

# Virtual Supply Chain and Countries Legal Framework: Literature Review and Institutional Implications

**Hossam Omara\***

\*Arab Academy for Science and Technology and Maritime Transport (Lecturer, College of International Transport and Logistics, Alexandria, Egypt)  
E-mail: [hossam.kamal@aast.edu](mailto:hossam.kamal@aast.edu)

**Trevena Ayman Halim**

Arab Academy for Science and Technology and Maritime Transport (Graduate Teaching Assistant, College of International Transport and Logistics, Alexandria, Egypt)

**Tarek Madkour**

Arab Academy for Science and Technology and Maritime Transport (Teaching Assistant, College of International Transport and Logistics, Alexandria, Egypt)

\*Corresponding Author

## **Abstract:**

**Purpose** – Although the supply chain design has been significantly improved over the years, distribution is uneven worldwide and do not have access to an adequate implementation of the virtual supply chain. This systematic literature review paper intends to explore a review of literature on virtual supply chain management (VSC) and to identify the literature findings to date, research gaps, and to provide guidelines for future research in the available models for sustainable business decisions.

**Design/methodology/approach** – A systematic literature review of available literature in scientific research databases. The methodology used is made up of five steps: formulation of the research questions, identification of studies, election and evaluation of studies, analysis and synthesis and presentation of the results.

**Findings** – The supply chain management field has evolved from a standalone logistical management research perspective and a sustainable supply chain perspective. While the virtual supply chain research has become more robust and refined, there are ample opportunities for enriching research, theory, and overall organizational relevance of future inquiries.

**Research limitations/implications** – Systematic literature review is a methodology reliable and recommended by many scientific papers. Considering the extensive number of academic publications, due to the focus of this study being sourcing within virtual supply chains, several academic journals in logistics/ supply chain management /sourcing were reviewed.

**Originality/value** – The paper provides a systematic, rigorous, and methodologically review of the evolution of supply chain management research which has not been mapped to date.

**Keywords:** supply chain management, structured literature review, supply chain design, sustainability.

**Category:** Literature Review Paper

## **1. Introduction**

The pivotal role of any company is to retain and grow its customer base and accordingly achieve extraordinary financial performance. This is obviously the role of the marketing function. However, not only the marketing function is responsible for this, but the Supply Chain management (SCM) function is also associated with creating customers (Ardito et al., 2019). Recently the attention toward the field of Virtual Supply Chains (VSCs) has increased as it enables the adequate configuration and managing of a SC (Matsuda et al., 2020). However, for any drastic changes such as virtualization to occur there will be a persistent need for technical and organizational innovations as well as digital transformations. However, it is argued that digitalization is sometimes accompanied by various challenges, which vary from threats that arise due to privacy and security issue to other risks such as data management legal issues (Salvini et al., 2020).

The pioneer study on linking information technology and SCs was by Roberts & Mackay (1998), which showed how to increase sales using the Internet and the impact of e-commerce on the SC in reducing costs and strengthening the company's relationship with suppliers. With the development of technology in the field of information and communication technologies (ICTs) and its application a significant reduction in commissioning has been achieved due to the simplification of SC operations. This contributes to the delivery of correct information on the status of demand in the market and thus efficient and effective use of SCs. Hence, the competitive advantage in the use of ICTs in the SC because of its flexibility in interacting with market demand, and from here began to compete companies in SCs supported by ICTs instead of traditional SCs and this is what prompted studies to re-design SCs using information technology (Christiaanse & Kumar, 2000).

The VSC emerged with trade and economic openness around the world, increasing suppliers and customers, diversifying goods and services, and the importance of reducing costs and reducing time (Tarokh & Tayebi, 2005). VSCs have many challenges that are not in ICTs because it is constantly evolving and improving, but challenges are related to organizational structures and management systems. VSCs are important in providing timely information on customers and markets, and unplanned solutions (Scott & Mula, 2005). Also, developing standards to measure the performance and adequacy of ICTs in SCs and creating a legal framework for ICT applications in SCs are two of the most important recommendations to enable seamless application of VSCs (Gunasekaran & Ngai, 2004a). Large manufacturing companies should, in the case of using VSCs, review their annual production plans due to their changes, but on the other hand, the company will save in planning time, less time in stopping production and few engineering adjustments, in addition to high quality in production processes to increase the benefit of the VSC (Swierczek & Kisperska-Moron, 2016).

