Digital Supply Chain: Survey of the Literature

Faisal Iddris *faisal.iddrisl@hh.se*
School of Business, Engineering and Science
Halmstad, University
Halmstad, Sweden

Abstract

Purpose- The aim of this research is to provide accumulated body of prior knowledge on digital supply chain (DSC) and provides opportunities for further research.

Design/Methodology/approach-This study presents a literature review of 60 peer-reviewed articles from 2000-2017.

Findings-Based on the analysis of the 60 articles, the paper finds that the main drivers of digital supply chain consist of technologies, digitization, integration, collaboration and coordination. The analysis reveals that the most dominant research method used was survey-type research (40.0 percent). The conclusion is that there is the need for researchers to employ qualitative case to empirically examine the development of DSC, this may lead to high level conceptualisation and theoretical development in the field of DSC. In addition, the analysis revealed that 73.3 percent of the articles failed to discuss any theoretical foundation. Thus, this review provides foundation for conceptualization and theory development in the field of digital supply chain.

Originality/value-There has been some reviews of supply chain management in general; but there are little attempts scholars to synthesize extant literature on digital supply chain. Thus, the aim of this research is to provide accumulated body of prior knowledge of digital supply chain and provides opportunities for further research.

Keywords: Digital Supply Chain, Digitization, Coordination, Collaboration.

1. INTRODUCTION

A Supply chain processes can be enhanced through the use of digital technologies in order to ensure customer responsiveness. This is due to the ability of smart products (smart phones, tablet computer, handheld devices) to convert any electronic message required by existing systems and allow for electronic data communication between firm and supply chain members. Xue, Zhang, Ling and Zhao [1] describe digital supply chain (DSC) as inter-organisational systems (IOSs) that firms implement to digitize the processes of transaction and collaboration with their supply chain partners (i.e., upstream suppliers and downstream customers). Currently companies are investing in digitalization of their supply chain. For example, Amazon, Alibaba, Lufthansa, BMW, DHL DB Schenker are investing in digitalization. Some of the digitalized processes and tools these companies are investing in include digital mobility lab, e-freight, e-payment, robotics for handling goods, drones for deliveries and new apps for own-asset-light delivery services [2]. The 2016 survey of 337 leading global manufacturing executives by Capgemini Consulting and GT Nexus revealed that 70 percent of the respondents have initiated DSC transformation [3]. Generally, digitalization and electronic commerce are radically transforming supply chain structures in different sectors [4]. The difference between DSC and traditional supply chain is that, DSC offers swift shift from manual transactions to digitalised information flows in both intra-firm and inter-firm operations by offering companies the option of reducing internal management costs and increasing efficiency through the digitalisation Korpela, Hallikas and Dahlberg [5], conversely, supply chain is described as a functions within and outside

a company that enable the value chain to make products and provide services to the customer [6]. Thus the main difference between the two concepts relate to the degree of digitisation of the supply chain processes.

The main purpose of this review is to collect and accumulate available research in peer-reviewed journals to support the collection and dissemination of scholarly knowledge as well as serving as guide for future research.

The remainder of this paper is structured as follows: First, the research the background of DSC is presented. This is followed by the research methodology employed in analysing the selected articles. Then, the findings and conclusions are presented.

2. BACKGROUND

Statistics by, the Digital Universe of Opportunities [7], indicate that world's total digital data volume stood at 4.4 zettabytes (trillion gigabytes) in 2013 and is expected to reach 44 zettabytes by 2020. The rise in the volume of data is creating opportunities for digital supply chain [8]. In addition, the recent increased interest in DSC is as a result of enabling technologies, such as big data analytics, cloud computing, 3D printing, drones, and internet of things (IoT) coupled with the need for supply chain to respond swiftly to customer's demands. These technologies are radically transforming supply chain operations. Next, we described these technologies in detail.

2.1 Technological Enablers of Digital Supply Chain (DSC)

- *Big data analytics*: This refers to the application of advanced statistics to any kind of stored electronic communication, which may include "messages, updates, and images posted to social networks, readings from sensors, and GPS signals from cell phones Kache and Seuring [9]. Big data analytics help in reducing order-to-delivery cycle times, improve customer relationship, improve supply chain efficiency. Big data allow firms to gather large amount of data from videos, tweets, click streams and other sources. The data analytics greatly influence supply chain competitiveness [10].

- *Cloud computing:* This refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services" [11]. The cloud-based platform provides synchronisation of supply chain management with IT system of an organisation. This helps with scalability, cost reduction, accessibility and efficiency in supply chain operations.

- *3D printing or direct digital manufacturing*: 3-D printing uses CAD software and additive manufacturing-based technologies to print objects through fusing a variety of materials with a laser [12]. The 3D printing or direct digital manufacturing enables small quantities of customized goods to be produced at relatively low costs. Swanson [13] indicates that Amazon is revolutionising its supply chain by providing retail outlets where customers can print more than 200 products. This means that there will be few raw materials, elimination of warehouse and shipping cost and that can lead to supply chain transition [14].

