



EXPLORING ENABLERS, BARRIERS AND OPPORTUNITIES TO DIGITAL SUPPLY CHAIN MANAGEMENT IN VIETNAMESE MANUFACTURING SMES

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Abstract

This paper examines the enablers, barriers and opportunities of digital supply chain management (DSCM) in manufacturing Small and Medium-sized Enterprises (SMEs) in Vietnam from expert's perspective. The study is a foundational effort to contribute to the establishment of new digital management era in many emerging economies. Applying a systematic literature review (SLR) of relevant studies and a qualitative data methodology this research also aims to explore the factors affecting technology adoption in supply chain management from managerial perspective of Vietnamese manufacturing SMEs. Findings of the research reveal that the enablers and barriers are classified into four main dimensions which are Organisational, Technological, Strategic and Legal – Ethical issues. In addition, our findings also reveal that external factors deeply influence the adoption intention in Vietnamese manufacturing SMEs. The development of digital SCM could be different in each case according to companies' characteristics and business environment. Our study therefore adds to the limited research in the domain of digital technology adoption in SMEs in developing country context.

Keywords: Enablers, Barriers, Opportunities, Digital Supply Chain Management, SMEs, Manufacturing industry, Vietnam.

INTRODUCTION

Industry 4.0 has been recognised as the new efficient component of an economic strategy that results in lower costs and boosts efficiency in many industries (Frederico, Graza-Reyes, Anosike & Kumar, 2019). More precisely, digital technologies of Industry 4.0 have changed the way supply chain operations are structured (Radanliev, Roure, Nurse, Montalvo & Burnap, 2019). This norm has started gaining considerable attention among researchers and scholars all over the world (Soares, Soltani &

Liao, 2017), however, it is still relatively unfamiliar to developing countries and creates an invisible gap in research for emerging economies' market, especially in the context of SMEs. The literature on digital supply chain management and what can influence it has mainly focused on large multi-national corporates in developed countries as SMEs often have to face more challenges and barriers than Multi-National Enterprises (MNEs) such as lesser scope for the use of modern machinery (Wuest & Thoben, 2011) or disadvantage in the purchase of raw materials and other accessories (Thakkar, Kanda & Deshmukh, 2012).

On the other hand, strategy to adopt digital SCM in SMEs is often missed, particularly when it comes to emerging economies like Vietnam. In Vietnam the manufacturing industry has

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attracted investment in recent years but yet being at the early stages of development and adoption for digital applications. Fundamental to Vietnam's economic growth is a significant rise in manufacturing output. Since 2017, the manufacturing output of Vietnam has increased by 14.4%. The first half of 2018 witnessed Vietnam's continuing manufacturing boom at 12.9%, followed by the industrial and construction sector growth in the economy at 9.1% (Deloitte, 2018). As a result, Vietnam quickly became one of the largest exporters of garments and textiles in the world. The country is having key advantages for industrial development such as stable and substantial foreign direct investment (FDI) flow and low – cost labour workforce. Additionally, the Vietnamese government is taking steps in the right direction to improve factory structure standards and realising the positive influences of manufacturing on the economy (Sourcify, 2019). Therefore, Vietnam has the potential to become the next manufacturing hub in Asia if they are able to capture the right benefits that digital technologies are offering.

Hence, there is a need to explore how digital initiatives have impacted the SCM implementation in the Vietnamese manufacturing industry. The study therefore focuses on answering following research question:

RQ: What are the enablers, barriers, and opportunities of Digital Supply Chain Management in the manufacturing SMEs in Vietnam?

The study will therefore first aim to identify the enablers, barriers, and opportunities of digital supply chain adoption from the perspective of manufacturing SMEs in Vietnam, which are conducted from both primary and secondary data analyses. The study will also explore the relationship between digital supply chain management (SCM) and the business success/performance of manufacturing SMEs. Rest of the paper is organised as follows; Section 2 provides a comprehensive overview of the literature; Section 3 highlights the

methodology followed; Section 4 presents the findings

LITERATURE REVIEW

Digital Supply Chain Management

Supply chain has become one of the most significant changes in the prototype of modern business management as individual businesses no longer compete as solely autonomous entities (Lambert, Cooper & Pagh, 1998). Hence, SCM is believed to be one of the most important notions in the extremely competitive business environment since it covers the planning and management of all activities from sourcing, procurement, conversion to logistics (Barutçu & Tunca, 2012) and from original suppliers to end - users such as customers or other stakeholders (Lambert, Cooper & Pagh, 1998). With technologies, supply chain management is enabled with less paperwork, better communication and timesaving implementation (Handfied and Nichols, 1999). Previous studies have indicated that there has been several different definitions of Digital Supply Chain Management (DSCM) throughout history. For example, Kinnet (2015) defines DSCM as an intelligent, value driven network that leverages new approaches with technology and analytics to create new forms of revenue and business value.

However, Büyüközkan & Göçer (2018) stated that most of these definitions share a unifying common concept which is viewed as “an intelligent best-fit technological system that is based on the capability of massive data disposal and excellent cooperation and communication for digital hardware, software, and networks to support and synchronise interaction between organisations by making services more valuable, accessible and affordable with consistent, agile and effective outcomes”. New keys of the manufacturing paradigms consist of large data analysis and knowledge bases, which can be supported by technologies: Integrated manufacturing (3D printing, robotics automation, advanced materials) and intelligent manufacturing (virtual or augmented reality, Industrial

Internet of Things or CPS). As a result, the seller and buyer instead of meeting face-to-face, they can interact digitally through the supply chain.

