

Technology innovation in supply chain logistics: A Systematic Literature Review (2003-2019)

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Abstract

The key purpose of this study is to explore the supply chain logistics industry by focusing on the challenges existing in this industry together with the available technology innovation solutions to potentially address these challenges. To this aim, the paper systematically reviews the literature available in this industry, uncovering research strengths and limitations and discussing future research recommendations. The review was conducted by a key word search from selected databases. Overall, 34 relevant papers were identified through the inclusion and exclusion review process. After providing the review method, the paper introduces two main concepts, challenges and innovation technology in supply chain logistics. The literature review results relating to the two concepts are presented and principle findings are discussed. Based on reviewed literature, this study can be of value to future related studies in establishing the relation between existing challenges in supply chain logistics and available technology innovation solutions.

Keywords

Supply chain logistics, Technology innovation, Challenges, Information technologies

1. Introduction

International business has been experiencing a period of significant transformation. Trends towards globalisation, integrated logistics and the development of information and communication technology are all re-shaping the world's trading patterns and subsequently physical trade flows (Vasiliauskas & Jakubauskas, 2007). To be internationally competitive, industries organise strategic worldwide networks that can deliver efficient and high-quality responses to demand from any part of the world market. The effective and integrated organisation of such activities has often been referred to as global logistics or supply chain management (SCM), and it has become the core of global competitive power (Vasiliauskas & Jakubauskas, 2007). SCM is a multi-faceted process with many stakeholders and even more moving parts. Modern supply chains are often very complex, spanning multiple countries and involving many steps.

Supply chain management plays a significant role in the success of any company's operations and has a direct impact on its bottom line. More importantly, supply chain management processes play a big role in customer satisfaction, which is more important than low product costs. The improvement of SCM has been the main source for businesses to make new profits and sustain competitive advantage. SCM processes involving relations between humans, nature, technology and resources are more and more complicated every year. Take for example, logistics processes have to change with all the changes that happen in the continuous improvement context such as lean, total quality management, agility, etc. (Nilsson, 2006). This means that there are more opportunities for errors than ever before, and in today's world, errors disrupt the supply chains. There are also numerous cases where the SCM systems have been the origin of bottlenecks in a firm's general management (Nemoto & Koichiro, 2007). The elimination of such bottlenecks has potential to reduce total cost and to improve the quality of services provided to clients. From a social viewpoint, a competent logistics system can offer opportunities to reduce road congestion and environmental pollution, which could result in improved economic productivity (Erkan, 2014).

Several innovations have been developed to advance the logistics and supply chain systems. These innovations may be widely grouped into innovations to improve individual processes of logistics and supply chain, and innovations to improve the logistics and supply chain system wholly. SCM and Third-Party Logistics (3PL) have had innovations

that have successfully attracted business attention (Vasiliauskas A. V & Jakubauskas G., 2007). Many exciting things are happening as supply chain executives respond to changes arising from the convenience of Big Data, supply chain digitization and omni-channel marketing, to name just a few. The economy's performance has a direct effect on supply chain trends (Erkan, 2014).

In the rapid growing industry of logistics and supply chain management, Jacobs and Chase (2011) state that the key challenge in creating a great supply chain for manufactured products lies in determining the method products move from the manufacturer to the end customer. When dealing with the end consumer, this consists of the movement of the product from the point of origin, which is the manufacturing plant to a warehouse and then to retail stores or the end customer. Warehousing and distribution are often contracted to 3rd party logistics service providers hence most companies outsource their logistics activities to logistics service providers (Lin, 2008).

It is generally believed that adoption of new technologies, especially information technologies, not only improves the operating efficiencies, but also generates competitive advantages in the logistics and supply chain industry (Lin & Lin, 2014). Lin and Lin (2014) further add that, to establish and maintain a supply chain's competitive advantage, classification of the elements for the inclination and adoption of new technologies is essential. In earlier work by Lin (2008), it states that it is essential for logistics service providers to focus on adopting more efficient technologies to deliver great services to their customers. Consequently, the application of technologies becomes more vital for the industry. The advantages provided by technologies include; efficiency improvements, improved service quality, flexibility, and cost savings (Lin & Lin, 2014). Many businesses have noted technological innovation as a primary variable and a differentiating factor among logistics service providers. These technological innovations are placed in four groups; data acquisition, information, warehousing and transportation technologies (Lin, 2008).