- *Drones:* These are unmanned aircraft that are presenting potential use in supply chain. For example, Amazon is working on a way to deliver products ordered online via unmanned aircraft [15]. The drones can read RFID tags or bar code, Q-code, and send the information to centralised database for processing. The advantage of using drones is that it can capture data in aerial view more easily and faster than humans using hand held devices to capture the same data.

- *Mobile applications*: This refers types of application software designed to run on a wireless mobile devices, such as a smartphone or tablet computer instead of laptop computers or a laptop. Mobile applications such as mobile payment, mobile RFID, advance bar code scanning, map routing, inventory optimisation are enhancing supply chain operations. Mobile

applications facilitate the generation of real-time information that decreases inventory and can lead to growth in revenue for the provider company [16]. In summary these technologies are revolutionising supply chain operations.

2.2 Research Methodology

Digital supply chain is an emerging field thus; by following other scholars this study used a single key word approach used by [17, 18] in search of relevant literature. Webster and Watson [19] classify reviews into two types: first researchers can investigate mature topic where an accumulated body of research exists that need synthesis and analysis. In this case the researcher can conduct extensive review and propose a conceptual model that synthesizes and extends existing research. Second, researchers can tackle an emerging issue that would benefit from exposure to potential theoretical foundation. The researcher's contribution can be found in fresh theoretical foundations in developing conceptual model. Therefore this paper uses the logic of the second category in order to review the selected papers.

Delimitations and the Search for Literature

A literature review study requires that a boundary is clearly defined to delimitate the research. In this study three important notes are made:

a) The analysis aimed only at articles in peer-reviewed scientific journals published in English with a management and business focus. This excludes articles in other languages as well as those with a computer science, engineering, econometric, finance, and patents focus.

b) Papers dealing with digital economy, digital library and digital business in general were eliminated

c) A single key word "digital supply chain" was used in the search process; this was to ensure the article's applicability [17]. Also, to ensure that articles contain "digital supply chain" as key phrase throughout the title, abstract, keywords and, the whole paper.

The search was done in Halmstad University megaindex electronic library platform. The library includes the following electronic databases: ABI Inform, Academic Search Elite, ACM DigitalLibrary, DiVA, Ebook Central (tidigare Ebrary), Emerald, IEEE Xplore, JSTOR, Lecture notes in computer science, Libris, Sage journals online, ScienceDirect, Scopus, SpringerLink, Taylor & Francis online, Web of Science and Wiley online library.

a) This review process started by keying in the single keyword "digital supply chain" into the electronic database.

b) The search period was limited to 2017 in order to access complete year publications

c) The initial search generated 656 publications. These include magazines (218), academic journals (125), trade publications (40), books (28) eBooks (20), news (9) Electronic Resources (1) Conference Materials (1)

d) Next the search was limited to peer-reviewed and full-text; as a result 119 articles emerged from the 125 academic journals as indicated above.

e) Next, the titles, abstracts, keywords and journal information of the articles were imported into Microsoft excel for further analysis.

f) Here, the abstract and titles were thoroughly read to identify most relevant articles pertaining to DSC. In that process the 119 articles were grouped into A, B, and C list (Thorpe et al., 2005). "A" was defined as studies that were definitely relevant. "B" was defined as studies whose relevance was not clear at first. "C" was defined as studies that were less relevant or where the nature of the research work was unclear [20, p.258]. Therefore, A=60 articles were relevant, B=41 partially relevant and C=18 less relevant. Next, full-texts of

combined A and B (101) were read in detail in order to ascertain substantive relevance. Through this process 30 articles were excluded from the analysis as they fall outside the scope of the study. Thus, 60 articles were found to address DSCs.

g) In the final step, the full-text of the 60 articles that were deemed relevant articles were exported to Microsoft Excel and Nvivo qualitative software for further analysis (see appendix, Table A1) for the complete set of 60 articles reviewed for this study.

Note: This paper used C to represent article count in the analysis part of this SLR.

2.3 Descriptive Analysis

The literature identified comprises of 60 articles. The allocation of the articles in the research period (2000-2017) is shown in Fig. 1. The analysis shows that high number of publications was recorded between 2003, 2007, and 2008 until 2009 where a slight decline is recorded. Then from 2014 there is an increase in publications after another decline in 2016. Afterwards there has been an increase in publication from 2017. This increasing trend depicts the increasing interest from scholars.

