OPERATIONS AND SUPPLY CHAIN MANAGEMENT
Vol. 14, No. 4, 2021, pp. 467 – 475
ISSN 1979-3561 | EISSN 2759-9363

The State of Cold Logistics Supply Chain in a Developing Asian Country – A Preliminary Insights

Mohd Faizal Abu Hassan
Department of Commerce,
Sultan Haji Ahmad Shah's Polytechnic, 25350, Kuantan, Pahang, Malaysia
Email: faizalhassan.poli@1govuc.gov.my

Abdul Hafaz Ngah
Faculty of Business, Economics and Social Development,
Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
Email: hafaz.ngah@umt.edu.my *(Corresponding Author)*

Mohamed Syazwan Ab Talib
UBD School of Business and Economics
Universiti Brunei Darussalam, Jalan Tungku Link BE1410, Brunei Darussalam
Email: syazwan.talib@ubd.edu.bn

ABSTRACT

The increasing demand for cold chain logistics services in Malaysia has shown positive development. Food and beverages (F&B) industries dominate the demand and demand for pharmaceuticals and chemicals products are also on the rise. However, the under-supply of cold chain services could lead to a supply shortage in the future. Hence, this study aims to understand the reasons to adopt cold chain services among the providers from the perspectives in Malaysia. This exploratory study utilised a qualitative design and approach to gathering information on cold chain adoption. A purposive sampling method was applied, followed by interviews with the respondents who hold managerial positions. The results in this study showed that income diversification, higher profit margins, customer demand, company's capabilities in terms of expertise, and resources were among the enablers that offered cold chain services. Furthermore, these enablers agreed that cost, lack of expertise and resources, customers location, and lack of government support were the barriers to these services. Later, the respondents agreed that the future of the cold supply chain in Malaysia had shown a positive trend driven by demand. Moreover, this study's outcome can be a preliminary work to confirm the future findings and become a reference for non-providers for evaluation in their decision-making to become a cold chain provider.

Keywords: *cold logistics, adoption, providers, cold chain*

1. INTRODUCTION

Cold logistics supply chains (CLSC) has been utilized for a long time, even before the modern cold chain technology existed, which uses natural ice to preserve fish stockpiles among the British fishermen (Rodrigue & Notteboom, 2016). CLSC is a series of operations comprising facilities for maintaining the ideal conditions of goods within a specific temperature range from the point of origin to the point of consumption (Tsai & Pawar, 2018). Furthermore, CLSC is a post-production supply chain for temperature-sensitive or perishable goods that are specifically designed to keep these products in an ideal condition of the environment. This design will maintain an optimal temperature and humidity that guarantees the products' safety, preserving the value, and maximizing the commercial potential (Aworh, 2020; Bremer, 2018). Moreover, the CLSC service comprises pre-harvest and post-harvest handling, storage, and transportation as well as controlling and monitoring within the cold temperature environment. According to Bremer (2018), the temperature range for Cold Chain Product (CCP) refers to its requirement between below –18°C (deep-frozen) and up to +14°C.

The idea for the usage of cold chain is to preserve the integrity, freshness, and quality of the products to be available for consumers (Khan & Ali, 2021). It guarantees the shelf life of goods such as medicines, blood, flowers, fruits, vegetables, seafood, meat, processed food product, dairy products, and frozen food (Shashi *et al*., 2018). The integrity of the CCP must be handled appropriately, as these products can cause adverse effects on human health when deteriorated, which will reduce the product's prices and affect the stock availability (Chaudhuri *et al*., 2018). Hence, in all phases of transportation processes like loading, unloading, handling, and storage until the consumer's receipt, the integrity of the cold chain must be preserved (Salin & Nayga, 2003). According to Ali *et al*. (2018), perishable products are transported through cold chain logistics within and outside country borders to preserve their value. Therefore, in the cases of logistics disruption in the food supply, this specific issue can cause potential food waste, which leads to food shortages and economic losses. Thus, the respected parties must maintain the supply chain operation of CCP. According to Gligor *et al.* (2018), the cold chain could provide a variety of benefits such as impede the spoilage of perishable products, deter harmful changes that

occur in products, decrease the activity of microbiological changes as well as physiological changes within products, prevent browning and the loss of texture. Nevertheless, customers nowadays are demanding high-quality, fresh, healthy food products, and thus, the usage of the cold chain has become a necessity rather than an option (Shashi *et al*., 2018). Ultimately, the temperature-controlled condition created by cold chain management would give a positive impact on the products' safety, which will prolong the shelf life and improve their final qualities (Aworh, 2020).