In the logistics industry, one of the main objectives is to create and sustain a competitive advantage and profitability. Yet, globalization and growing supply chain interconnectivity have led to greater complexity, uncertainty, and vulnerability in supply chains. Consequently, supply chains must become smarter to confront these challenges. Therefore, this paper focuses on identifying the prevalent challenges met with in establishing and retaining a competitive advantage in the logistics and supply chain industry as well as the existing technological innovation solutions to address these challenges. The evolution of both the challenges and their technology innovation solutions are thus explored. Two research questions were posed:

- 1) What are the key challenges in establishing and retaining a competitive advantage in logistics and supply chain management?
- 2) What solutions does technology innovation offer to the challenges in logistics and supply chain?

After this introductory section, the following section will provide definitions of the terms logistics and supply chain that are used in this paper. The approach used in carrying out the structured literature review will be briefly presented followed by the literature review itself then a section of the findings and discussions. Concluding remarks and insights for further work will be in the final section.

1.1 Defining Supply Chain and Logistics

Supply Chain Management (SCM) is a growing and evolving discipline. It involves, planning, design, control and implementation of all business processes related to procurement, manufacturing, distribution and sales order fulfillment functions of a business (CSCMP, 2019). The Council of Supply Chain Management Professionals (CSCMP, 2019) states that supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, 3rd party service providers, and customers (CSCMP, 2019). In essence, supply chain management integrates supply and demand management within and across companies.

Logistics has aided and contributed to enabling global trade. Logistics can be defined as, the process of anticipating customer needs and wants; acquiring the capital, materials, people, technologies, and information necessary to meet those needs and wants; optimizing the goods- or service- producing network to fulfil customer requests; and utilizing the network to fulfil customer requests in a timely manner (Coyle, Langely Jr, Novack, & Gibson 2013). Third Party Logistics Service Providers both at global levels and local levels form major partners to manage and offer Supply Chain services. According to the CSCMP (2019), Logistics management is that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and

related information between the point of origin and the point of consumption in order to meet customers' requirements. Logistics is the backbone on which supply chains are driven. Logistics, therefore refers to the management of the flow of goods and supplies involving information, data and documentation between two entities or points. Logistics plays an important role in post procurement function of delivery of raw material from the supplier to the point of production and finished goods supply chain management from the point of dispatch from factory to the point of delivery to the customer.

The logistics industry which forms part of the supply chain is big, according to Jacobs and Chase (2011) logistics businesses account for 8 to 9 percent of the U.S gross domestic product. Efficient warehousing and distribution centres are the core of logistics, the location of these facilities is vital to both new and existing businesses' success. Management and the operation of these centres to assure storage and rapid flow of goods, services together with the related information from the manufacturing plant to the point of consumption is crucial in establishing and maintaining supply chain competitiveness.

2. Review Approach

The key challenges in the logistics and supply chain industry together with technological innovation solutions for the identified challenges were studied following a systematic literature review (SLR) approach. This research analyses published literature using a SLR methodology adapted from Garza-Reys (2015) and guidelines as stated by Kitchenham (2004). The steps followed included the search strategy and keywords, screening and selection methods, the data extraction and quality assessment process, and finally the methods of synthesis and analysis. Screening of the articles was conducted with the aid of screening tables using the inclusion and exclusion criteria to select relevant articles. The data extraction was managed with the aid of an Author Matrix and the quality was determined based on the results of the quality assessment criteria. Finally, the method of synthesis and analysis was done with the aid of a concept matrix.

An iterative search strategy that is not biased was used to obtain only the multiple primary studies connecting to the research questions. Use of Boolean AND to connect key terms and OR to include spellings and synonyms. Initially 4050 records were obtained and this was reduced to 1440 articles after removing duplicates and focusing on sources with accessible content, excluding periodicals and restricting the search to academic full text journals. A further screening reduced the articles to 145 that were reviewed based on their fit to the research questions. The dataset was then reduced from 145 to 34 articles and subsequent data extraction was done with the aid of an Author Matrix. A summary of the studied articles is in table 1 while table 2 presents the results of the concept matrix.

Table 1. Summary of studied articles

Year of publication	Reviewed Authors
2008 -older	9
2009 - 2013	6
2014 - 2019	19

Table 2. Concept matrix summary

Concept	Number of Publications
Challenge	16
Technology	12
Innovation	19
Technology Innovation	5

3. Literature Review Analysis

The four concepts presented in table 2 were consolidated into two main topics of; challenges and technology innovation in supply chain logistics. Technology, innovation and technology innovation are closely related terms and authors have used them interchangeably in publications as such, these three terms were consolidated to one concept, technology innovation. Challenges and technology innovations in supply chain logistics as identified from different

authors are discussed. Authors, agreements and arguments related to the challenges in supply chain logistics will be presented first.