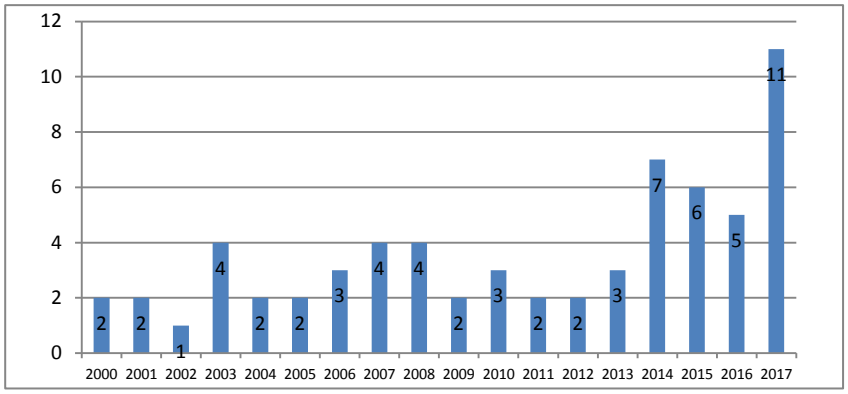

FIGURE 1: Distribution of publications per year across the period studied.

2.3.1. Types of Journal Outlets

From the total of 60 articles selected, 38 different types of journal outlets were used by the authors to disseminate their research output. Table 2 presents top 11 journal outlets. According to the findings in in the table, supply chain management: an international journal was most used by the authors (C=12, 20.0 %), Management science (C=3, 5%), International Journal of Production Research (C=2, 3.3%) International Journal of Production Economics (C=2, 3.3%) International Journal of Physical Distribution & Logistics Management (C=2, 3.3%) Strategy & Leadership (C=2, 3.3%) the rest are one paper per each journal outlets. The rest of the journals outlets were not shown for lack of space.

Journals	Freg.	%
Supply Chain Management: An International Journal	12	20
Management Science	3	5
Vaccine	2	3.3
Strategy & Leadership	2	3.3
Media Asia	2	3.3
Journal of Manufacturing Technology Management	2	3.3
Journal of Digital Asset Management	2	3.3
International Journal of Production Research	2	3.3
International Journal of Production Economics	2	3.3
International Journal of Physical Distribution & Logistics Management	2	3.3
Information Systems Research;	2	3.3

TABLE 1: Top Eleven Journal Outlets.

2.3.2 Number of Countries

The analysis highlights the number of publications from 22 countries (Table 3). The total number of 65 publications is different from 60 publications, the reason being that this paper added the country of the co-authors; else it will appear as if all the papers were single-authored. From the overall papers analyzed the largest contribution comes from the US (C=27, 42.2%), followed by UK (C=10, 15.6%) and Italy (C=3, 4.7%). The results in Table 2 clearly show that the first two countries (US and UK contribute to over 50% of the publications in the field of DSC research. The skewed record number of publications across the countries raises important research agenda for supply chain and DSC researchers to explore as to whether there is lack of knowledge or interest. Researchers from US, UK and Italy can collaborate with other researchers from countries with low publications as shown in this review, and if possible collaborate with countries in the Middle East, Africa and South America to undertake more productive research which is important for the global emergence of DSC research.

Country	Freg.	%
US	27	42.2
UK	10	15.6
Italy	3	4.7
Taiwan	2	3.1
Canada	2	3.1
China	2	3.1
India	2	3.1
Finland	2	3.1
Norway	2	3.1
Hong kong	2	3.1
Sweden	1	1.6
Ireland	1	1.6
Germany	1	1.6
Scottland	1	1.6
Greece	1	1.6
Holland	1	1.6

Latvia	1	1.6
Malaysia	1	1.6
Poland	1	1.6
Singapore	1	1.6
Total	**65**	**100**

TABLE 2: Countries and Number of Publications.

2.3.3 Research methodologies applied in the selected articles.

Methods	Freq.	%
survey	27	45.0
conceptual analysis	21	35.0
case study (qualitative)	6	10.0
mixed-method	3	5.0
Mathematical modelling	2	3.3
narrative review	1	1.7
Total	60	100

TABLE 3: methods used in the reviewed articles

Turning to the research methods employed in each article, as table 4 shows, majority of the studies used survey type research-method (C=27, 45.0 %), followed by conceptual analysis (C=21, 35.0 %. Considering the emerging nature of the field, we expect studies in DSC chain to employ qualitative case study approach as it may help conceptualisation and theory development and also lead to novel ideas.

2.3.4 Theories used applied in the selected articles

One important aspect of reviewing the extant literature is identifying the theory underpinning a particular study. According to Yin [21] theory or theoretical preposition helps in generalization of research findings. Also “theories give researchers different “lenses” through which to look at complicated problems and social issues, focusing their attention on different aspects of the data and providing a framework within which to conduct their analysis” [22, p.631]. Hence, examining theories used help to provide better understanding of the field under review. The findings in (Table 4) show that a large number of articles (C=44, 73.3%) reviewed failed to discuss any theoretical foundation. Absence of theories may be due to emerging nature of the field of DSC. Hence, most of the studies are descriptive in nature. Another reason might be that authors are more interested in solving practical problems than specifically contributing to theoretical development in the field of DSC.