It has been estimated that about 40 percent of all food requires a cold chain (Bremer, 2018), though, the issue of food loss persists in industrial and developing countries at all stages in the supply chain. In most developing countries, cold chains remain underdeveloped, where most countries would increase the food production to offset the loss to meet the increasing customer demands rather than applying technological advances (Gligor *et al*., 2018). Kaipia *et al*. (2013) estimated that around 35 percent of food loss is due to the whole supply chain process, which originated from the production site to the retailer. Similarly, the situation occurs in Malaysia, where the amount of food waste needs to be addressed (Naidu, 2017), where some of the food is still consumable (Bernama, 2016).

In Malaysia, it is expected that the yearly growth rate of industries that rely on cold chain logistics from the year 2015 to 2020, would be 5 to 10 percent (Tan & Li, 2018). However, the cold chain service adoption/offering in Malaysia is relatively low, and thus, the cold chain services need to be pulled by customers instead of the providers, which will push the service to the market. In the cold chain industry, the food waste problem is well recognized, and there is limited employment, especially in developing countries (Gligor *et al*., 2018; Shashi *et al*., 2018). Nevertheless, few efforts are made to explore the reasons for the limited adoption of cold chain technology in developing countries like Malaysia. Furthermore, there is a small number of logistic providers that dare to offer CLSC, and the reason behind their brave decision to offer these services is still under-explored.

Therefore, this paper aimed to investigate and to understand the reasons behind companies that are offering cold chain services in Malaysia. This idea will enable scholars and other service providers an insight for future reference. Moreover, there was an inadequate study on the area, especially with regards to developing countries, where most studies were specifically from well-developed countries and were conducted based on the consumers' perspective. Thus, this paper focused on the perspective of a developing country and the angle of service providers. Hence, the findings from the study will potentially help various parties to understand the cold chain supply in Malaysia, which will be reflected in other developing countries around the globe.

2. LITERATURE REVIEW

The logistics industries in Malaysia has been established for many years, which, according to the logistics directory published in Malaysia, there are 3594 lists of logistics companies in Malaysia (Cavendish, 2020). Additionally, this list includes domestics and multinational companies that venture into the logistics and supply chain business. However, cold chain services are considered a niche market (Tan & Li, 2018), and there are not many providers that offer service for the Malaysian market.

Currently, the usage of the CLSC has increased due to the importance to maintain optimal temperatures, especially for the postharvest or post-production for temperatures sensitive goods (Ambuko et al., 2018; Bremer, 2018) and also derived demand from the Halal logistics sectors. According to Tieman & Ghazali (2014), to maintain the Halal assurance for Halal products, utilising a controlled temperature is one of the characteristics of a Halal Supply Chain foundation. Halal supply chain requires the availability and use of appropriate logistics infrastructures such as warehouse, storage, transport, retail, and cold chain facilities (Khan et al., 2019; Rahman et al., 2018). The same issue has been raised by Abu et al. (2018), where the temperature breakdowns during halal meat handling are being questioned. This idea can be confirmed when a leading service provider has ventured into CLSC business in Malaysia by acquiring two established cold logistics companies in 2017. They see a growing demand for cold chain services, which oversees the transportation of ice cream and fast food (Cavendish, 2020). However, according to Tieman & Ghazali (2014), there are inadequate temperature-controlled storage facilities at terminals, and a dedicated Halal cold room is often not available. Nevertheless, Talib et al. (2014) indicated that the temperature-controlled warehouse is a value-added service to the Halal logistics industry in Malaysia. Additionally, it is noteworthy that the lack of cold storage for agri-products is the most significant post-harvesting problems (De & Singh, 2021).