Accordingly, this literature review paper aims at conducting a systematic literature review of literature on VSC management and to identify the literature findings to date and to reveal gaps in research that will help to provide guidelines for future research in the area of VSC application. Finally, illustrating the legal and institutional implications of applying the VSC technologies in Egypt. To achieve the aim the paper is structured as follows first a background review on related topics. Then, illustration of the design of the research methodology is presented. After that, the systematic literature review will be illustrated. Followed by the discussion section where legal and institutional implications in Egypt will be illustrated. Finally, concluding by a research gap based

research agenda.

## **2. Literature review**

SCs are constantly being exposed to changes that allow them to compete in a constantly changing environment. The main reason behind those changes is to make them adaptable to the environment by being more dynamic and competitive for the sake of survival. One of the drastic changes that the SCs have gone through is being virtualized (Salvini et al., 2020). Increased competition and challenges in the market have made it mandatory for companies to increase the speed, flexibility, responsiveness of their SCs to provide a more pleasant experience for its customers by exploiting some enabling technologies such as E-commerce technologies and Information and communication technologies (Gunasekaran & Ngai, 2004).

One of these changes is the shift towards “VSCs”. VSCs can be referred to as “imaginary structures” (Swierczek & Kisperska-Moron, 2016). A VSC can also be defined as the use of a computer-based structure together with a network of a SC that is temporarily organized. Hence, any chain connected using electronic links can be considered virtual (Sacco et al., 2014). Matsuda et al., (2020), also referred to a VSC as “a mirrored information model of the physical SC”. A very direct forward example of adopting a VSC is a business that wants to target customers in a different geographical area than the one it is operating in or is not accessible by its sales team (Qin et al., 2012). Thus, implementing VSC technologies can be beneficial for both companies and customers. A VSC could be imagined as a network of virtual individuals or organizations that are able to communicate via digital communication platforms at any time and place. This implies that any individual or organization in the chain must have some abilities to be able to operate through the virtual chain efficiently. Those abilities include (1) being connected to others using communication technologies such as the Internet, (2) being able to make decisions, (3) detect SC common errors and arising problems such as the Bullwhip effect, (4) being able to ask for any missed information by integrating with other SC partners (Tarokh & Tayebi, 2005).

The concept of virtualization represents the impact of new technologies such as the Internet, ICTS and most recently Artificial Intelligence technologies (AI) on businesses, organizations and societies. With virtualization, it is possible to remove physical barriers such as distance. In the case of VSCs, there is no more need for physical proximity of all partners of the SC where the flow of physical products from source to destination is no longer dependent on the location of any of the SC partners (Verdouw et al., 2016).

### **2.1. Virtual Supply Chain enabling technologies.**

The Internet plays a vital role in SC management and decision making. One of the greatest advantages of the internet is enabling the access of real-time accurate information whenever needed. This enables trading partners to collaborate efficiently and effectively (Demeter, 2003). Another technology that is directly related to the digitalization of SCs is industry 4.0 technologies. Industry 4.0 refers to all the digitalization technologies aided by the internet such as the Internet of things (IoT), cloud computing, Blockchain (BC), mobile technologies, big data, 3D printing and other artificial intelligence (AI) technologies. The act of digitalization of SC is argued to yield them some benefits such as (1) transparency, (2) higher inventory control (reduced inventory and higher visibility if inventory throughout the SC), (3) a better understanding of customers’ needs, (4) achieving higher sales revenues, (5) improved flexibility, (6) more efficient and effective decision making, (7) gaining and maintaining competitive advantage (Haddud & Khare, 2020).