3.1 Challenges in Supply Chain Logistics

Othman and Sze Voon (2018) identifies late deliveries, high volatility orders, bad attitude by drivers and inadequate communication as the major challenges in logistics as presented in figure 1. Kembro and Norrman (2019) suggest that late deliveries are caused by amplified consumer requirements relating to order response time signifying more difficult lead times. In line with issues pertaining to late deliveries, they also identify flexibility in delivery options and unstable demand as challenges. Kwan Tan, Yifei, Zhang and Hilmola (2014) claim that customer expectations and unstable demand are impractical when dealing with globalization of the supply chain network. Contrary to the noted issue of unstable demand as identified by Kwan Tan et al. (2014), in the halal industry, lack of demand is also noted as a challenge (Suhaiza, Iranmanesh, Aziz & Kanopathy, 2017).



Figure 1. Summary of the major challenges in supply chain logistics (Source: Othman and Sze Voon, 2018)

3.1.1 Uncertainties in supply chain logistics

Uncertainty has been largely defined as variability, in the supply chain management literature and is therefore, associated with lack of control and power over the supply chain environment (Flynn, Koufteros and Guanyi Lu (2016) and Carter, Rogers & Choi (2015 b)). The growing complexity of global supply chain networks and the increased likelihood for delivery delays as well as quality problems cause supply chain uncertainties (Simangunsong, Hendry & Stevenson, 2012). Nilsson (2006) identify four dimensions of uncertainty in the growth of the supply chains that are attributed the increase in complexity in processes and activities within the supply chain logistics as illustrated in figure 2. The four dimensions of uncertainty identified by Nilsson (2006) and later affirmed by Kwan Tan, et al (2014), and Kembro et al (2019) are:

- **Customer demands and expectations:** This pertains to increasing and changing demands from customers. Examples include; decrease in delivery time frames, tailored order bookings, increased packaging options, specialized labelling, increase in the number of different goods per pallet and per order, increased frequency of deliveries, Just in Time (JIT) demands, increase the variety of products, and the decrease in the volume per order. On Time in Full (OTIF) service level agreement (SLA).
- **Internal processes:** Internal communication between sales/marketing and logistics is a source of countless uncertainty in daily logistics activities. Limited knowledge of logistics in organizations as an activity which is valuable. Logistics processes are expected to function efficiently at a high level of accuracy; however, without related costs.
- **Human factors:** The human factor creates uncertainty as people cannot work like automated machines and therefore are bound to make mistakes. Another dimension is the importance of meeting the “right” people when talking to customers. Human factors contribute towards value creation and production of uncertainty in the logistics context. A high level of awareness and understanding of human involvement can be leveraged on to obtain gains from improvement efforts and achieve better integration with customers and internally. Also, power, hidden truths and protectionism are other aspects that influence the perception of human related uncertainty.

- General trends: These include general trends relating to overall developments of technology, ideas, and concepts. The environment is continually changing hence it is essential to check if improvements efforts are the right ones.

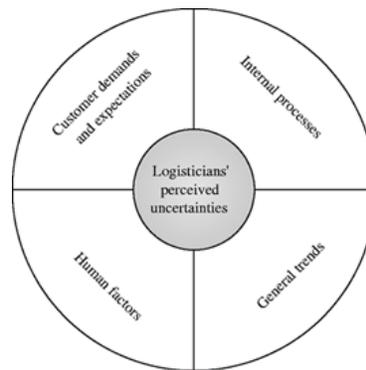


Figure 2. Uncertainties in supply chain logistics (Source: Nilsson, 2006)

3.1.2 Technology challenges in supply chain logistics

The general trends relating to technology, result in three challenges linked to a constantly changing environment (figure 3). According to Nilsson (2006), these are:

- 1) Holistic perspective: – the need for understanding the organisation is an existing challenge; however, the need is on an endless incline due to unpredictable logistics systems resulting from efforts to improve, rationalisations, and IT related support tools.
- 2) Sensitivity and attention to detail: - to meet customer demands, having details makes a difference.
- 3) Understanding and sense-making: - while information is regarded as important, the real challenge is of a more indirect type that is related to the understanding and sense-making of the information generated and what to do with it

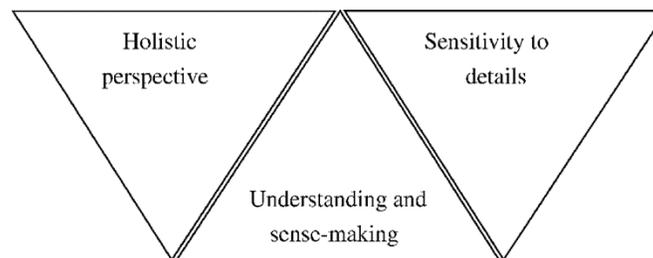


Figure 3. Challenges relating to technology in supply chain logistics (Source: Nilsson, 2006)