Theory	Freg.	%
No underpinning theory	44	73.3
multiple theories	3	5.0
transactional cost economics	2	3.3
resource based view	1	1.7
transactional cost economics	2	3.3
information process theory	1	1.7
diffusion of innovation theory	1	1.7
combinatorial technological evolution	1	1.7
agency theory	1	1.7
modular system theory	1	1.7
relational based theory	1	1.7
governace-knowledge fit theory	1	1.7
Actor Network theory	1	1.7
Total	60	100

TABLE 4: Theories used in the reviewed papers.

The few authors that use theory are: M. Davis, Mora-Monge, Quesada and Gonzalez [23] used contingency "fit" theory and resource-based view of the firms to investigate the role of global factors in the value creation process from e-business and supply chain; Xue, Zhang, Ling and Zhao [1] used modular system theory to investigate risk Mitigation in supply chain digitization; the remaining theories and their frequencies are presented in Table 4.

2.3.5 Towards the Conceptual Framework

This section presents analysis carried out from the full-text of the 60 articles to identify the main drivers of DSC, we inductively derived the drivers from the data, where our data are the articles [20].

There were seven major drivers that emerge from the data (technologies, integration internet, electronic, collaboration and digitization). In this analysis, the Internet and electronics were considered as part of technologies thus, the rest of the drivers that were analysed further are: integration, technologies, digitization, collaboration and coordination. In order to highlight drivers of DSC, a conceptual framework was developed. (See figure 2). The drivers are described in details below:

Technologies: for the articles reviewed, (31 out of the 60) cited technologies in electronic supply chain management in general. This is obvious as technologies are playing an important role in changing the dynamics of supply chain. A survey by European A.T. Kernrney/WHU logistics [2] indicates that technologies are major drivers of digitization of supply chain. Some of the technologies identified in this review include radio frequency identification (RFID), Big Data Analytics, 3D printing or additive manufacturing and Internet of things (IoT). Attaran [24] notes that RFID is the most recent prolific technology that provides supply chain collaboration and visibility, and these technologies can lead to evolutionary change by incorporating legacy systems with the real-time supply chain management. The emergence of the Internet combined with leaps in information technology, has generated interest in study big data analytics [9]. The availability of storage, network, and telecommunications capabilities enables companies to have access to large amount of data almost in real-time. The emergence of these technologies has been identified to be the major drivers of DSC.

Digitization: Only (10 out of the 60) articles reviewed cited digitisation as s factor of supply chain. This reflects the newness of the concepts of digitalisation in the area of supply chain studies. Yoo, Lyytinen, Boland and Berente [25, p.6] defined digitalization as "the transformation

of socio-technical structures that were previously mediated by non-digital artefacts or relationships into ones that are mediated by digitized artefacts and relationships. According to Farahani, Meier and Wilke [26] new digital technologies are disrupting nearly all aspects of traditional supply chain management. Even manufacturing is becoming an integral part of a wider digital infrastructure [27]. One area that has witnessed wider application of DSC is e -publishing, movie streaming and music industry. In general digitization will continue to play an important role for managing global supply chains, this is due to a rapid change in values derived from physical artefact to data created by smart product [28] such as mobile phones, wireless devices, scanners. Thus, digitization may continue to drive DSC.

Integration: This was the second most cited factor influencing digital supply chain was cited by (31 out of the 60 articles). Integration is the key to efficiency and success of e-supply chains [29]. [30] Further noted that e-Supply chain integration enables organizations to share real time information seamlessly, improve productivity, increase efficiency, improve the ability of the supply-chain to deliver faster and better products/services, improve the balance between supply and demand and reduce the cost through better coordination and information sharing. Empirical evidence from Rai, Patnayakuni and Seth [31] shows that the development of supply chain process integration positions firms to realize improvements in their performance, specifically operational excellence and increased revenues. A survey of European supply chain managers by European A.T. Kernrney/WHU logistics [2] revealed that approximately 80 percent of the respondents agreed that integration is key to digitization of their supply chains. Thus, the need for integration greatly contributes to DSC.