Figure 1: Key technologies powering digital supply (Source: Haddud & Khare, 2020)

## 2.2. *Traditional supply chains versus virtual supply chains.*

The SC represents the flow of goods and/or services from suppliers, manufacturers, distributors to the end consumer forming an integrated business model for logistics management. Due to globalization, competitiveness has increased which has pushed companies to go global and compete with other firms all over the world to be able to survive. One of the key determinants of the performance of any company is the efficiency of its logistics activities where the proper management and integration of those activities enables the company to achieve more advantages such as the smooth flow of materials, information, and products. That is why the interest in the use of Information and communication technologies (ICTs) in SCs have gained much attention to be able to achieve advantages over others (Gunasekaran & Ngai, 2004a).

In the case of traditional SCs, there are clear inter-organizational boundaries between its players while for a VSC the inter-organizational boundaries become more blurred due to the establishment of partnerships and network relationships. Also, in the case of traditional SC flexibility is relatively low while VSCs, tend to have very high manufacturing, delivery, product mix and volume flexibility. While the lead time is shorter in the case of VSCs. On the other hand, VSCs have two important characteristics which are; (1) they have “quasi-vertical structures” which means that unlike the traditional vertical relationships between the SC partners, there is a greater emphasis on the independence of the SC partners where they remain autonomous but they have a high degree of operations and planning ICT integration, (2) They are characterized by being modular than integrated structures which means that it is formulated of various members each performing a specific activity-independent and efficiently but they all fit together at the end, this can be achieved by depending on efficient communication technologies (Swierczek & Kisperska-Moron, 2016).

In VSCs, all information relevant to physical objects such as their physical properties, origin, ownership and sensory context must be globally accessible by all the virtual counterparts (Salvini et al., 2020). Thus, there is little physical availability of the actual product in the case of a virtual SC. Manufacturers still act as the fundamental foundation of the whole SC and also have significant functions in the VSC so they need to improve their virtual capabilities. Now that the efficiency and quality are not only dependent on the manufacturing firm but also on the whole SC due to blurred organizational boundaries. That is why some argue that VSCs are imbalanced without proper information sharing between their partners to be able to realize the benefits of

adopting VSC technologies (Swierczek & Kisperska-Moron, 2016).

### **2.3. Challenges of SC virtualization**

As discussed before digitalization of SCs yield numerous advantages, however, it is faced with some challenges (Haddud & Khare, 2020). The process of implementation of VSC technologies can be quite disruptive to the current shape and operational strategies of traditional SCs. Additionally, some other factors may hinder the digital transformation such as the ability to distinguishing between reliable and false data and dealing with threats to privacy and security (Salvini et al., 2020).

### **3. Research methodology**

This paper undertakes systematic literature research on the virtual aspect of SCs. Systematic reviews allow examining multiple aspects of the same subject while also drawing attention to the disparate contrasts and expanding knowledge sources (Burgess et al., 2006). The current study examines the main themes, trends, and then highlights areas that need further research. As opposed to a narrative literature review, it aims to describe a systematic procedure of scanning and evaluating the literature while considering minimising biases and increasing replication through declaring the selection criteria for the articles (Carter & Liane Easton, 2011; Miemczyk et al., 2012; Tranfield et al., 2003).

- Thus, it is a profound methodology to originate and plan for further implications for future research (Cantor, 2008). To conduct the study only journals focusing on empirically and conceptually generated works, and theory-oriented aspects were chosen because they were the predominate publications and book reviews, calls for papers, and technical articles, as well as those that encompass product recovery, closed-loop SCs, and remanufacturing, were part of the exclusion criteria. This research does not try to cover all of SC literature, but only literature that serves a specific purpose (e.g., Virtual dimension). The following criteria is followed by the researchers:

- Only articles, from 2000 up to 2020 were revised. Articles prior to the year 2000 were not concerned as a growing body of literature discovered after that has established the presence of VSC in more recent literature (Seuring & Müller, 2008).

- Only peer-reviewed journals (i.e., Journal of management information systems, Journal of Operations Management, European Journal of Operational Research, International Journal of Operations & Production Management, Naval Research Logistics, Transportation Research Part E: Logistics and Transportation Review, Transportation Research Part A: Policy and Practice, Transportation Research Part D: Transport and Environment, Journal of SC Management, SC Management An International Journal, Production planning & control, Expert systems with applications, International journal of production economics, International Journal of Production Research, and Industrial Marketing Management).