Ho and Lin (2008), noted that demand uncertainty tends to increase the organisation's temptation to implement new technologies. Further, Sauvage and Thierry (2003) state that the cost of implementing new technologies remains a challenge due to customer specific software designs, implementation of modified maintenance mechanisms and the development of systems to convert language that is incompatible. Exploring more technology issues, Ali, Jaafar, and Mohamad (2008) identify the challenges in Information Technology (IT) within supply chain logistics. The challenges with IT are related to high costs and the general performance and ability to function. Ülgen, et al. (2015), noted that the challenges with IT are related to the lack of integration support, varying or independent goals and the absence of required IT data for capturing and reporting.

3.1.3 Operational Challenges in Supply chain logistics

With increasing operational costs, organisations have difficulty in staying ahead of competition (Kwan Tan, et al., 2014). Operational performance deals with challenges pertaining to quality, speed and efficiency (Soosay & Hyland, 2004). According to Razzera and Machado (2018), cost and resistance to change are major challenges to innovation in supply chain logistics together with the lack of visibility and traceability. A critical issue as identified by Cichosz,

Goldsby, Knemeyer and Taylor (2017) is customer satisfaction, aligning innovation between the service provider and the customer. Kwan Tan, et al. (2014) mention the difficulty in integrating warehouse, transport, and customers' network in a unified method as a challenge. Björklund and Forslund, (2018) noted that stores located in large cities with traffic congestion during the day face elevated challenges. Further, Ali, et al. (2008) remark on the absence of one established source of logistics data and information, the absence of skilled and trained labour, the absence of information sharing with regards to the growth and development of the logistics industry as challenges within the supply chain logistics industry. In line with the challenges noted by Ali, et al (2008) regarding the absence of skilled labour, Evangelista and McKinnon (2013) also identified technology skills in the labour force to be lacking. They note that there is a growing challenge with the lack of refined management techniques amid organisations within the supply chain.

3.1.4 Environmental challenges in supply chain logistics

As environmental matters have become serious concerns globally, organizations are continually under pressure to develop environmentally accountable friendly operations (Ho & Lin, 2008). Environmental obligations have become an important variable within the supply chain logistics industry. Ho and Lin (2008), note that there has been a significant inclination in the interest and response to the idea of protecting the environment in recent years. Additionally, they state that, the operation of logistics services frequently leads to numerous undesirable effects on the natural environment, amongst others these include, air pollutants, hazardous waste disposal, solid waste disposal, fuel consumption. As identified by Baz & Laguir (2017), environmental challenges relating to green initiatives, the lack of collaboration, involvement of partners and the absence of an environmental strategy are related to green logistics. Other known challenges related to rising environmental concerns are (for example) pollution associated with industrial development (Marchet, Melacini & Perotti 2013). According to Marchet, et al. (2013), the main objectives lie in reducing greenhouse gases and carbon dioxide emissions. The need for "green" vehicle fleet is unavoidable, with government regulations, increasing fuel costs, limited fuel availability, and the aim to improve the organisation's image (Marchet, et al., 2013) all pushing towards "green" logistics.

In addition to the discussed challenges, logistics companies are experiencing challenges related to sustainability (Lieb & Lieb, 2010). These challenges include; finding a balance between sustainability efforts and customer expectation, defining suitable environmental standards, founding sustainability primacies within the organization, producing precise information related to existing sustainability practices with the organisation and developing sensitivity to sustainability matters within the organization.

3.1.5 Some industry specific challenges in supply chain logistics

Supply chain logistics challenges specific to the halal industry include; unclear halal procedures, absence of collaboration among governing activities, lacking cost-effective standards, competition in the transportation sector, lacking compulsion in halal logistics, financial challenges and an overall misunderstanding of halal practices (Suhaiza, et al., 2017). While in the mining industry as identified by Barve and Muduli (2013) they experience challenges relating to poor legislation and an absence of environmental awareness.