Rahman et al. (2018) suggested that temperature control and warehouse equipment that is used to store or refrigerated products should be designed to achieve the required temperatures and effectively maintained following the Halalan Toyyiban requirements. Moreover, Abbas et al. (2006) highlighted the benefits of cold storage regarding the shelf life assessment on Malaysian freshwater fish during cold storage. It was found that this idea is one of the crucial criteria for marketing that ultimately controls the shelf life, and therefore, the processor or retailer can plan the length of time a product can be stored. In other words, this method will enable the control of the market and assure better profitability and increased sales. This idea aligned with Chye et al. (2004)'s study, where the author revealed the bacteriological quality and safety of raw milk in Malaysia. The study reported that keeping milk in clean containers at refrigerated temperatures immediately after the milking process might delay the onset of initial microbial load and prevent the multiplication of micro-organisms, specifically between milking at the farm and transportation to the processing plant. Demand from the pharmaceutical sectors also vital in Malaysia, where some of the raw materials used need cold storage and special attention immediately (Abideen & Mohamad, 2020; Abideen & Mohamad, 2019).

To date, there were preliminary studies that investigated the drivers for logistics companies to offer CLSC services in Malaysia. In the Malaysian research field, only a few studies investigated the topic of CLSC, such as the non-adoption in dairy industries that caused harmful bacteria to develop (Chye et al., 2004), poor adherence, and

knowledge on cold chain handling for vaccines (Azira et al., 2013), and low optimisation of refrigerators for vaccines that led to the reduction on the potency of the vaccine (Azira et al., 2014). Furthermore, other research included the temperature breaks during the distribution of vaccines to Kelantan state (Hanjeet et al., 1996), the issues of mixing between halal and non-halal products in cold storage (Rahman et al., 2018), and the effects of freezing on minimally processed durian for long term storage (Tan et al., 2020). Recently, Nier et al. (2020) has confirmed that drone technology usage for stock counting is unsuitable inside cold warehouses in Malaysia. Given these points, the area of CLSC within the Malaysian context has not been paid much attention, and there were preliminary studies on the context of service providers. Moreover, one of the industry's roles was to provide routinisation among the players to remain relevant and competitive. Therefore, this paper served to fill these research gaps.

Contrary to the international level, the area of CLSC is still going to the mainstream. The topics of cold chain adoption at the international research communities have become at the forefront, where the international researchers are now focusing on the latest technological advancement topics. These topics include reviews of fuzzy technology applications in the Agri-supply chain, which discussed the cold storage deficiencies issues (De & Singh, 2021). Ashok et al. (2017) has studied the improvement of the cold chain system within the vaccine's distribution across developing countries. Additionally, the author suggested that the respective parties must address their cold chain capacity, upgrade their cold chain service with the latest technology that is suitable for the country, and effectively control the temperature excursions and equipment breakdowns. Also, Vass et al. (2021) has found that many 3PL firms using sensors in conjunction with the Internet of Things (IoT) technology to monitor the temperatures in their operations remotely. Melis et al. (2018) indicated the new trends in cold chain monitoring applications, where it was found that there was no single solution that fits all the problems, in which modern technology like Radio Frequency and Wireless Sensor Networks that were used for tracking and tracing had their benefits and limitation for the employment in the cold chain. In their study, Chaudhuri et al. (2018) identified the multiple types of data that could be collected and analysed across the cold chain networks, which could be translated to support a real-time assessment of quality, determination of actual remaining shelf life of products, and use the information for decision-making in the CLSC. Incidentally, developing countries like Africa discussed advanced topics like maintaining cold chain integrity (Goedhals et al., 2017). Meanwhile, Shi and Yan (2016) discussed the factors affecting Radio Frequency Identification (RFID) adoption in the agricultural product distribution industry in China. They identified factors using technology, organisation, and environmental framework regarding the RFID adoption that can be used for future references.