Manufacturing sector and the adoption of Digital SCM: the SMEs' perspective

In the manufacturing field, the use of new technologies can improve demand forecasting and production planning, which leads to better quality and higher profit margins (WEF, 2017). However, a study by Moeuf et al. (2017) claims that SMEs have not exploited all the resources for implementing technologies in its supply chain and often limited themselves to the adoption of Cloud Computing and the Internet of Things (IoT). Likewise, SMEs seem to have adopted those concepts only for monitoring industrial processes and there is still an absence of real applications in the field of manufactured planning. Consequently, the study concludes that technology development in SMEs remains cost-driven initiatives and there is still no evidence of real business model transformation. The correct integration of digital technologies into a supply chain is believed to rely on a well-designed plan (Wang, 2015).

Moreover, a lot of SMEs actually face difficulties in achieving those plans due to the fact that most SMEs do not have financial resources to invest in new manufacturing technologies and to change the range offered to the customers (Türkeş et al., 2019). In the case of ASEAN, many countries' markets are still in the developing stage where the region's lawmakers might not consider the importance of developing IT in the first place. In addition, ingraining habits and cultures of top management in companies also prevent changes in the supply chain.

According to Martinsuo and Luomaranta (2018), SMEs would need broader networks and support to adopt the new technologies as the digitalisation of manufacturing industries is being carried out differently in distinct nations and they cannot develop the value chain in isolation. They also find that SMEs in different supply chain positions experience similar

operational and external challenges, while experience different technology, strategy, supply chain, and organisational challenges. Moreover, different companies had various different strategies for technology utilisations, embedded between static and low - technology to more dynamic and development oriented.

Martinsuo and Luomaranta (2018) further assert that SMEs should plan strategies to overcome the challenges in digital technology adoption which include a clear identification of the benefits of the technology investment, a selection of focal application areas and decision on "make or buy". In addition, scouting and collaborating with some potentially lead customers or government-funded projects to gather data, increase digitalisation and create demand through innovative paradigms and activate supply chain partners. SMEs could take some proactive actions to overcome the lack of technological knowledge such as reducing technical and material uncertainties through learning, small-scale experiments and research, giving resources to designers to learn and experiment.

A case study of 51 firms in India mostly SMEs shows that firms with more internationally oriented approach have adopted more advanced e-business technologies in the manufacturing sector, as well as wage rates and scale of operations (Lal, 2002). The study also states that it is essential to create proper local, national, and global information infrastructure to derive the maximum benefit from information and communication technologies (ICT) revolution. Overall, a lot of challenges exists for the adoption of technologies in SCM such as cyber security, legislation and lack of standardisation. It is important to notice that the opportunities for digital supply chain initiatives are not just for big corporations. For example, a worldwide famous SME that perfectly seized the opportunity is Alibaba Group. They have been using their own internet-based wholesale programmes as a digital distribution platform to increase the productivity and consumer

markets (Sommer, 2015). According to Radaliev et al. (2019), it is essential for SMEs to carefully plan its adoption to future technologies, in order to reduce costs and ensure compliance with technological updates in their supply chain.

Previous studies including Kehoe & Boughton (2001) and Deloitte & Touche (1998) had assessed the impact of digital revolution on the establishment of supply chains, however, they are mainly focused on more mature enterprises such as leading manufacturing organisations in the UK, US and a certain bias might be included in the analysis. Elements such as cultural or location-based restrictions could not be presented in many pieces of research due to the difference in government systems and economic environments of each nation. Thus, primary data research is required in order to study the impact of digital SCM on Vietnamese manufacturing SMEs. The impact of Digital SCM in SMEs has not been mentioned as much as MNEs in comparison. According to Mittal, Khan, Romero & Wuest (2018), a great number of available academic and consulting studies focused on MNEs and treated SMEs similarly in their development process of technological applications. However, other scholars claimed that SMEs are unlikely, and they have different advantages and challenges (Saad, Kumar, & Bradford, 2017). Hence, this lack of SMEs based research towards digitalisation in manufacturing sector demonstrates a research gap within the current scientific body of knowledge.

Systematic Literature Review (SLR)

In this study, the Systematic Literature Review (SLR) (Figure 1) has been used (Biel and Glock, 2016; Papadopoulos et al., 2016; Soares et al, 2017) to tease out the enablers, barriers and opportunities of digital SCM. When conducting a literature review, these keywords have been searched: Enables and barriers; Digitalisation and supply chain; Challenges and opportunities; Digital supply chain in SMEs in the manufacturing sector; Digital supply chain management; Digital supply chain in developed

countries; Digital supply chain in developing countries; Vietnamese manufacturing SMEs and digital supply chain management; Application of digital supply chain in manufacturing enterprises. Around 80 articles were shortlisted in the preliminary research however, after carefully screening the articles and applying a set of criteria finally 27 articles were finalized which formed the sample for this study (see Table 1).

Table 1. *Shortlisted articles from SLR*

Author, Year	Type of Journal	Relevant Key Point
Clemons and Row (1992)	Journal of Management Information Systems	Barriers of Digital SCM
Brown et al. (1998)	International Journal of Quality and Reliability Manage	Barriers of Digital SCM
Mukhopadhyay and Kekre (2002)	Management Science	Barriers of Digital SCM
Julien and Ramangalahy (2003)	Entrepreneur Theory and Practice	Opportunities of Digital SCM
Lai et al. (2005)	Transportation Journal	Enablers of Digital SCM
Lancaster et al. (2006)	Information Management and Computer Security	Enablers of Digital SCM
Ngai, Chau & Chan (2011)	The Journal of Strategic Information Systems	Enablers of Digital SCM
Zhang et al. (2011)	International Journal of Operations & Production Management	Opportunities of Digital SCM
Kagermann et al. (2013)	Final Report of the Industrie 4.0 Working Group, Forschungsunion.	Enablers of Digital SCM
Carruthers (2014)	IEEE Internet of Things.	Barriers of Digital SCM
Chae (2015)	International Journal of Production Economics.	Opportunities of Digital SCM
DiMase et al. (2015)	Environment System Decision	Barriers of Digital SCM
Wang (2015)	Computers and Industrial Engineering	Opportunities of Digital SCM
Schmidt et al. (2015)	Proceedings of the International Conference on Business Information Systems	Barriers of Digital SCM
Erol, Schumacher	International	Barriers of