3.2 Technology Innovation in supply chain logistics

Innovation can be understood as a tool for the exploitation of financial resources to achieve profit-raising ideas and solutions (Antonowicz, 2014). According to Björklund and Forslund (2018), innovation is a process of transforming identified opportunities into novel ideas and the implementation of these ideas. Innovation could also be taken as transformation of what a business is currently offering, an alteration in a business model or in service-offerings, that should potentially improve the ease with which recipients obtain the service and their overall experience (Antonowicz, 2014). Soosay and Hyland (2004) identify lower operating costs and increase in profitability as reasons to innovate. Technology innovation exists in several ways linked to the process, stock or transport solutions (Bajec, 2012). He further states that innovations within supply chain logistics can be accomplished in three ways; new technologies; new modes of collaboration and new knowledge. The rate at which technology is changing requires innovation in business processes as they must adapt to the novel tools in technology (Grawe, 2009). According to Grawe (2009), technology innovation and logistics abilities have a positive relation to the ability of an organisation to manage production activities.

Technology innovation classification and innovation activities in supply chain logistics: Three key innovation activities in supply chain logistics have been identified by Wong and Ngai (2019) as logistics-oriented, marketing-oriented, and technological development-oriented. Mathauer and Hofman (2019) classify technology innovation

into two main groups of; hardware and software with sub groups of customized and standardized hardware and software.

- 1) Hardware: Customized hardware consists of hardware technology tailored for specific customer needs while, standardized hardware often referred to as “off the shelf” is accessible to any individual
- 2) Software: Customized software technology is tailored to meet customers’ needs and standardized is accessible to any individual “off the shelf”.

When considering the challenges as identified by Ali, et al. (2008) regarding the high cost of new technologies, purchasing of standardized solutions has proven to be a quick and cost-efficient method of gaining access to new technologies (Mathauer & Hofman, 2019). Björklund and Forslund (2018) and Lin (2008) classify innovation in logistics technologies according to logistics activities into four categories of data technology as;

- information technologies;
- data acquisition technologies;
- warehousing technologies and
- transportation technologies.

Looking at these four categories, the most known innovations in recent times according to Bajec (2012) are information technology innovations.

3.2.1 Information technology innovations in supply chain logistics

Noorliza (2018) defines information technologies as the integration of information that monitors stock in every location all over the supply chain with several warehouses in different countries. Lin (2007) states that information technologies include devices or structures that facilitate efficient communication of business-related information between numerous organizations. He also stipulates that several logistics managers perceive information technology as a key source to enhance productivity and competitiveness. He further notes that information technologies enhance supply chain management and lists the information technologies commonly used in supply chain logistics as: electronic data interchange (EDI); the internet; value added network (VAN); point of sales (POS); electronic ordering system (EOS); logistics information system; computer telephony integration and enterprise information portals. Razzera and Machado (2018) pointed out that information technology offers the greatest investment in relation to innovation in services. While Cichosz, et al. (2017) refer to EDI as a technological innovation but Lin (2007) define EDI as, “inter-company computer-to-computer exchange of business documents in standard formats”. According to Grawe, (2009), EDI is a tool used in an organisation to advance communication with customers, develop novel services to tap into new customer markets while adding value to current customers. Sauvage and Thierry (2003), state that the rigorous use of progressively efficient electronic transfer technologies has become an absolute necessity for maintaining a competitive advantage, while reducing uncertainty and costs associated with adjusting to contingencies. One of the major pros of implementing new or improved solutions linked to IT systems is a high level of automation, which in turn amongst others, streamlines the procurement processes, decreases the number of workers, eliminates faults, increases precision and assists in overcoming the silo and bullwhip effects (Bajec, 2012). Bajec (2012) divides information technologies into three sections; identification technology; data communication technologies and data acquisition technologies.

Data acquisition technologies: Logistics service providers generally manage big volumes of goods and data, as a result, the collection and exchange of data is crucial for managing and controlling information in logistics (Björklund & Forslund, 2018). Logistics service providers can deliver customer goods with increased levels of accuracy and efficiency with the support of high quality in data acquisition. Sauvage and Thierry (2003) noted that technology increases the rate of data preparation and transmission times leading to rapid response speed to market needs. Identified data acquisition technologies include; bar coding systems and radio frequency identification systems (RFID) which facilitates the collection and exchange of logistics data (Björklund & Forslund, 2018) (Lin, 2007). In agreement with Björklund and Forslund (2018) and Lin (2007), Cichosz, et al (2017) indicate that technological logistics innovations include RFID tags and barcodes. Erceg and Sekulosk (2019) refers to RFID as wireless product identification technology which results in redefined supply chain processes. Logistics companies have exploited diverse logistics information technologies as listed by Björklund and Forslund (2018) and Lin (2007) as well as cargo tracking systems and internet facilities (Noorliza, 2018).