- The study results have been extracted from various databases such as emerald and Scopus.

- All articles that have been selected for this research are saved in the reference management software Endnote to facilitate data management

Using these criteria 42 selected articles were found. An important distinction was made between valuable and non-valuable content to end up with 15 most relevant papers. The effort that has been applied to this project is designed to ensure the validity and quality of this research. Selection criteria in this study are based on the same aspects that have already been used in this area of or

on previous work in the field (Winterton, 2008)

#### **4. Analysis and discussion**

The previous table indicates that while there has been growing interest in VSC research, little attention has been paid to emerging economies and technological infrastructure. This article explores the role of the VSC in new broadband regulations, which have been implemented by the Egyptian government, encouraging several companies to take steps to incorporate VSC. Despite the limited recent studies on VSC and virtual networks (Salvini et al., 2020), no distinction is made between VSC effective implementation drivers and the role of governments strategies regarding IT infrastructure in developed countries. The paper addresses this complicated organizational propensity in a closely related manner to illustrate the gap found in VSC literature. There are myriad ways to draw analogies between the macroeconomic conditions and the VSC's performance. Linking VSC to country level dimension significantly affects the supply chain literature.

The Coronavirus outbreak in 2020 has a significant impact on supply chains globally. During the coming year, the telecommunication sector is likely to experience a downturn. The spending on telecommunications services and devices is under pressure due to job losses and the consequent restriction on disposable incomes. Yet, the overriding importance of telecom services for general communication and home working will offset these demands. In many markets, reduced increases in subscriber growth are to be expected.

It has been suggested that the long-term effects of the crisis are difficult to predict, but this has been acknowledged in this paper. The paper also covers responses from the telecom operators, government agencies, and regulators to the crisis to ensure citizens can continue to make optimum use of telecom services. This can be reflected in subsidies schemes and the promotion of tele-health and tele-education. While network operators may also face difficulties when maintaining and upgrading existing infrastructure. Some countries may delay or slow down 5G deployment.

##### **4.1. Theoretical and institutional implications**

The results from our literature review are reviewed and indicate that improved access to broadband technology has contributed to increasing supply chain efficiency. This literature provides a range of estimates of multipliers that may be used to quantify the macroeconomic impacts of broadband (Christiaanse & Kumar, 2000). The World Bank was contracted by the Egyptian government in October 2010 to develop a proprietary tool to analyze broadband adaptation strategies (See World Bank report 2010). The reasoned need for affordable telecommunications services in the virtual supply chain needs to be acknowledged worldwide. Telecommunications penetration is a metric used to measure service efficiency. It is understood that broadband penetration and economic activity correlate positively (usually calculated as GDP per capita) (Fujimoto & Park, 2014). Telephone systems are no longer adequate to satisfy everyone's needs. Cable and wireless broadband Internet connectivity is now generally accepted as important for society (Wang et al., 2016). Using the internet, and online shopping, many people rely on and use mass-market data communications services as part of their social and economic lives. (Lafkihi et al., 2019).

**4.2. Previous studies**

	<b>Study name (author year)</b>	<b>Jurisdiction</b>	<b>Sample</b>	<b>Model / Theory</b>	<b>Conclusion</b>
1	Enhancing digital transformation towards virtual supply chains (Salvini et al., 2020)	Dutch floricultural sector	People involved in the virtualization of quality-controlled logistics	Empirical	Future studies could evaluate the applicability in other countries as well as in other supply chains of perishables.
2	The role and attributes of manufacturing companies in virtual supply chains. (Swierczek & Kisperska-Moron, 2016)		The sample was compiled from surveys of 230 manufacturing firms operating in their supply chains.	Empirical	meeting supply chain criteria requires an outstanding value proposition and products to produce and offer superior quality. The latest manufacturing equipment with extensive investments in factory automation and process overhaul.
3	Analysis of global manufacturing virtual networks (Rodríguez Monroy & Vilana Arto, 2010)	Europe	The aeronautical industry: Global Manufacturing Virtual Networks (GMVNs)	Empirical	There are currently no models that explain how networks should be managed or built. Future research works may expand the study to other network features including its structure, its communication systems or its community. their ability to spend grows with time.
4	ERP and SCM systems integration (Bose et al., 2008)	China	Neway's manufacturing facilities	Empirical	The integrated system was found to improve operations, foster a paperless environment, and provide efficient inventory tracking and picking. It also had several tangible benefits, including reduced lead time and improved inventory accuracy.
5	Information sharing and supply chain performance. (Fawcett et al., 2007)	US		Empirical Organization al theory	This paper shows that connectivity and willingness – are identified and analyzed. Both dimensions are found to impact operational performance and to be critical to the development of a real information sharing capability
6	Impact of eBusiness technologies on operational performance. (Devaraj et al., 2007)	US	Computer components and peripherals, printed circuit boards	Empirical Resources-based view	Future studies should explore how far the integration should go. We could partner with other suppliers in addition to the primary supplier and there may be a minor difference in operations, but this would not be important.