& Sihh (2016)	Conference on Competitive Manufacturing.	Digital SCM
Hermann et al. (2016)	49th Hawaii International Conference on System Sciences	Barriers of Digital SCM
Anderson (2016)	NIST Economic Analysis Briefs	Barriers of Digital SCM
Bruemmer (2016)	Construction Business Owner Magazine	
Schroder (2016)	The Friedrich-Ebert-Stiftung.	Barriers of Digital SCM
Muller et al. (2017)	Annual Report on European SMEs 2016/2017	Barriers of Digital SCM
Ras et al. (2017)	Proceedings of the 10th International Conference on Pervasive Technologies Related to Assistive Environments	Barriers of Digital SCM
Kiel et al. (2017)	The International Society for Professional Innovation Management	Barriers of Digital SCM
Marques et al. (2017)	Journal of Ambient Intelligence and Smart Environments	Barriers of Digital SCM
Mittal et al. (2018)	Journal of Manufacturing Systems	Barriers of Digital SCM
Speece et al. (2018)	Proceedings of the 43rd Annual Macromarketing Conference	Barriers of Digital SCM
Wyes (2018)	Economic Research Institute for ASEAN and East Asia	Enablers of Digital SCM
Radanliev et al. (2019)	SSRN Electronic Journal	Barriers of Digital SCM, Opportunities of Digital SCM

Firstly, Google Scholar and Science Direct as two basic and accessible platforms were utilised to search for relevant journals' sources

Table 2. *Enablers of DSC in manufacturing SMEs*

Enablers	Concepts (apply to SMEs)	Author/ Source/ Years
Enable supply chain agility	IT integration in supply chain helps enhance visibility, efficiently create changes and incorporation with customers. It is driven by the scale of the company or the complexity of the supply chain as the larger the company or the more complex the supply chains are, the higher the value of IT integration to the supply chain agility.	Ngai, Chau & Chan, 2011

which then being evaluated in relation to the paper objectives. Precisely, the taxonomy and analysis are based on books, conference papers, published journal articles and industrial reports. Also, other credible and official sources such as World Bank, Deloitte or WTO had been used in this research. In order to understand the legislation affecting the implementation of technology in a nation, official laws report was also reviewed carefully. Furthermore, there were several criteria to examine the shortlisted articles; given as – (i) only the articles written in English will be considered; (ii) the articles belonging to peer reviewed publications and published reports are considered. As a result, 27 journals that met the requirements were finalised. Figure 1 below depicts the SLR methodology.

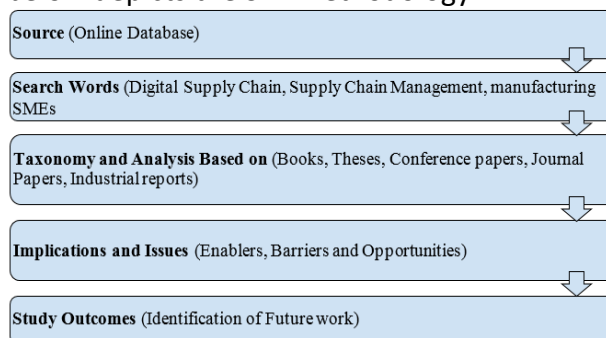


Figure 1. Systematic Literature Review Methodology

Enablers, Barriers, and Opportunities to Digital Supply Chain Management

The study also focused on identification of the enablers, barriers and opportunities of digital supply chain management. Table 2, 3, and 4 below summarises the key enablers, barriers and opportunities to digital supply chain management.

Increase the region's productivity and move up the economic value chain	The digital supply chain helps some ASEAN countries (e.g. Singapore, Malaysia) move up the economic value chain with the increase of labour cost in the manufacturing sector. The Internet of Things and Services allow the networking of the whole factory to form a smart environment.	Wyes (2018); Kagermann et al. (2013)
Able to analyse a huge amount of information in SCM	An integration of technology sensors and devices with equipment and machinery through the Internet of Thing (IoT), and advances in computational ability allow the analysis of huge information (big data) in a supply chain.	Wyes (2018)
More flexible, faster operation in manufacturing sector	Discrete manufacturing industries such as automotive, electrical or electronics gains operational efficiencies reaped from new technologies. High – value product manufacturing such as printed electronics and miniaturization can undertake a high degree of automation and optimisation. With IoT in place at a factory, employees can get better visibility into their assets worldwide. Standard asset management tasks such as asset transfers, disposals, reclassifications, and adjustments can be streamlined and managed centrally and in real time.	Wyes (2018)
Agile in managing supply network	IT and Internet help the communication in real time among supply chain members become more convenient and effective, provide the software-platform infrastructure for managing all supply chain activities. Digital SCM allows companies in supply chain to monitor the inventories, improve the utilization of their transportation and warehouse assets, eliminate duplication of effort in performing numerous logistic activities for their user companies.	Lancaster et al. (2006); Lai et al. (2005)