Warehousing technologies: Warehousing technologies perform a vital role in the logistical system. A warehouse is not merely viewed as a storage facility, it is viewed as a switching facility (Lin, 2007). There are several available warehousing technologies that are commonly used in supply chain logistics, including (Lin, 2007); Automated storage and retrieval system (AS/RS); Automatic sorting system; Computer-aided picking system and Thermostat warehouse. The AS/RS offers a fast and efficient way to search and move locations from a warehouse. It is an average to high

density, hands free buffering of materials in distribution and manufacturing environments (Lin, 2007). In the warehousing space during order picking and packing, highly automatized packaging equipment is available to complete every picked order by automatically measuring the height of the goods in the package, cutting off and folding the package close to the height of goods. This automatized packaging equipment warrants increased fill rate in the prime package resulting in increased pallet fill rates in staging areas for dispatch and in transportation vehicles (Björklund & Forslund, 2018).

In warehousing technologies, RFID chips are used to monitor the inventory levels and storage locations. RFID tags can be linked to goods, pallets which carry products, storage locations, forklifts used to move products in the warehouse and shipping bays (Erceg & Sekulosk, 2019).

Transportation technologies: One of the most noticeable elements of logistics is transportation technologies as it provides the main role of goods movement. The key goal of the transportation management system involves the movement of goods from the point of origin to the desired destination in a manner that minimizes costs and damages while meeting the demands of customers in service delivery and availability of information regarding shipments (Björklund & Forslund, 2018). The frequently used transportation technologies in supply chain logistics include: (Björklund & Forslund, 2018); Transportation information system; Global positioning system (GPS); Geographical information system (GIS); Radio-frequency communication system, and Transportation data recorder. In transportation technologies, RFID may be used in tires to monitor the level of air pressure, this increases durability of the tires and allows for ideal performance (Antonowicz, 2014)

The transportation information system and GIS are tools that have the potential to assist managers in logistics to plan, manage and control logistics challenges. During the transportation of goods, the GPS and radio-frequency communication system can track and provide drivers with guidance (Björklund & Forslund, 2018). Noorliza (2018) indicates that with GPS, existing logistics companies have developed significant resources for tracking and traceability. According to Antonowicz (2014), other transportation solutions within logistics supply chain include; intelligent container terminals, ultramodern bimodal systems or underground systems for the transportation of goods. For deliveries into areas affected by high volumes of traffic during the day, Björklund & Forslund (2018) identify electric hybrid trucks with collaboration of truck manufactures to allow silent night deliveries. With the aid of GPS, the truck distinguishes whether it's a zone is quiet or not then it turns the radio off and minimizes the beeping noise when reversing. The truck driver unlocks the store and offloads the truck in the accurate temperature zones with handling equipment which is suitable for the quiet vehicle such as quiet forklifts.

Other tools related to transportation technologies as defined by Björklund and Forslund (2018) include the small order calculator. The tool can consolidate several small orders into one shipment, reducing transportation costs. Antonowicz (2014) further adds that the success of innovation in transport is dependent on an in depth understanding of market dynamics in transportation services and cooperation of transport users who create demand for transport services and establishes expectations for services offered.

Information technologies: To simultaneously achieve improved communication of data, information and knowledge together with coordination, decision-making and planning, logistics firms are redesigning their structures and relationships (Chapman, et al., 2003). According to Björklund and Forslund (2018), in the current era of information and knowledge-based economy, the survival of an organisation depends on methods to improve their technology innovation capability.

There are several emerging digital tools that link internal operations and supports real-time engagement of the labour force, collaboration amid suppliers, results-oriented consumer experience together with other real-time operations attracting novel technologies such as (Erceg & Sekulosk, 2019): Artificial intelligence (AI); Internet of Things (IoT) and Big Data.

The capability to manage data from various sources is achieved through innovative web and mobile applications and software, this integrates and expands processes with an open digital platform (Erceg & Sekulosk, 2019). According to Bajec (2012), the implementation of software solutions within supply chain logistics includes the opportunity to channel ordering in the supplier's system and the implementation of software tools. Software solutions offer a variety of capabilities related to digital planning, digital logistics and order fulfilment (Erceg & Sekulosk, 2019). Software tools in supply chain logistics delivers real-time logical systems that bring about flow of information and products

through the entire network chain. The software tools listed by Bajec (2012) include tools such as vendor managed inventory (VMI) and transferring of complete order to external service providers. Software solutions focus on singular and modular processes within the supply chain and can result in solutions for integration within enterprise resource planning systems (Erceg & Sekulosk, 2019). Other software solutions and methods as identified by Bajec (2012) include solutions such as customer relationship management, consolidated shipments, cross-dock distribution and transshipment methods. Front-end web portals are used to improve customers' visibility during the returns process while implementation of advanced technology applications and centralized asset-recovery program control the returns process (Bajec, 2012). Web and Mobile applications offer unique web application capacities which results in the client-driven framework concentrated on data gathering and analysis. These applications offer information about customers, knowledge sharing on new available solutions assisting in identifying collaborators (Erceg & Sekulosk, 2019).