Collaboration: the need for collaboration in DSC was cited by (24 out of the 60 articles). Collaboration can be described as a process whereby two or more companies share the responsibility of exchanging common planning, management, execution, and performance measurement information Anthony [1]. A study by Min, Roath, Daugherty, Genchev, Chen, Arndt and Glenn Richey [32] shows that collaboration is the driving force behind effective supply chain management and may be the ultimate core capability. With the recent exponential growth in digital platforms, the need for interfirm and intra-firms collaboration is at the heart for businesses. Kache and Seuring [9] show that collaboration approaches with key supply chain members is critical for effective utilisation of data analytics and information availability across the supply chain. Lefebvre, Cassivi and Lefebvre [33] reported that major electronic suppliers like Dell or automobile manufacturers like Volvo, BMW and DaimlerChrysler are collaborating to support integrated product life cycles from design right up to recycling. The information gathered is made possible by the use of product life cycle databases, which supports the electronic collaboration between product integrators, suppliers and customers. And with the increase in digital manufacturing in recent times, Holmström and Partanen [27] indicate that high-capacity utilization of digital manufacturing could be achieved in collaboration with one or a few equipment manufacturers. Because digital manufacturing is moving closer to the use locations where a single machine can support a higher number of equipment manufacturers. Thus, the need for increased collaboration among supply chain members may contribute to DSC.

Coordination: with regards to the need for coordination in DSC, (22 out of the 60) articles cited coordination as factor influencing DSC. Malone and Crowston [34,p.3] defined coordination as the act of managing interdependence between activities performed to achieve a goal. Because supply chain consists of different functions: marketing, logistics, inventory, manufacturing, operations, purchasing and procurement, the need for coordination among these functional units is becoming a challenge for organisations. Also, poor coordination among supply chain members can cause dysfunctional operational performance [35]. Therefore, coordination is viewed as the key to attaining flexibility, which is necessary to enable an organisation to progressively improve logistics processes in response to rapidly changing market conditions [35]. Johnson, Klassen, Leenders and Awaysheh [36] indicates that coordination is needed by firms aiming at replacing manual paper-based systems with electronic systems, as more and more firms beginning to integrate their online and traditional operations and share more information over the Internet coordination are becoming more significant [37]. Hence, the need for

coordination is a major driver for DSC as firms see the coordination of various functions and activities as crucial for improved performance. In summary five main factors: technologies, digitization, integration, collaboration and coordination are found to influence the emergence of DSC.

3 LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This concluding section will point out some of the most important findings of the research and show some directions for further studies. This study has taken a broader look at digital supply chain and issues emerging in this field. It offers a conceptual framework (figure 2) based on the literature review. The exponential growth in digital technologies means that digitisation will continue to permeate every facet of business operations more especially in the field of supply chain. Frequently, pressure from customers and competitive environment means that focal firms are under intense pressure to develop strategies for proper coordination, collaboration, integration, digitisation and the use of technologies, in order to respond to customers' demand in a swift manner. Moreover, because the degree of digitization of supply chain can determine the success of the real-time inventory monitoring, resource allocation, customer interaction and overall efficiency, it is imperative for companies become more knowledgeable in DSC and how it can ultimately lead to improved performance and profitability.

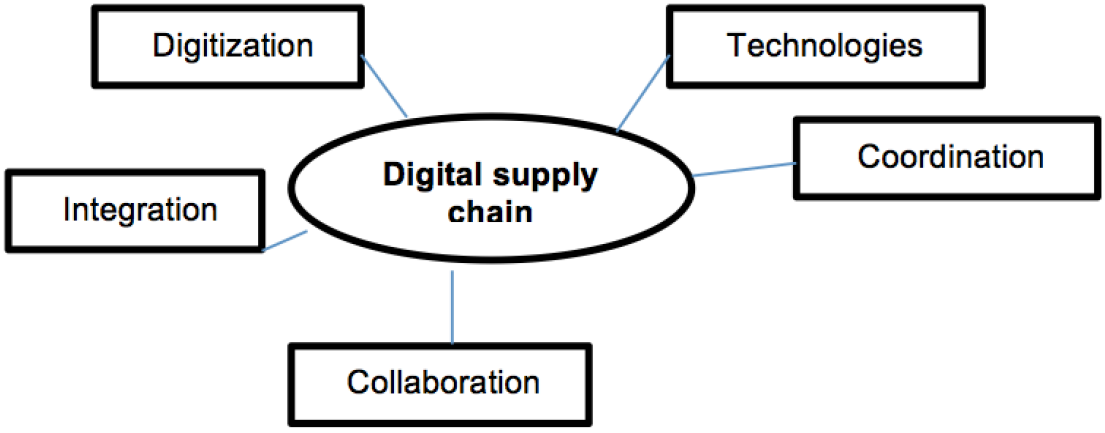

FIGURE 2: Drivers of digital supply chain.

3.1 Theoretical Background is Often Missing

The analysis revealed that over 73.3 percent of the papers failed to discuss any theoretical foundation. The use of limited theories may be due to two reasons: first, because DSC is an emerging field, the authors are unsure which theories to use or appropriate; Second, the field of supply chain in general lacks "unified theory" [38, 39] . Therefore, the authors might not be sure which theories to use. Thus, this paper suggests that researchers adopt inductive qualitative research approach that can lead to the development of concepts, frameworks and DSC theory.