Table 3. *Barriers of DSC in manufacturing SMEs*

Barriers	Concepts	Author/ Years
Lack of organisations' digital vision and strategy to succeed	Digital transformation is an innovative approach to business operations and especially the manufacturing organisations, however, many organisations seem to fail to illustrate its digital vision and strategy. They struggle when transforming the visionary ideas of digital revolution.	Erol et al. (2016)
Constrain of financial resource	SMEs rely more on the access to investment and the return on investment than MNEs. Owner of SMEs often are individual and numerous risk factors involved with the small-scale businesses. SMEs often have limited capabilities to invest in innovative technologies.	Mittal et al. (2018);
Constrain of technical resources and usage of Advanced Manufacturing Technologies (AMTs), Digital Gap	SMEs often don't have enough resources to test new avenues outside of their core competencies, they are not "early adopters" due to the fear of investing wrong technologies or adopting inefficient practices. Technologies transferred from developed to developing countries rarely include the most advanced one, create a never-closed gap widen in R&D capability.	Mittal et al. (2018); Speece et al. (2018)

Exploring Enablers, Barriers and Opportunities

Research and Development on Digital SCM are low	Most business companies are facing different problematic issues such as ineffective adoption of digital technologies and the lack of accurate decision strategies during this business transformation as they do not have enough focused research. SMEs might be limited to access to shared knowledge of technologies and they lack alliances with universities and research institutions to update themselves with the on-going digital revolution.	Schmidt et al. (2015); Hermann et al. (2016); Mittal et al. (2018)
Standard Consideration	The presence of standardisation in SMEs is rarely found due to the shortage of resources to pass the certificate (e.g. ISO 9000 certification).	Brown et al. (1998)
Cyber resources	Adoption of technologies depends on the SME's cyber resource, as many SMEs do not have the same supply chain resources as large enterprises.	Radanliev et al. (2019)
Cyber Security Risk Assessment	The integration of technologies such as software defined networks, storage, mesh networks, peer-to-peer connectivity, protocols and enterprise grade cloud hosting, artificial intelligence, machine learning and data analytics in supply chains create cyber security risk. As the adoption of smart manufacturing technologies is usually high cost, SMEs could face the dilemma of integrating less secure systems. Thus, integrating cyber element in manufacturing also creates an inherent cyber risk.	Anderson (2016); Carruthers (2014); DiMase et al. (2015)
Legal Issues	A developed of cyber-physical network where a lot of machines, sensors, facilities and humans are interlinked to the internet and exchange data with each other might lead to the appearance of several complex legal issues. Data privacy and security issues should be considered when adopting modern technological management in business	Schroder (2016); Muller et al. (2017)
Profiling and complexity issues	The supply chain is becoming global and characterised by highly complex structure. Hence, employees should be trained to understand the essential processes, dependencies and data interpretation to accept digitisation in the manufacturing environment. Business companies commonly lacks competencies on managing the complex issues related to data analysis, space or time, usage of instructions. Hence, it leads to the uncertain in adopters to follow the digital supply chain.	Erol et al. (2016); Ras et al. (2017)
Unclear economic benefit of digital investments	The lack of economic discussions and a clearly defined return on investments tends to be one of the major challenges to technologies' implementation in the supply chain.	Kiel et al. (2017); Marques et al. (2017)
Transaction risk	The focal firm must tailor its digital supply chain system to accommodate the special needs of certain partners, which makes the digital supply chain system more transaction specific and increases transactions risk. Another challenge is the misuse of critical resources such as sensitive information and know-how would be transferred by the partners as part of the relationship and cannot be controlled. All in all, it would lead to the destruction of the focal firm's competitive advantage in the future.	Mukhopadhyay and Kekre (2002); Clemons and Row (1992)

Table 4. *Opportunities of DSC in manufacturing SMEs*

Opportunities	Concepts	Author/ Years
More advanced data collecting devices	Wearable devices with intelligence are potentially used in SCM for data collection soon as the fast development of cutting- edge techniques. With data standardisation, IT companies could produce more reliable and smart devices for SCM such as smart robotic, intelligent adaptive or multi – functional ubiquitous devices.	Wang (2015)
Reduce costs, risks	Cloud-based collaboration technologies lower the risks of out-of-date and incorrect information.	Zhang et al. (2011)
Allow real-time feedback from users and markets	Information - sharing between the parties has been recognised as an essential part of SCM to improve performance, responsiveness and flexibility, while declining uncertainties within supply chain partners. And with current research focusing on technology and function aspects, companies can use data from real-time analysis of social media activities as a key source to predict demand and get valuable customer insights and trends for new product developments	Zhang et al. (2011); Chae (2015)
Cyber recovery planning	SMEs can gain access to existing knowledge to create more resilient systems and processes in the future	Radanliev et al. (2019)
Reduce labour costs	With the use of robotics and automatic workflows, companies can cut down the labour costs far greater than before	Bruemmer (2016)
Create Specialised products	Manufacturing specialised products could help SMEs to differentiate themselves from the competitors and adopting technologies allows more competitive opportunity for every business	Julien and Ramangalahy (2003)

In addition, to identification of enablers and barriers to digital supply chain management, the study also attempted to identify the opportunities that it presents. Wang (2015) notes that with data standardisation, IT companies could produce more reliable and smart devices for SCM such as smart robotic, intelligent adaptive or multi – functional ubiquitous devices. Studies have shown that cloud-based collaboration technologies lower the risks of out-of-date and incorrect information. Additionally, with the use of robotics and automatic workflows, companies can cut down the labour costs (Bruemmer, 2016). Information sharing and storage becomes central to digital SCM to improve

performance, responsiveness and flexibility, while reducing uncertainties within supply chain partners (Zhang et al. 2011; Chae, 2015). This creates opportunities for SMEs to gain access to existing knowledge and create a resilient system and processes in the future (Radanliev et al. 2019). Moreover, manufacturing specialised products could help SMEs to differentiate themselves from the competitors and adopting technologies allows more competitive opportunity for every business (Julien and Ramangalahy, 2003).