3. METHODOLOGY

3.1. Research Design

The purpose of this study was to explore the drivers and barriers in cold chain adoption among the logistics service providers in Malaysia. Hence the perspective in this area are not extensively studied; a qualitative method using an interview approach is deemed appropriate. This is because experimental design reveals the phenomenon at an early stage of maturity, and these methods effectively understand managers' perspectives on the phenomena (Vass et al., 2021). An in-depth interview was conducted using an open-ended and discovery-oriented method to deeply explore the respondent's feelings and perspectives on the subject and encourage respondents to discuss new ideas and facts without constraints (Guion et al., 2011; Vass et al., 2021). The interview is conducted in semi-structured nature to bring preliminary issues to the surface. The interviewer can ask follow-up questions based on the answers, resulting in a flexible interview process (Roso et al., 2020). Rapport with all of the respondents was established before this study was conducted is showed in Table 1.

3.2. Data Collection Protocols and Procedures

These respondents were selected based on different criteria. Respondent X was chosen because his company is a newcomer in CLSC solutions. Respondent Y company is mentioned as the market leader in the 2018 market report published by Tan and Li (2018). In contrast, Respondent Y company were selected due to the wide range of CCP handling ranging from food, pharmaceutical, and chemical. All of the respondents were contacted directly or through their secretary and their time session has been pre-planned during working hours.

A semi-structured interview lasting 40-60 minutes was conducted in the English language inside their office and a meeting room. All respondents have given their consent that the session can be recorded using a recording device for transcribing and analysing the in-depth interview later on (Tieman, 2011). The transcribing process was done within two days after each interview, and a verbatim text of each interview was done by writing out each question and the response from the recorded audio. The content analysis was conducted with the process of re-reading the interview transcripts as part of the analysing process to identify the themes and similarities of answers from the respondents. The analysis and interpretation of transcripts were made by coding the text into manageable content categories proposed by Sekaran and Bougie (2016). Subsequently, the credibility of the interview information was verified by sending back the text recording to all respondents, and they agreed to the transcribed analyses.

3.3. Sampling Design

The non-probability sampling design was used in this study to understand the drivers and barriers for cold chain adoption among the logistics service providers in Malaysia. A purposive sampling method was employed where data was collected within the identified specific target groups (Sekaran & Bougie, 2016). According to Vass et al. (2021), expert interviews are useful when exploring a new but under-investigated phenomenon. Participants were identified as expertise in CLSC, in which they held managerial roles and were directly involved in managing the cold chain operation in their companies. **Table 2** shows the information summary of the participants. During the interviews, participants were asked to give their comments and opinions on various issues

and aspects regarding the cold chain adoption among the Malaysian logistics service providers. As for anonymity purposes, their names and the company represented were re-coded in line with respecting the image and confidentiality of the interviewed corporation (Talib & Hamid, 2014).

Table 2 Selected representatives of cold chain service providers in Malaysia

Company	Age	Gender	Position	Years in position	Years in industry	Description
X	53	Male	CEO and Group Managing Director	21	24	A total logistics service provider was primarily serving automotive customers and newly ventured into cold logistics. The individual owns a cold warehouse and cold transport operation. They provided cold chain services in less than three years.
Y	50	Male	Operation Manager	10	20	A total logistics service provider. The company served the cold chain market for more than ten years, specifically for food and beverage customers. This company is the market leader of cold chain providers based on the published market report in 2018 and owned a cold warehouse and cold transport operation.
Z	43	Male	Assistant General Manager	4	20	A total logistics service provider of cold storage service for high-end food, pharmaceutical, and chemical products. Currently only offering service for cold storage.

4. RESULTS AND FINDINGS

During the interview session, the respondent's opinion and answer regarding the adoption factors of cold chain technology were identified and analysed.