3.2 Digital Supply Chain Studies Mainly Used Survey Approach

The analysis revealed that 44.9 percent used survey-type research method, 32.7 percent used conceptual analysis and 14.3 percent used case study. Since DSC is an emerging field, there is the need for more qualitative studies, [28,p.4179] suggest that in the area of DSC, "scientific rigor is achieved through conducting grounded theory research and in-depth interviews as methods of data collection". Thus, there is the need for a case study approach using inductive method; this methodological approach is appropriate in areas where there are limited theories [40]. In general

survey research is noted to be more useful in theory and/or hypothesis testing. Meanwhile this review shows that almost half of the articles reviewed (49 percent) used survey type research while 14.3 percent used case study. Hence, this paper suggests that researchers employ qualitative case study to empirically examine the development of DSC, as this may lead to high-level conceptualisation and theoretical development in the field of DSC.

As stated already, certain measures have been taken to ensure the quality of this study. However, in a literature review of this nature, the experience and knowledge of the researcher have strong impact of the findings. Future research might improve this framework by exploring other publications; this might allow other factors to be identified in detail.

Even though, we analysed the articles using mega index database, we believe that more exhaustive review is needed using other keywords such as supply chain automation, supply chain analytics, digital networks, digital demand management and digital logistics, as well as other combined keywords.

4. REFERENCES

[1] L. Xue, C. Zhang, H. Ling, X. Zhao, Risk Mitigation in Supply Chain Digitization: System Modularity and Information Technology Governance, Journal of Management Information Systems, 30 (2013) 325-352.

[2] European A.T. Kernrney/WHU logistics, Digital Supply Chains: Increasing Critical for Competitive Edge https://www.atkearney.se/documents/10192/6500433/Digital+Supply+Chains.pdf/a12fffe7-a022-4ab3-a37c-b4fb986088f0, (2015).

[3] GTNEXUS, Research Report: The Current and Future State of Digital Supply Chain Transformation, http://www.gtnexus.com/resources/papers-and-reports/current-and-future-state-digital-supply-chain-transformation, (2016).

[4] F. Vendrell-Herrero, V. Myrthianos, G. Parry, O.F. Bustinza, Digital dark matter within product service systems, Competitiveness Review, 27 (2017) 62-79.

[5] K. Korpela, J. Hallikas, T. Dahlberg, Digital Supply Chain Transformation toward Blockchain Integration, in: Proceedings of the 50th Hawaii International Conference on System Sciences, 2017.

[6] J.F. Cox, J.H.a. Blackstone, M.S. Spencer, APICS Dictionary, 8th ed., American Production and Inventory Control Society, Falls Church, VA., (1995).

[7] The Digital Universe of Opportunities, Rich Data and the Increasing Value of the Internet of Things," IDC iView, © 2014 IDC., (2014).

[8] EY, Digital supply chain: it's all about that data, http://www.ey.com/Publication/vwLUAssets/Digital_supply_chain__its_all_about_the_data/$FILE/EY-digital-supply-chain-its-all-about-that-data-final.pdf (2016).

[9] F. Kache, S. Seuring, Challenges and opportunities of digital information at the intersection of Big Data Analytics and supply chain management, International Journal of Operations & Production Management, 37 (2017) 10-36.

[10] Y. Tan, J.E. Carrillo, H.K. Cheng, The agency model for digital goods, Decision Sciences, (2015).

[11] M. Armbrust, A. Fox, R. Griffith, A.D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, A view of cloud computing, Communications of the ACM, 53 (2010) 50-58.

[12] B. Berman, 3-D printing: The new industrial revolution, Business Horizons, 55 (2012), 155-162.

[13] D. Swanson, The Impact of Digitization on Product Offerings: Using Direct Digital Manufacturing in the Supply Chain, in: Proceedings of the 50th Hawaii International Conference on System Sciences, 2017.

[14] A. Sasson, J.C. Johnson, The 3D printing order: variability, supercenters and supply chain reconfigurations, International Journal of Physical Distribution & Logistics Management, 46 (2016) 82-94.

[15] S.E. Fawcett, M.A. Waller, Supply chain game changers—mega, nano, and virtual trends—and forces that impede supply chain design (ie, building a winning team), Journal of Business Logistics, 35 (2014) 157-164.

[16] A.C. Cagliano, A.D. Marco, C. Rafele, E-grocery supply chain management enabled by mobile tools, Business Process Management Journal, 23 (2017) 47-70.

[17] M.M. Kamal, Z. Irani, Analysing supply chain integration through a systematic literature review: a normative perspective, Supply Chain Management: An International Journal, 19 (2014) 523-557.

[18] E. Delbufalo, C. Cerruti, Configuration and the Capability of Firms to Innovate: A Theoretical Framework, International Journal of Management, 29 (2012) 16-28.