Research Gap

Through a systematic literature review, it appears that existing research studies do not facilitate a discussion on the effect of cultural

elements or location – based restrictions on the implementation of digital supply chain management in emerging economies. Against this brief outline, it seems hard to identify elements that enable and that prevent the development of technologies in SCM. Overall, a research gap indicated in this study is “elements such as cultural or location – based restrictions that could not be presented in many studies due to the difference in government systems and economic environments of each nation”. Exploring this gap with a more inductive approach seems justified as this allows distinguishing the key issues. As a consequence, the next section will continue with the presentation of the research methodology in order to outline a suitable methodological research approach.

MATERIALS AND METHODS

A combination of primary and secondary data was utilised to generate findings for this research. Using only secondary data as the sole source of information has its disadvantage of being outdated and lack of specific information for this particular study of the Vietnamese market. Hence, a follow-up qualitative data methodology was used to collect primary data for this exploratory research through semi-structured interviews with Vietnamese manufacturing SMEs.

Data Collection

In order to gain insightful opinions from managers’ perspective, interview is the most appropriate method for this study. Semi-structured interview is chosen as it is the type of interview that allows researchers to take the best of both structured and unstructured interview while minimizing the risks (Myers, 2009). The interviews were conducted via Skype, as it was the most appropriate method reflecting the time span of the study, cost, and resources associated with and availability for data gathering. Interviewees had received email one week before the Skype schedule to review the questionnaire instruction, glossary of terms regarding digital SCM and the

questions list. Each online interview required 45-60 minutes for completion. In total six expert industry participants agreed to be interviewed who had managerial positions with expertise in SCM in Vietnam. This included two assistant managers, two vice-presidents, and two chief executive officers. The participant came from different industries such as paint, textile, lumber and software manufacturing industry. The data collection for this study took between July to August 2019.

The interviewee details were obtained through the snowball sampling method, which is the reference from other acquaintance Vietnamese researchers to gain the connection to several SMEs in Vietnam. Using the definition according to the Decree No. 90/2001/CP-ND (2001) by Government of Viet Nam, SMEs "are independent business entities, which have registered their business in accordance with prevailing laws, with a registered capital of VND 10 billion (approximately US\$ 670,000) maximum or an annual average number of labours of up to 300 people". Additionally, SME is an important group of enterprises in Viet Nam at the moment. Following the definitions above and according to an evaluation of ADB (2004), it is estimated that more than 90% of all private Vietnamese enterprises are SMEs. In a nutshell, the manufacturing SMEs from Vietnam are considered to be potential target population in this research. The selection of industries was made on the basis of cost, time constraints and resource requirements. As the outcome of this research is to collect data from the experts’ point of view and as not many SMEs in Vietnam are familiar with the concept of Digital SCM as compared to developed nations, the scope of this qualitative data collection is rather small and focuses on different groups of SMEs in Vietnam. There are various types of Vietnamese SMEs and each interviewee represented a type of business and manufacturing industries (see Table 5).

Table 5. *Interviewee Profile*

Company (CO)	Number of Employees	Core processes	Type of industry	Digital SCM implementation
CO1:	80	Manufacturing	Paint manufacturing and trade	Applied (RFID, ERP)
CO2:	50	Fabrication, Manufacturing	Footwear manufacturing and trade	Applied at early stage (Internet based communication channel)
CO3:	40	Manufacturing, assembly	Software, IT industry	Applied (RFID)
CO4:	50	Fabrication, Manufacturing	Textile manufacturing and trade	Applied at early stage (Productivity quota system)
CO5:	70	Manufacturing	Lumber manufacturing and trade	Applied at early stage (Monitoring of product delivery by software)
CO6:	60	Manufacturing, assembly	Paper Tissue manufacturing and trade	Applied at early stage (Internet based communication channel)

Method of Analysis and Data Validation

Since this research adopts the grounded theory approach by Glaser and Strauss (1967) to code the interview data, the coding scheme was created and organised into a three-stage concept hierarchy. The three original stages included (1) Open coding, where text is read reflectively to identify relevant categories (2) Axial coding, where the categories are refined, generated and related (3) Selective coding, where the “core category” in the theory is picked out and related to other categories.

To ensure validation of data, interview participants for this research (mainly managerial employees or executives) were selected from a variety of companies in different industries. Accordingly, the anonymity of participants is also an important ethical issue and all the participants had been informed that their data would be anonymised before the actual interview. The consent form and participant information sheet were sent to the interviewees in advance as the manager might reveal internal information about their business operations. In a nutshell, the given information by the interviewees was strictly confidential and privacy-protected.

RESULTS AND DISCUSSIONS

After operating coding and classifying procedures for qualitative data analysis based on the ground theory approach, the four highest level conceptual categories presented

by the interviewees are organisational (OR), technological (TE), strategic (ST) and legal, ethical issue (LE). They represent four critical dimensions of concern regarding those participating firms. All interview participants indicated that the elements in those four dimensions could affect their decision toward digital SCM adoption. Out of six companies, two of them had applied technologies in supply chain management and four of them had not fully used the technologies effectively in the management scheme. All of the SMEs participated in the research were aware of digital supply chain and the Industry 4.0 in general but agreed that it was hardly applicable for small companies in developing countries. They expressed that developing cost for digital SCM was a vital issue and could vigorously impact the companies’ operation as SMEs often have constraint resources and they could face high jeopardy of bankruptcy if the investment in digital is not reliable. In each dimension, the enablers, barriers and opportunities were categorised as seen in Figure 2.