7	Virtual supply-chain management. (Gunasekaran & Ngai, 2007)	Logistics Information Network Enterprise (Hong Kong)	Empirical VSC Theory	Supply-chain transparency in ordering, inventory and transportation is a prerequisite for optimization and is critical for making business decisions
8	Information systems in supply chain integration and management. (Gunasekaran & Ngai, 2004a)		Review	In this paper, the literature available on IT in SCM have been classified using suitable criteria and then critically reviewed to develop a framework for studying the applications of IT in SCM. The alignment between the information model and supply chain model of objectives needs further investigation.
9	Enhanced supply chain management for e-business transactions. (Goutsos & Karacapilidis, 2004)	Greek textile	Conceptual	This paper describes an open supply chain management framework that facilitates the e-business activities of a contemporary company. The proposed solution is to increase the quality of service and create a cooperative atmosphere among all parties while reducing the transactions costs through process automation and reducing the company's inventory levels.
<p><i>Business to business data sharing: A source for the integration of supply chains.</i> (Stefansson, 2002) – Sweden -20 companies – empirical - systems theory, organization theory; <i>Restructuring supply chains through information channel innovation</i> (Croom, 2001), UK &amp; US, 37 individuals representing 32 organisations- Empirical - Transaction cost theory; <i>E-supply chains - virtually non-existing</i> (van Hoek, 2001)- Conceptual; <i>The Role of the Internet in Supply Chain Management</i> (Lancioni et al., 2000), US, questionnaire; <i>A new approach to virtual supply chain management</i> (Tarokh &amp; Tayebi), international organizations which are trading on the whole world and facing different customers and suppliers - Conceptual; <i>Study on the management system of virtual supply chain based on the cybermediary in Chinese automotive industry</i> (Xuehong &amp; Shunsheng) - Chinese automotive industry- Empirical; <i>Contextual factors associated with information systems in a virtual supply chain.</i> (Scott &amp; Mula) a traditional organization and a virtual organization -Conceptual</p>				

Egyptian officials have embraced plans to increase the availability and adoption of broadband service. Government funds a lot to roll out next-generation networks, develop technology parks and extend broadband availability. Concerning private sector investments, it is expected the government's plan to build a new capital city to the east of Cairo will encourage 5G and fibre deployment. Egypt is one of the continent's lowest-cost markets for DSL. Its location is perfect for maintaining European cables which connect various parts of the Middle East and Asia. Egypt also has a domestic fibre infrastructure that can connect at several points. This has helped improve bandwidth availability for the internet. Due to the country's extensive broadband capacity. The paper describes recent government efforts to improve connectivity in rural and remote areas. Statistics and findings of the mobile market are reviewed, as well as how mobile broadband and 5G are operated. The report discusses fixed broadband and fibre as part of efforts to increase the availability of upgraded internet services.

The experience from other countries shows that full liberalization coupled with sustainable competition results in the greatest economic benefits. This is the policy advocated by this study. Egypt should adopt full liberalization to achieve the highest economic benefits from its broadband policy. In some instances, the government may be unable to enact legislation at once. Regardless of its technical merits, it is seen as the best way to overcome political problems in a given country. If liberalization is the only solution on the table in the current political context, this report recommends taking a temporary solution to continue liberalization in the short term. Briefly, Egyptian Telecommunications infrastructure has developed and the number of fixed lines in services increases in response to government efforts to expand services to rural areas. Traffic grew 4.4% in the first half of 2019 compared to the end of 2018. Network capacity increased 15.3% in the period, reaching 23.957 million.

