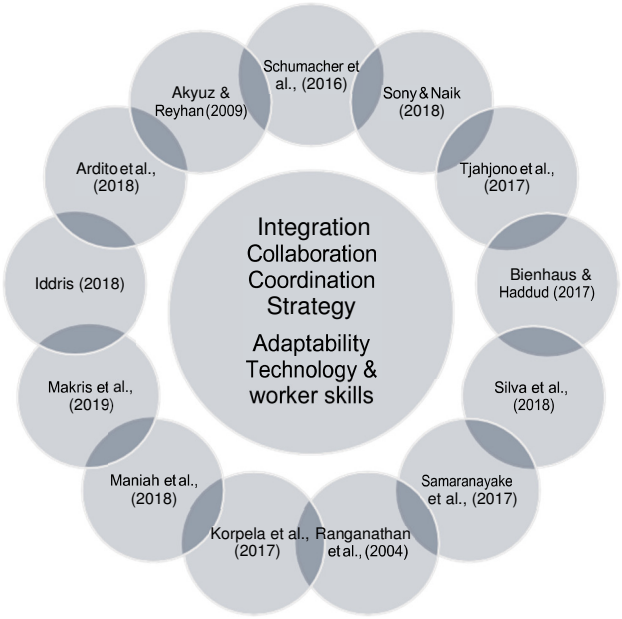

Figure 2. Digital supply chain categories in relation to the most relevant publications.

Table 1 presents a summary result of the factor categories and the related publications in the SCM digitalization body of knowledge. The total publication in supply chain integration is 36.58%, supply chain collaboration is 14.63%, supply chain coordination is 17.07%, supply chain strategy is 4.87%, organization adaptability (flexibility) is 7.31%, technology transfer and skilled worker is 19.51%.

Table 1: List of factor categories and related papers

Factor Categories	Authors	Number of Publications
Integration	Hsu & Wallace (2007), Ghadimi et al. (2019), Nurmilaakso & Kotinurmi (2004), Wang et al., (2006), Zhou et al., (2016), Yu (2015), Dossou (2018), Camara et al., (2016); Maqueira et al., (2018), Buyukozkan & Gocer (2018), D'Ignazio & Giovannetti (2013), Fuentes et al., (2016), Moodley (2002), Min (2018), Dossou & Nachidi (2017)	15
Collaboration	Li (2012), Ratnasingam (2006), Piera et al., (2014), Jun & Wei (2011), Jimenez et al., (2018), Wu & Chi (2018)	6
Coordination	Yan et al., (2017), Singh et al., (2018), Ogulin et al., (2012), Lv (2017), Yin & Khoo (2007), Huo et al., (2015), Wang et al., (2018)	7

Strategy	Mensah et al., (2015), Kotzab et al., (2003)	2
Organization Adaptability (Flexibility)	Kassem et al., (2018), Gosain et al., (2004), Makris et al., (2011)	3
Technology Transfer and Skilled Worker	Sendlhofer & Lernborg (2017), Kolding et al., (2018), Gunasekaran et al., (2016), Wamba et al., (2015), Dedrick et al., (2008), Silva et al., (2018), Christopher (2012), Cezarino et al., (2018)	8

5. CONCLUSIONS

In this study, we explored the key factor categories of supply chain digitalization in the current literature. We used a systematic literature review method to analyze papers matching our research criteria. Structured content analysis was used to review 106 English articles published in peer-reviewed and accredited journals from 2002 to 2019. The result showed that supply chain integration, collaboration, coordination, strategy, technology & worker skills, and adaptability are among the significant factor categories that should be addressed to assess an organization's readiness to adopt a digital supply chain. These factors can be used to assess the readiness of an organization, and as general guide for applying the digital supply chain.

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