4.1. What Makes the Companies Decided to Provide CLSC Services?

Initially, all of the participant's company are providing standard ambient logistics services. After some time, their company decided to ventures into CLSC. Participants are having different reasons for their company's decisions to offers CLSC. Respondent X stated that they want to diversify their income and leverage income generation risks from a multiple market segment. He also mentions that the increase of e-commerce phenomenon has closed the traditional brick and mortar retailers and those spot has been replaced with the F&B outlet which requires CLSC which also addressed by Zhang et al., (2016). Respondent Y asserted that increasing consumption of a ready-to-eat meal, frozen food, and chain restaurants also drive the demand for CLSC (Al Theeb et al., 2020; Khan & Ali, 2021). He also supposed that his company readiness to perform in CLSC services are among the reasons. Finally, Respondent Z claimed that higher profit margin, demand from customers, government regulation for products stored in their warehouses, and perfect location in high demand areas are why his company served CLSC.

4.2. What Would Be the Future Demand and Supply for the Cold Chain in Malaysia?

The future demand for cold chain services in Malaysia was promising based on the Department of Commerce (2016) and Tan and Li (2018). These reports projected that the demand for the cold chain industry in Malaysia would increase in the following years based on the economic conditions. The purpose of these reports was to attract new investments and ventures where the cold chain sectors in Malaysia offer many opportunities. This predicament was due to insufficient service providers. Subsequently, from the interview sessions, all of the participants agreed upon the promising future of the Malaysian cold chain industries, where it is in the state of pull-demand. Respondent X mention that demand increasing was driven by changes in consumer habits such as the increasing trend to consume a ready-to-eat meal and frozen food, time constraints to prepare a meal, and attraction from the emergence of chain restaurants which is aligned with Al Theeb et al., (2020) and Khan & Ali, (2021). Most of the participants agree that complexity and increases in the number of cold chain service user's franchises lead to outsourcing the CLSC. Respondent Z asserted, "…in the beginning we only provide cold storage services…since the revenue contributed by this area is high as 50% from our total revenue, then our company direction seeks an opportunity to offers the cold transport to our clients".

4.3. What is the Level of Competition Among Local Providers Versus International Providers?

In the beginning, the cold chain market share in Malaysia lead by a local establishment (respondent's X company), until 2017, the position was taken by a multinational establishment with its move to acquire two other companies in the market (Shankar, 2019; Tan & Li, 2018). All participants agreed that the competition level of the cold chain industry in Malaysia was relatively modest, where more prominent companies tend to dominate the market. Both respondents X and Z stated that foreign company willingness to offers CLSC in Malaysia because they are following their existing customers from outside to move into Malaysia. However, their reluctance to invest in assets enables them to offers a competitive price. Later, when these customers are revising their operation, a new contract will be commissioned and this is where local companies can have the opportunity. Respondent Y expressed that better offers on costs/rates, competitive price, and service records could be determinants to secure the contracts. Respondent Z emphasised that 30-40% of providers sub-contracted to other parties, not offering end-to-end services, having related certification like HACCP (hazard analysis critical control

point) and GDPMD (good distribution practice for medical devices), and not serving the other type of cold chain products like pharmaceutical to lose their competitiveness.

4.4. What is the Status of Modern Cold Chain Technology Adoption?

The cold chain sector was also experiencing modernisation like other industries, from natural resources like regular ice for the cooling process to the usage of multiple sensors to provide data and control using the software. Moreover, companies should start adopting modern cold chain technologies like RFID and the like. Specifically, adopting these technologies allowed for a more transparent and effective business model because, in CLSC, the idea was all about the constant maintenance for the correct temperature to avoid breaks (Qi et al., 2014; Shi & Yan, 2016). Hence, failure to adopt these technologies could result in temperature breaks and damaging the cold chain products and suffering loss. Additionally, by not adopting the new technologies, this idea could lead to a lesser attraction towards the service users, especially those who are planning to keep the expensive products. All participants agreed that Malaysia is still behind in technology adoption. Respondent X asserted that "…the standard of expertise in Malaysia is relatively low…" lack of awareness to outsource their operation causing those manufacturers to absorb the investment costs for hardware and bear the losses for their inefficiency. He added that contrary to the developed country, goods are consolidated using the Hub and Spoke concept to reduce costs. Respondent Z mentions that there is technology available like RFID, Wireless Sensor Network, WMS in the market, but they still control their operation with manual methods. "…We were just using a data logger in our reefer trucks and warehouse because the customers of our client do exercise the cold chain data/temperature logging and monitoring. During the multiple points of delivery, we do experience a variance of temperature due to the open-close of the reefer truck's door" [Respondent Y].