3.2.2 Environmental sustainability innovations in supply chain logistics

The integration of environmental management and logistics services has become a crucial topic for discussion in supply chain logistics (Ho & Lin, 2008). According to Ho & Lin (2008) innovations are divided into three factors; technological, organizational, and environmental. Logistics companies increase their advancement in green innovations by empowering and supporting their workers to environmental actions. Green innovations assist in upgrading environmental performance, limiting waste and achieving cost savings, and subsequently improving productivity and collaboration amid organisations (Ho & Lin, 2008).

To decrease the carbon footprint, organisations are reviewing new technologies to offer clients real-time visibility into the organisations' fleet performance. The aim of real-time visibility is the monitoring and advancement of vehicle routing, fuel utilization, speed and idle time. According to Lieb and Lieb (2010), reported solutions related to transportation are as follows; the launch of an Eco-Transport Program for the utilisation of environmentally friendly methods which promote consolidation of shipments, instructing reduced vehicle speed on the organisations' fleet to reduce fuel consumption and emissions and the installation of solar panels to supply power as an additional service. Marchet, et al. (2013), introduce sharing of vehicles across several customers as a more fuel-efficient method and limiting the speed when operating the company's equipment. In addition, (Marchet, et al., 2013) identify three key initiatives regarding warehouse energy efficiency, namely: the utilisation of alternate sources of energy (e.g. solar panels); material handling equipment that is energy-efficient and water systems (e.g. the utilisation of "gray water" systems).

Economically friendly warehouse design and energy efficiency initiatives lie in achieving energy efficiency through heating and lighting systems together with material handling equipment (Marchet, et al., 2013). According to Chen, et al. (2006), through innovation technologies, businesses can advance their corporate image and improve their competitive advantage with the aid of green differentiation. Companies worldwide are endlessly attempting to establish novel methods to decrease the emission of greenhouse gases and fuel consumption (Ho & Lin, 2008). Globally, several service providers utilise route-planning software to reduce carbon emission while others have started fuelling their fleet with bio-diesel. According to Chu, et al., (2019), green innovation has a positive effect on financial performance.

3.3 Review Summary

The reviewed literature shows the existence of several challenges in the supply chain logistics industry. The challenges identified are mostly aligned. However, there are some challenges that are industry specific that do not form part of the consensus amongst challenges from non-industry specific studies. We conclude that while common challenges exist within supply chain logistics across different industries and countries, there may be challenges that are unique to a specific industries or countries.

The review reveals that while there are challenges in supply chain logistics, some of these challenges are related to the available technology and innovation within supply chain logistics. From the analyses of the studied articles, several technology innovation solutions exist to address challenges within supply chain logistics. We conclude that technology and innovation have influenced the way organisations run their supply chains and logistics.

4. Principal Findings and Discussion

The main findings can be divided into three categories namely:

- General supply chain logistics challenges
- Technology related challenges
- Environmental and sustainability challenges

The general challenges found from reviewed literature point to customer demands and customer expectations. Uncertainty in customer demands results in high volatility orders. Increasing customer expectations relating to delivery lead times results in late deliveries. To meet demand and reduce delivery lead times, firms are experiencing increased operational cost. Challenges related to technology are linked to information technology, the high cost of implementation and integration of customized information technologies remains a challenge, the lack of visibility and traceability of orders throughout the supply chain, resistance to change and lack of skilled staff. The results further indicate that environmental and sustainability challenges are a growing concern in the supply chain logistics industry. Main challenges in this area include; developing environmentally friendly operations, reducing greenhouse gases and carbon dioxide emissions and balancing customer expectations and sustainability.