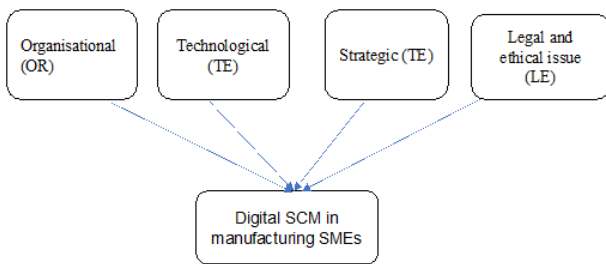


Figure 2. Factors affecting the adoption of digital SCM in manufacturing SMEs

In a nutshell, the key findings from the study are as follows:

- There are four main dimensions to assess the enablers and barriers of adopting digital supply chain management in manufacturing SMEs which are organisational, technological, strategic and legal, ethical issues.
- Manufacturing SMEs in Vietnam are aware of technology implementation in supply chain management but lack of proactive investment for its development due to various barriers from internal and external impacts.
- Financial resource and human resource with technology knowledgeable managerial hierarchy are the main internal impacts for Vietnamese manufacturing SMEs.
- Government support and data sharing standardisation between SMEs are the main external impacts for Vietnamese manufacturing SMEs.
- There are opportunities for the adoption of digital supply chain management in manufacturing SMEs in the future.

Accordingly, six interviews have indicated that Vietnamese manufacturing SMEs were at an early stage in digitalisation and adoption of SCM. Hence, in order to achieve the objectives of the study and answer the research question, the following propositions were formulated and put to test:

P1: There is a relationship between the adoption of digital supply chain management and the SME's competitive advantage.

Taking advantage of the modern technologies, as well as coming digital and e-commerce trends, would help to design the country's supply chains and build a more dynamic private sector (Cooper, 2018). The head of Microsoft Vietnam's Corporate Clients and Partners Division, expressed that Industry 4.0 offers many growth opportunities for SMEs as it provides a modern technological foundation, which the enterprises can use to access huge amounts of data on the market easily and to build effective business strategies (Vnexpress.com, 2018). As new websites and digital processing tools can bring services to manufacturing SMEs that were formerly unaffordable, ease a number of resources' cost or human constraints and decrease SMEs' expenditures in a range of aspects, from product development, assembly to insufficient research and development skills training, and insufficient knowledge of foreign markets and regulations. Digital technologies continue to make substantial changes to the economy with implications for expanded globally market. For Vietnam's case, it is common issue for SMEs in manufacturing that not many managers understand about SCM and advanced technology implementation. This was reflected by interviewee from CO1:

"If the company does not have good management personnel, it will not ensure the system of effective applications, which easily causes the failure of application".

However, Vietnam targets till 2025 to build a regional logistics hub enterprise with good management of supply chains (VCL Legal, 2018). This will enable mass customisation, allowing companies to meet customers' demands, creating value through constantly introducing new products and services to the market. Additionally, the collaboration between machines and humans could socially impact the life of the workers of the future, especially with respect to the optimisation of decision making. Thus, the ability to adopt DSCM shall bring an SME to a higher level in the market with their technological

competitive advantages. Subsequently, the study proposed a second proposition:

P2: Technology knowledge and skills have a positive impact on the adoption of digital supply chain management in Vietnamese manufacturing SMEs.

The benefits constitute the major factor that all companies consider in assessing the adoption of new technology. However, this analysis shows a tendency that Vietnamese manufacturing SMEs do not perceive the investment in digital supply chain management as their priority competitive advantage as there are many barriers in adopting the management system. Most of the participants approved that the reduction of uncertainty in the technology raises the trustworthiness of digitalisation and hence it could build up the SME's intention to adopt digital supply chain management. For example Interview from CO6 stated that:

“Technology has been considered in the company's communication system as there are more and more employees who understand the implementation of the Internet to business operation and this makes it easier to implement such technologies”.

However, the result also indicated that Vietnamese manufacturing SMEs in traditional industries like textile (CO4) or lumber (CO5) found difficulties in recruiting employees with technological knowledge in an immature economic environment such as Vietnam. Critically, technology knowledge is an extremely crucial factor and enabler for the transformation of traditional supply chain system. Therefore, those companies who target digital SCM as their competitive advantage will require a board range of digital specialists such as data scientists, user – experience designers and software providers who understand how to facilitate and fix the digital applications. However, supply of such experts remains limited, particularly more in the emerging markets like Southeast Asia countries. Besides recruiting new staffs for the digital development, it is necessary for

manufacturing SMEs to engage current employees within the chain to diminish resistance and drive behavioural shifts toward the integration of technology initiatives in the business management. Transformations are difficult, and long – term investments are needed to encourage upgrades in organisational managerial skills. Hence, the manager will need to empower staff with suitable digital tools and skillsets or to reward for their digital performing successes. Given that staff's abundant capacity to experiment with the digital innovation and supply chain management is also a challenge for the executives as there is often a large number of untrained workers in the manufacturing industries. The shifts in the workforce with the impact of digitalisation could also create a challenge for new employment models and structures. Moreover, the idea of “computer replace human” mentioned in the literature review did not convince enough for Vietnamese manufacturing SMEs case.

In consequence, management must be sensitive in dealing with the rearrangement of staffs who mismatched positions or cannot be reskilled or upskilled to work with the new technologies' application. While executives embrace the importance of digital transformation, few probably really comprehend what is required to truly evolve their organisations into effective digital businesses. This is where external expertise can blend strategies and execution with the soft skills for inspiring leadership, and train teams to transform businesses, quickly seize opportunities, and mitigate risks from digital transformation.