4.5. What is the Government's Roles in Promoting CLSC?

The government impacted promoting the usage of cold chain services, which was either by providing incentives or initiatives, imposing regulations, instruction, or policies for industry players to obey (Al-Shboul, 2019). Moreover, the government had the power to control or shape the industries by imposing all of those regulations. Additionally, the government should assist the industry players in increasing competitiveness, which benefits the end-users. However, not all business entities in Malaysia were aware of these government incentives or policies, in which the recorded response revealed the contradiction between the answers. Both respondents X and Z agreed that lack of promotion on government assistance. While Respondent Y is not aware of any incentives provided but individual government assistance could lead to an increase in supply. Participants agreed that the government needs to assist local companies in tax exemption and knowledge of CLSC technologies to increase their competitiveness. Respondent Z stressed, "…enforcement of regulations must be stringent to avoid temperature break issues…and products to be handled in truly manners especially at our wet market".

4.6. What is the Future of the Cold Chain in Malaysia?

According to the market reports, the future outlook of the cold chain industry in Malaysia was promising where demand for cold chain services rose, which involved the various opportunity for companies to grab within the cold chain sectors (Department of Commerce, 2016; Tan & Li, 2018). At the moment, most companies were focusing on the cold food chain, despite the various cold chain products that could be served like chemicals, pharmaceuticals, and cosmetics. Moreover, the cold chain industries were presented with opportunities derived from the demand for Halal logistics industries. The changes in the end user's habits and awareness contributed to the higher demand for cold chain in Malaysia. Participants acknowledge the promising growth of the CLSC in the future. They agreed that urbanisation, lesser time to prepare meals, higher income, and consumer habits to consume frozen foods and ready to eat meals could increase the demand for CLSC. Respondent Z mentions that his company expertise and capabilities would determine his company's future growth. Then he added that demand-pull, regulation enforcement, area that is still underserved like chemicals and pharmaceuticals product could contribute to the future demand. "…some providers only focusing on the storage parts but not attending the transportation parts" [Respondent Z].

4.7. Why Are Other Logistics Providers Still Reluctant to Offer this Service?

Despite the vast potential in cold chain services that resulted from the lesser competition, other logistics providers in Malaysia were still reluctant to venture into this business as parts of their money-maker. Even though the cold chain service sectors are attractive, in which the perennial increment of each cold chain sector is projected around 5 to 10 per cent, the un-willingness to offer the services have raised questions. Furthermore, it was reported that perishables are growing, though the opportunities to provide retailers with cold chain services still abound (Tan & Li, 2018). All participants agreed that higher costs to operate like electricity costs, lack of rolling capital, lack of expertise to handle sensitive products like pharmaceuticals are among the barriers to offers CLSC. Respondent Z also added that the lower demand for CLSC outside the central city and the reasonable time to deliver cold chain products within Malaysia could lead to reluctance factors. He then asserted, "…Bigger companies are paying lower rates for electricity consumption than the small companies". After further investigation, the Malaysian primary electricity provider which is Tenaga Nasional Berhad (TNB), has given incentives called Special Industrial Tariffs (SIT) for eligible industrial consumers to enjoy lower rates (Tenaga Nasional Berhad, 2020).