On technology innovation solutions to the challenges, the major findings show that technology innovation solutions exist to address most of the challenges deduced from the literature under study. However, the implementation of the available technology innovation solutions is critical. The main technology innovation solutions are imbedded in information technologies, data acquisition technologies, warehousing technologies and transportation technologies, which are the data technology categories identified by Björklund and Forslund (2018), and Lin (2008). We note that the time gap between 2008 and 2018 shows that these same technology innovation solutions have been identified for a while and are still valid hence their implementation is key to meeting the identified challenges. Specifically: - Information technologies being the most commonly used technology can be used to address the challenges of increased customer expectations regarding shorter delivery times. Electronic data transfer technology is used to advance communication with customers, eliminate errors and increase order accuracy, Data acquisition technologies such as barcoding and RFID offers solutions relating to accurate and efficient deliveries. Warehousing technologies include automated storage and retrieval system offering efficiency in moving inventory within the warehouse. Transportation technologies such as the GPS and radio-frequency communication system can be useful in addressing challenges related to track and traceability of shipments and vehicles. Other available technologies include emerging technologies offering real-time logistics systems that allow information and goods to flow through the entire supply chain, these technologies include, artificial intelligence, internet of things and big data.

5. Strengths and Limitations of the Review

This study contributes to supply chain logistics literature. The study was done in a more general approach that covered challenges and technology innovations across different countries and industries within supply chain logistics, hence it provides an overview of the supply chain logistics industry. The bulk of the reviewed literature includes papers published in the past ten years with a few of the publications older than ten years. The range of the reviewed articles enables prospects to examine trends in existing challenges and technology innovation. Interestingly, some of the challenges experienced ten years back were still current and some of the technologies discussed in past years were still being implemented. The majority of the authors identified challenges with unstable demand and increased customer expectations as well as the recent growing concern on environmental issues. The common technologies identified by most authors as part of the technological innovation solutions available within supply chain logistics include use of RFID, EDI and GPS.

The study had a few notable limitations such as, the literature review focuses only on secondary studies in the form of academic journals. At the rate technology is evolving, there is already new information available on this research topic which has not been published yet. Majority of the publications focus on the adoption of technology in supply chain logistics with limited focus on the available technology. Literature with direct focus on the challenges in supply chain logistics is limited, where available, it dates to over 10 years and it is usually specific to a certain industry such as challenges in the humanitarian industry. Like the publications on challenges, most of the publications regarding technology innovation are industry or country specific limiting the generalisation of the findings.

Environmental issues are a growing concern however only a limited number of studies focused on environmental issues in supply chain logistics in the past ten years. A few studies focused on the significance of environmental issues, while a selected few explored the innovation initiatives and others merely introduced possible factors affecting the adoption of best practices. Non-English publications were excluded from the search, studies relating to this topic

may have been published in other languages. To work with manageable data, the search was conducted from a limited number of databases, there may be other databases with additional information related to the research topic.

6. Generalisability and Managerial Implications

The results of this study are generalised across different countries and industries within supply chain logistics. Though most identified challenges may be applicable to several organisations across different countries and industries within supply chain logistics, it should be noted that some of the identified challenges may not be viewed as challenges in other organisations. This is because some of the challenges may have been challenges for certain companies in past years and measures have since been put in place to mitigate or resolve these challenges.

With regards to the available technology innovation solutions within supply chain logistics, care should be used when interpreting the results to applicable solutions in organisations. Since the literature studied is limited to secondary studies and discussed solutions may be outdated, considering the rate at which technology and innovation is advancing in recent years, this kind of work may need to include primary studies.

7. Future Research Recommendations

Based on the conducted review, as a recommendation, future research should focus on primary research obtained by an in-depth interview process conducted from leading global logistics companies such as DSV Global logistics and DHL. Considering the research methodologies used by the authors from the reviewed literature, it was noted that most authors' findings were based on questionnaires completed by managers. A global company would be ideal as it will include different countries where the company operates in different scales. It would be beneficial to study both the international and country specific issues experienced by different branches within the same company. The interview process must be conducted on a group of diverse respondents from different countries where both management and general workers are offered an opportunity to be interviewed. In addition, literature can be reviewed to identify the gaps between what has been published and what is currently happening within supply chain logistics. Future studies should consider including articles published online by logistics companies as I believe there are much more technology innovation solutions that exist in present times but have not been reported on in existing academic journals.

8. Concluding Remarks

The reviewed literature related to technology innovation proves that many companies agree that technology and innovation is essential in creating and attaining a competitive advantage; however, majority of the authors focused on the adoption of technology innovation and have not given much attention to the variety of available technology innovation solution and how they assist in addressing current challenges in the supply chain innovation.

This paper forms part of the early stages of identifying challenges and technology innovation solutions within supply chain innovation as it is based on secondary studies. Future studies should consider exploring both existing challenges within supply chain logistics and technology innovation using a combination of secondary and primary studies. This will offer a better presentation of current challenges and technology innovation solutions within this industry and positively contribute to research focusing on the application and adoption of technology within the supply chain logistics industry.

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