[19] J. Webster, R.T. Watson, Analyzing the past to prepare for the future: Writing a, MIS quarterly, 26 (2002) 13-23.

[20] R. Thorpe, R. Holt, A. Macpherson, L. Pittaway, Using knowledge within small and medium-sized firms: A systematic review of the evidence, International Journal of Management Reviews, 7 (2005) 257-281.

[21] R.K. Yin, Case study research: Design and methods, Sage publications, 2013.

[22] S. Reeves, M. Albert, A. Kuper, B.D. Hodges, Why use theories in qualitative research, Bmj, 337 (2008) 631-634.

[23] J. M. Davis, C. Mora-Monge, G. Quesada, M. Gonzalez, Cross-cultural influences on e-value creation in supply chains, Supply Chain Management: An International Journal, 19 (2014) 187-199.

[24] M. Attaran, RFID: an enabler of supply chain operations, Supply Chain Management: An: International Journal, 12 (2007) 249-257.

[25] Y. Yoo, K.J. Lyytinen, R.J. Boland, N. Berente, The Next Wave of Digital Innovation: Opportunities and Challenges: A Report on the Research Workshop'Digital Challenges in Innovation Research', (2010).

[26] P. Farahani, C. Meier, J. Wilke, Digital Supply Chain Management Agenda for the Automotive Supplier Industry, in: Shaping the Digital Enterprise, Springer, 2017, pp. 157-172.

[27] J. Holmström, J. Partanen, Digital manufacturing-driven transformations of service supply chains for complex products, Supply Chain Management: An International Journal, 19 (2014) 421-430.

[28] A. Pflaum, F. Bodendorf, G. Prockl, H. Chen, Introduction to The Digital Supply Chain of the Future: Technologies, Applications and Business Models Minitrack, (2017).

[29] G.A. Akyuz, M. Rehan, Requirements for forming an ‘e-supply chain’, International Journal of Production Research, 47 (2009) 3265-3287.

[30] A.Y.-L. Chong, L. Zhou, Demand chain management: Relationships between external antecedents, web-based integration and service innovation performance, International Journal of Production Economics, 154 (2014) 48-58.

[31] A. Rai, R. Patnayakuni, N. Seth, Firm performance impacts of digitally enabled supply chain integration capabilities, MIS quarterly, (2006) 225-246.

[32] S. Min, A.S. Roath, P.J. Daugherty, S.E. Genchev, H. Chen, A.D. Arndt, R. Glenn Richey, Supply chain collaboration: what's happening?, The international journal of logistics management, 16 (2005) 237-256.

[33] L. Lefebvre, L. Cassivi, É. Lefebvre, E-Commerce Transition Model for Supply Chain Management, Journal on Chain and Network Science, 1 (2001) 23-32.

[34] T.W. Malone, K. Crowston, What is coordination theory and how can it help design cooperative work systems?, in: Proceedings of the 1990 ACM conference on Computer-supported cooperative work, ACM, 1990, pp. 357-370.

[35] T.M. Simatupang, A.C. Wright, R. Sridharan, The knowledge of coordination for supply chain integration, Business process management journal, 8 (2002) 289-308.

[36] P. Johnson, R. Klassen, M. Leenders, A. Awaysheh, Utilizing e-business technologies in supply chains: The impact of firm characteristics and teams, Journal of Operations Management, 25 (2007) 1255-1274.

[37] J.M. Swaminathan, S.R. Tayur, Models for supply chains in e-business, Management Science, 49 (2003) 1387-1406.

[38] A. Halldorsson, H. Kotzab, J.H. Mikkola, T. Skjøtt-Larsen, Complementary theories to supply chain management, Supply chain management: An international journal, 12 (2007) 284-296.

[39] Á. Halldórsson, J. Hsuan, H. Kotzab, Complementary theories to supply chain management revisited – from borrowing theories to theorizing, Supply Chain Management: An International Journal, 20 (2015) 574-586.

[40] K.M. Eisenhardt, M.E. Graebner, S. Sonenshein, Grand challenges and inductive methods: Rigor without rigor mortis, Academy of Management Journal, 59 (2016) 1113-1123.

[41] T. Anthony, “Supply chain collaboration: success in the new internet economy”, Achieving Supply Chain Excellence through Technology, Montgomery Research Inc., San Francisco, CA, Vol. 2, pp. 41-4, (2000).