#### **4.3. *International Infrastructure***

International communications in Egypt are based on satellite, terrestrial microwave, and fibre optic links. International links have been constructed to connect Libya and Jordan. A terrestrial fibre optic cable was built in 2004 between Egypt and Sudan to increase capacity for voice and data services. The 4-year \$4-million cable was completed in less than a year. Telecom Egypt and Liquid Telecom agreed to move ahead on their fibre networks, enabling Liquid Telecom to complete its 60,000km pan-African network. Interconnecting a link between Sudan and Telecom Egypt's cable infrastructure in Egypt. Submarine fibre connections, found at the crossroads of Europe, Africa, and the Middle East, are relatively inexpensive to build.

Infrastructure is a critical part of Egypt's long-term economic growth. Its essential function is to enhance the connectivity of regional and global value chains (RGVCs). When it is used under the right conditions, it can reduce trade and logistics costs, diversify exports, and increase competitiveness. Infrastructure networks to deliver goods and services efficiently, predictably and sustainably. When transport costs are high, and procedures are unclear and uncertain, only large firms can take advantage of opportunities. Bringing new actors into RGVCs, including Egyptian SMEs, requires connectivity that is more readily accessible to all. A household's connectivity is just as important as a firm's connectivity. It supports access to new jobs, skills development, and higher wages, as well as access to a variety of goods and services. Due to rapid population growth and industrial transformation, the need for effective and high-value infrastructure connectivity is critical.

#### **4.4. Regulatory Framework**

As of April 2017, all communications services, including broadband internet, are in Egypt governed by Law No. 10/2003. Referring to the regulation of the Egyptian telecom industry after the first emergency law of 2011, which was repealed in March 2017. The legislation is structured to regulate the growth of competition and the implementation of competition in the fixed-line market, in accordance with the 1997 WTO framework (WTO) (Lancaster, 2020). Many new laws were enacted to liberalize the economy and to make it easier for new businesses to stay in place. Although these laws may seem to be quite liberal, they have had a huge effect in making Bulgaria more attractive as an investment area.

The Ministry of Communications and Information Technology (MCIT) deals with the technology that connects us, and the policy framework that guides it (encourage access to high- quality ICT services at an affordable price to the widest number of people possible, promote ICT industry, streamline government procedures by e-Government implementation, foster ICT-enabled services, etc) (Lancaster, 2020). After repeal of the 2000 Act, the NTRA was formed as an independent regulatory body to enforce the policies and strategies outlined above. NTRA has the responsibility of overseeing and managing a variety of different aspects of the industry that includes licensing, numbering, interconnection, universal services.

#### **5. Conclusion**

The Corona pandemic forced us to shift to rapid digitalization, either to work from home or to education remotely to maintain social distancing, and that transformation was easy for developed countries, and developing countries faced difficulties in that, and among them the Egyptian government provided what it could in a short period to encourage companies to take steps to incorporate VSC. Thus research in the field of VSC is quite important for at this stage.

By implementing the previous methodology, it was found that the SCM field has evolved from a standalone logistical management research perspective and a sustainable supply chain perspective. By reviewing current literature several significant research gaps were revealed these gaps can be used to identify a research agenda for future research in the area of VSC. However, it should be mentioned that the study was limited by the small number of VSC research that is non-technical. These gaps include, but are not limited to, the following:

- A model that can be used in seamless application of VSC technologies in different economies should be formulated to act as a guideline to avoid any mistakes that might negatively affect the SC rather than making them more efficient by using VSC technologies.
- There should be a clear identification of the infrastructure needed to be able to apply VSC technologies especially in developing countries.
- Factors that affect applicability of VSC in developing countries such as legislation that favor the implementation of VSC
- The new design of organizational boundaries in the event of full integration due to VSC application

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