Participants of the interview agreed that the support from government played a crucial role in motivate manufacturing SMEs. Therefore, this argument leads to the third proposition:

P3: Government's policies and economic environment have a positive impact on the adoption of digital supply chain management in Vietnamese manufacturing SME.

Many high – value creating applications run on the digital supply chains, such as blockchain or RFID trackers that need to obey existing rules and regulations of the government. Policies such as tax breaks, infra-structural support, support to reach maximum customers with multiple numbers of digital retail/electronic transactions can be facilitated to small companies to compete with large companies. However, Vietnam is presently deficient in regulations and governance regarding the transparency of information, data sharing security, the type of data to be shared and kind of technology that could be used. As one of the interviewee stated (CO1):

“Infrastructure investment for digital supply chain development project is still limited, there are not many policies to encourage investment in this area”.

A finding from Le and Harvie (2010) indicated that the Vietnamese government’s assistance to firms for land and premises when they start their business and credit during their operations, was found to have a significant negative relationship with the technical efficiency of Vietnamese manufacturing SMEs. The technology implementation requires great investment in a long-term vision as it has become a crucial part of life to be embarked in the digital world in both business and individual users.

The development of DSCM could be different in each country according to environmental factors such as the government or organisational culture. One of the explicit obstacles for Vietnamese SMEs in the digitalised era is the *“lack of alignment with each other”* (CO1), therefore, they do not have any standardisation to follow or any sharing platforms to acquire skill in the adoption of newest digital technologies. The interviewee (CO1) also stated that:

“In order to apply digital technology, in addition to investing in people, technology systems, businesses need to standardise organisational hierarchy and internal processes so that when applying technology, it will be

highly effective, less disturbing the daily activities”.

Consequently, the lack of standardisation for manufacturing SMEs to develop digital supply chain might be the result of the absence of government’s regulations. As proposed by Hsu et al. (2014), external impacts such as social competition, government regulations or economic condition could have a significant influence on a company’s adoption to digital technology. According to Cooper (2018), when the law on support for SMEs (SME Law, 04/2017/QH14) will come into force at the beginning of 2018, it is hoped to spread a message that SMEs will play a leading role in a dynamic, competitive and innovative private sector to guarantee a solid Vietnam’s future prosperity and growth. The government had shown a desire to help the community of SMEs and it is believed to be the time to turn word into actions.

On the other hand, Vietnamese SMEs in manufacturing industries should also strengthen their organisational and strategic planning as well as corporate governance and risk management. The existing IT prospect of SMEs sometimes cannot support innovative models like additive management, smart manufacturing or smart factory. According to Swierczek & Thai (2003), SMEs owner in Vietnam tend to be motivated by challenges and achievement more than the necessity and economic security. As they maintain a short – term approach based on Net Profit rather than Business Growth, SMEs then need to invest in critical assets, from capital investments to information technology infrastructure and talent and integrate these into customer and business strategies to enable a digital future. Lastly, catching opportunities for cooperation among enterprises to improve creativity, innovation, and participation in the global value chain, to join industry associations to access information about state policies, corporate government experience.

The finding shows that the intention to adopt digital supply chain management can be influenced by four main facets and is highly

considered by the criterion such as benefits and costs, the trustworthiness of technology, and external motivations from the government and economics environment. The four dimensions affecting digital supply chain in manufacturing SMEs can result in both of opportunities and threats because all the different areas are interrelated, with no clear boundaries between them, depending on where it was analysed, it could have a positive or negative connotation.

For each company who was interviewed, there were different reasons for the appearance of enablers and barriers for digital supply chain management. In company 1 (CO1), the technology enablers for them came from the support of one of their subsidiary, which had greater network and financial resources as being a member of a largest Financial Group. Therefore, the Vietnamese partnership of CO1 could take advantage of transferred technologies from foreign enterprises surpassing the others, leading in the market with nearly 20 million USD revenue in the previous 2018 fiscal year as stated in their annual report. The suppliers also trusted the companies who had more creditability in order to cooperate together in the supply chains. Fast-moving consumer goods manufacturers such as footwear company (CO2) or textile company (CO4) could highly

forecast the sales based on analysing consumer behaviours and managing operation processes with the help of digital supply chain. And company such as CO3 who assembled software products usually required great investment in recruiting technicians and engineers, so they can enhance the quality of technologies to catch up with the modern generation. For companies who produce heavy products such as lumber company (CO5), they would consider carefully with the investment in technologies as they could not see the immediate benefits of them. Likewise, company evolved from traditional family profession like company 6 (CO6) used to perceive technology as an addition to business operation and rarely considered adopting digital aspects in manufacturing processes. Hence, through the analysis summary, the results showed unexpected finding that different type of manufacturing industries also affect the digital adopting level of SMEs in Vietnam. Such companies working in software manufacturing industry like Company 3 (CO3) have better chances to pursue digital technologies than other studied industries. For that reason, further research is required which should also test the propositions identified in this study. The summary of the findings is presented in Table 6.