Appendix Table A1, The 60 selected literature reviewed in this study

Author (s)	Country	Method	Theory
Susarla, Parameswaran, and Whinston (2000)	US	conceptual analysis	unspecified
Wynarczyk (2000)	UK	survey	unspecified
Lefebvre, Cassivi, and Lefebvre (2001)	Canada	case study	unspecified
van Hoek (2001)	UK	conceptual analysis	unspecified
McCormack and Kasper (2002)	US	survey	unspecified
Koudal and Wellener (2003)	UK	conceptual analysis	unspecified
Swaminathan and Tayur (2003)	US	Narrative review	unspecified
Wagner, Fillis, and Johansson (2003)	Scotland	case study	unspecified
D etmar, Arun, and Richard (2004)	US	survey	information process theory/strength of weak ties theory
Yen, Farhoomand, and Ng (2004)	Hong Kong	conceptual analysis	unspecified
Caputo, Soliman, Cucchiella, Fratocchi, and Marcello Pelagagge (2005)	Italy	conceptual analysis	unspecified
Vlachopoulou, Manthou, and Folinas (2005)	Italy	conceptual analysis	unspecified
Iskanius and Kilpala (2006)	Greece	conceptual analysis	unspecified
Lau et al. (2006)	Finland	Case study	unspecified
Rai, Patnayakuni, and Seth (2006)	US	survey	RBV
Attaran (2007)	US	conceptual analysis	unspecified
Ghose, Mukhopadhyay, and Rajan (2007)	US	survey	unspecified
Johnson, Klassen, Leenders, and Awaysheh (2007)	US	Mixed-method	Transactional Cost Economics, Resource –Based View, Relational
Sammon and Hanley (2007)	Ireland	Mixed-method	unspecified
Gallear, Clegg, Ghobadian, and O'Regan (2008)	US/Canada	conceptual analysis	unspecified
Gonnering (2008)	UK	conceptual analysis	unspecified
Hosanagar, Chuang, Krishnan, and Smith (2008) 2008	US	survey	unspecified
Wager (2008) 2008	US	conceptual analysis	unspecified
Dong, Xu, and Zhu (2009)	China/US	survey	Transactional Cost Economics, Resource –Based View
Akyuz and Rehan (2009)	Turkey	conceptual analysis	unspecified
Graham and Smart (2010)	UK	case study	unspecified

Plomp and Batenburg (2010)	Holland	survey	unspecified
Wang, Chen, and Xie (2010)	China	case study	unspecified
O'leary (2011)	US	Conceptual analysis	unspecified
Berman (2012)	US	conceptual analysis	unspecified
Dasgupta (2012)	US	conceptual	unspecified
Hsin Chang, Tsai, and Hsu (2013)	Taiwan	survey	Unspecified
Hwang and Lu (2013)	Taiwan	survey	unspecified
Xue, Zhang, Ling, and Zhao (2013)	China/US	survey	Modular system theory
Holmström and Partanen (2014)	Finland	conceptual analysis	Brian Arthur's combinatorial technological evolution
Chong and Zhou (2014)	Malaysia	survey	diffusion of innovation theory

D'Ignazio and Giovannetti (2014)	UK	survey	unspecified
M. Davis, Mora-Monge, Quesada, and Gonzalez (2014)	US/Singapore	survey	Resource-Based View
Xue (2014)	US	survey	governance-knowledge fit theory
Colbjørnsen (2014)	Norway	conceptual analysis	Actor network theory
Das, Jack C.P. Cheng, and Law (2015)	US	conceptual analysis	unspecified
Hajdul and Mindur (2015)	Poland	Mixed-method	unspecified
Kehoe and Mateer (2015)	UK	Conceptual analysis	unspecified
Li, Lin, Xu, and Swain (2015)	US/China	survey	unspecified
Tan, Carrillo, and Cheng (2015)	US	survey	agency theory
Parry, Brax, Maull, and Ng (2016)	UK	case study	unspecified
Sasson and Johnson (2016)	Norway	conceptual analysis	unspecified
Stephanie, Sharma, and Ramasubbu (2016)	India	conceptual analysis	unspecified
Peng (2016)	China	conceptual analysis	unspecified
Scuotto, Caputo, Villasalero, and Del Giudice (2017)	Italy	survey	unspecified
Gilbert, Thakare, Ramanujapuram, and Akkihal (2017)	India	survey	unspecified
Kache and Seuring (2017)	Germany	survey	unspecified
Merlino and Sproģe (2017)	Latvia	conceptual analysis	unspecified
Vendrell-Herrero, Bustinza, Parry, and Georgantzis (2017)	Taiwan	survey	unspecified
Gharehgozli, Iakovou, Chang, and Swaney (2017)	US	conceptual analysis	unspecified
Pal and Sandberg (2017)	Sweden	conceptual analysis	unspecified

Huang, Lin, and Fang (2017)	Taiwan	Modelling	unspecified
Tjahjono, Esplugues, Ares, and Pelaez (2017)	UK	conceptual analysis	unspecified
Pereira, Barreto, and Amaral (2017)	Portugal	conceptual analysis	unspecified
Santos et al. (2017)	Portugal	Modelling	unspecified