5. DISCUSSION AND CONCLUSION

5.1. Discussion of Results

This study found that LSP's attraction to offers CLSC is generated from positive income due to the lower number of providers and level of competition (Tan & Li, 2018), derived from the e-commerce phenomenon were forcing the

traditional retailers to closed down their stores and that vacant location is replaced with the F&B retailers (Zhang et al., 2016), changes in consumer's habits like increasing for the consumption of frozen food and ready to-eat-meal which sees the used for more CLSC to delivers these products to retail stores (Al Theeb et al., 2020; Khan & Ali, 2021), demand from customers, organisation readiness, and government regulation. In the future, it is expected that the demand will increase mainly derived from the halal and pharmaceutical sectors (Abideen & Mohamad, 2020; Abideen & Mohamad, 2019; Khan et al., 2019; Rahman et al., 2018). For the time being, the market competition is modest as the LSPs need to be ready for their capital investments, ability to invest in cold chain assets and related certifications for increasing the competitiveness level which seems too high for smaller companies. It is suggested that the level of awareness to adopt SLCS among logistics partners be increased for avoiding temperature break issues and unnecessary product loss (Abu et al., 2018; De & Singh, 2021). The Malaysian government should be more proactive to promote the CLSC sectors which can be done by giving more incentives especially to the SME's. It is renowned that high cost to operates CLSC become a barrier for LSPs to adopt CLSC (Laraswati et al., 2016). There is also a need to increase the number of an expert in CLSC and adoption of moderns technology like Warehouse Management Systems (WMS) to support operation, improve service and reputation which makes cold chain LSPs to staying competitive (Vatumalae et al., 2020).

5.2. Summary

The objective of this study was to investigate and understand the reason for companies adopting CLSC in Malaysia. Based on the series of interviews, it was found that companies that were already adopting cold chain services were due to various reasons. Among the reasons were for the income protection of the company, where they did not want to focus all of their revenues and profits from the same sources of the area and also for the diversification of their business profile. Some of the companies offered the services because of the higher profit margins, and all respondents agreed that the demand from customers was the main reason to offer cold chain services. All of the reasons were later supported by whether these providers could provide a good service, which depended on their expertise and resource availability.

In terms of barriers, all of the respondents agreed that cost was the main reason for not adopting the service, including a lack of expertise and resources. Furthermore, the customers' location played a role in adopting CLSC. At the same time, the interviews showed insufficient support from the government, in which despite the incentives given, there was no concept of progression. Moreover, encouragement, policy implementation, and education were among the industry players' vital supports. Additionally, the respondents agreed that the CLSC industry's future in Malaysia was promising, though several areas were still underserved and needed to be explored. In terms of competition, the current market has been led by a foreign company, albeit most of the market portion is dominated by local companies. Correspondingly, the supply and demand of Malaysian cold chain services were not balanced. Customers needed to acquire the providers' service, while some areas were still experiencing a shortage of CLSC.

The usage of modern technology in CLSC in Malaysia was relatively low as various companies were not ready to adopt it. Currently, most providers were preparing their respective companies to achieve the key performance indicators (KPI). However, the adoption of new technology was not uncommon for companies, and several market developments were forcing logistics service providers (LSPs) to implement new technology continuously. Although the technology was a necessary pre-condition for digitalisation, CLSCs did not need to be digitalised. Nevertheless, four factors influenced the ease of technology adoption in a company, namely, technology factor, human/organisation factor, economic and political environment, and legislation hurdles. Notably, the factors correlated with the ideas from the Technology-Organisation-Environment (TOE)'s framework. Given that the study only utilised data from three respondents, it is essential to acquire more data from a broader population. Lastly, since this is an exploratory study, further research is necessary to confirm the findings in this study.

5.3. Research Implications

The findings from this study could implicate in two ways, namely, theoretical implication and practical implication. On the theoretical part, this study could become a reference for other studies that are employing a conceptual framework, especially in terms of cold chain adoption. Additionally, this study contributed to the literature for future reference in the research area.

In the practical implication, the results from this study could provide ideas for new CLSC adopters to consider the enablers and the barriers in implementing CLSC. Moreover, the Malaysian government should address the issues to promote the adoption of CLSC. Based on the findings, the cost and lack of government support are identified as the significant barriers to the CLSC implementation. Hence, the government should play a critical role in reducing the cost of operation in cold chain services. Furthermore, the Malaysian government should assist in the CLSC area by providing more incentives like tax relief on cold chain investment and import duty exemption on machinery and equipment purchases. These measures could attract more significant players, which potentially lead to job creation and flourish the industries and the country's economy. Subsequently, the influx of these service providers could promote healthy competition, which leads to competitive rates that benefit the CLSC's consumers, and thus, ultimately lowering their logistics costs.