Table 6. *Factor Summarised Findings (enablers, barriers and opportunities) for digital SCM*

Main Dimensions	Enablers	Barriers	Opportunities
Organisational (OR)	<ul style="list-style-type: none"> • A general standard (All CO) • Understanding of digital implications in SCM (All CO) • Executive’s vision (All CO) 	<ul style="list-style-type: none"> • Financial constraints (All CO) • Human resource constraints (All CO) • Risk Aversion (CO4/ CO5/ CO6) 	<ul style="list-style-type: none"> • Less faults from humans’ activities (CO1/ CO3) • Well-oriented management scheme (All CO)
Technological (TE)	<ul style="list-style-type: none"> • Big data base (CO1/ CO2/ CO3) • Geography proximity (All CO) • Advance digital platform (All CO) 	<ul style="list-style-type: none"> • Lack of standards and data sharing protocol (All CO) • Competition from MNEs with better technological ability (All CO) • Lack of infrastructure and Internet - based network (CO1/ CO2/ CO4/ CO5/ CO6) 	<ul style="list-style-type: none"> • Forecast false operation (CO3) • A quicker response to failure (CO1/ CO3) • Allow customers to track their products (CO5)
Strategic (ST)	<ul style="list-style-type: none"> • Enhance technology knowledge in SMEs (All CO) • Investment in research and development (All CO) 	<ul style="list-style-type: none"> • Lack of governmental support and policies (All CO) • Poor research and development (All CO) • Unclear economic benefit of digital investment (CO2/ CO4/ CO5/ CO6) 	<ul style="list-style-type: none"> • Diminish steps in unifying decision (CO1) • Raise companies’ awareness (All CO)

Legal and ethical issues (LE)	<ul style="list-style-type: none"> • Collaboration between SMEs (All CO) • Supply chains' network (CO1/ CO3) 	<ul style="list-style-type: none"> • Legal issue restricted (All CO) • Lack of coordination and partnership (CO2/ CO3/ CO4/ CO5/ CO6) • Security issue (All CO) 	<ul style="list-style-type: none"> • Protection of customer's security (CO3)
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CONCLUSIONS

This study is built to fill the research gap that allows companies and experts to understand and support manufacturing SMEs in their journey towards the digital era. There are theoretical and managerial contributions from this study to the whole notion of DSCM for further research in Vietnamese context.

Theoretical Contribution

Findings of the research reveal that enablers and barriers of DSCM are classified into four main dimensions which are Organisational, Technological, Strategic and Legal – Ethical issues. This study is a foundational effort to contribute to the establishment of new digital management era in emerging economies. The findings of this study are aligned with the existing literature review which represented numerous internal and external barriers to SMEs to acquire digital supply chain managements, especially in developing countries. It demonstrates the importance of a clear understanding and an implementation strategy which are crucial for SMEs' managerial governance focusing on gaining technological competitive advantage. The digital transformation could be a competitive game-changer that raises creativity, revenues, efficiency and profitability, and helps SMEs to potentially disrupt more well-known multinational brands. Initiatives require a departure from traditional operating models and legacies to apply new tools and technologies, ecosystems and technology platforms to deliver upgraded products and services.

The development of DSCM could be different in each case according to environmental factors such as the government or organisational culture. The essential of digital technology innovation in business operation, especially in supply chain

management will be the norm for companies to survive the intense and competitive market. Overall, it appears that the Vietnamese discourse on digital supply chain management is still nascent and under-developed. This is, however, understandable, since the digital revolution in Vietnam has started only recently. From this point onwards, contribution to the discourse is most expected from academics, with more in-depth studies that cover a more diverse range of aspects related to digital supply chain management in Vietnamese manufacturing industry. Whether or not these endeavours crystalize into a meaningful policy outcome from the government is a matter of time and effort. Vietnam still has time for the development of digital technology in SMEs management scheme, but such a window of opportunity can easily slip past without adequate focus and serious study.

Managerial Contribution

The result of this research has significant managerial and practical implications as the empirical analyses of this study offer some guidelines for logistics and supply chain managers in SMEs to examine the adoption of digital technology. On the other hand, IT solution providers can put to good use from the study findings of this work by correcting their solutions to alleviate the digital SCM adoption addressed herein, for example, raising the trustworthiness of digital implementation, reducing the security risk for manufacturing processes or adjusting the cost of facilitating the technology system for SMEs.

This study reveals that external factor deeply influences the adoption intention in Vietnamese manufacturing SMEs. Nevertheless, the development of digital SCM for them implies a great internal effort to overcome a set of major barriers. Participants

of the interview believed that the government support played a crucial role in motivate manufacturing SMEs in Vietnam environment. Besides, the government should not ignore this potential opportunity to support its manufacturing SMEs in the global market. Vietnamese government's policies such as investment in research and development technology institutes could be of great help for their SMEs to explore the digital world. In order to encourage the establishment of new and technically more efficient private manufacturing SMEs and its supply chain management, it is important to reconsider Enterprise Law in Vietnam. Consequently, a reassessment of government financial assistance policies, including that of SMEs assistance, with the aim of distinguishing how these could be more effectively utilised.

Given the requirement to approach the most knowledgeable industry's specialists and companies, the qualitative data collected from six chosen manufacturing SMEs in Vietnam satisfied the purpose of the research. Without the time and cost limitation, a larger sample for the qualitative and quantitative data collection would allow a better validation of the findings, as the impact of research participants, which gave false information accidentally or purposely, could be reduced and more precise information could be obtained. Notwithstanding, despite the limitations, valuable knowledge and analyse of digital SCM and SMEs could be obtained, and the research opens up a valid starting point for further research. Based on the research presented, other managers and researchers are encouraged to investigate the comprehensive technology initiative in supply chain management so the small and start – up companies can enhance their participation opportunity in the global market. This will be beneficial from an academic as well as a managerial standpoint. Government support and the company's business culture and resources are major factors that affect the adoption of DSCM in the future. A digital supply chain is a new trend in the manufacturing industry, and it is confirmed

that interviewed SMEs are aware of the shifts in regard to the use of technologies with opportunities and barriers for their competitive advantage in the global market. Future studies should therefore focus on delving in more detail on implementation of industry 4.0 technologies in supply chains, namely supply chain 4.0 in developing country context and empirically validate the findings using robust statistical techniques.

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