Moreover, the Malaysian government should discuss with the electricity supplier to lower the consumption tariffs for cold chain service providers. The tariff reduction would reduce the operational costs and the logistics cost, which stimulates the CLSC adoption rate. Hence, CLSC offers more profit margin than standard ambient services, while the competition among the providers is not aggressive, and thus, industry players possess more opportunities in this area. Therefore, the Malaysian government should provide information regarding this opportunity to the logistics providers to promote cold chain adoption.

In terms of the service providers, they should not only focus on the SLCS of the existing consumers in Malaysia but to attract international consumers such as Singapore and Thailand, given that Malaysia is strategically located to become a significant global logistics hub (SMEBIZ, 2019). For instance, the Malacca straight is among the critical shipping trade route, and the Malaysian port is among the top performer in the world. Hence, Malaysia possesses natural competitive advantages in location, space, infrastructure, lower cost, language capabilities, labour expertise, and connectivity compared to our neighbouring country. Various business operators have started to relocate their operations into Malaysia, and giant companies like Alibaba even chose Malaysia over Singapore as their new logistics hub (Leung, 2017). Given these points, Malaysia could potentially provide the opportunity for CLSC service providers to gain market share. Specifically, non-service providers should grab this opportunity as the demand for CSLC is increasing. The shortage of supply leads to the existing providers' monopoly as the consumers possess limited options for the selection of other service providers.

5.4. Limitation and Recommendation

This study faced several limitations, namely the lack of sample sizes, in which studies at the organisational level are often faced with similar issues. Secondly, conducting the study during the MCO is challenging as researchers and respondents must comply with the restriction order, limiting movement and appointment time. Lastly, the study encountered the issue of expertise's availability, given the limited companies in Malaysia that offer CLSC services, and thus, diminishing the number of experts in the field. Additionally, the implementation of the MCO has made it challenging to obtain experts on the subject of CLSC.

Hence, further study is necessary to gain more sample size, which strengthens the reliability of the results. Furthermore, the study should be conducted before and after MCO to gain more sample size. Moreover, additional research is needed in this area, especially from developing countries like Malaysia, to understand the principles of CLSC better. Additionally, the study only focused on the current CLSC, in which the views differ from the non-service providers. Hence, future study is necessary to obtain the view from the logistic providers that do not offer CLSC in their business operation.

REFERENCES

Abbas, K. A., Sapuan, S. M., & Mokhtar, A. S. (2006). Shelf life assessment of Malaysian Pangasius sutchi during cold storage. *Sadhana - Academy Proceedings in Engineering Sciences*, *31*(5), 635–643. https://doi.org/10.1007/BF02715919

Abideen, A., & Mohamad, F. B. (2020). Improving the performance of a Malaysian pharmaceutical warehouse supply chain by integrating value stream mapping and discrete event simulation. *Journal of Modelling in Management*. https://doi.org/10.1108/JM2-07-2019-0159

Abideen, A. Z., & Mohamad, F. B. (2019). Supply chain lead time reduction in a pharmaceutical production warehouse – a case study. *International Journal of Pharmaceutical and Healthcare Marketing*, *14*(1), 61–88. https://doi.org/10.1108/IJPHM-02-2019-0005

Abu, A., Arshad, R., Abdullah, C., Bakar, A., & Ramli, Z. (2018). Capturing the Halal Food Market: Limitations of Halal Integrity within the Supply Chain, the Malaysian Experience. *American Journal of Economics*, *8*(6), 272–278. https://doi.org/10.5923/j.economics.20180806.06

Al-Shboul, M. A. (2019). Towards better understanding of determinants logistical factors in SMEs for cloud ERP adoption in developing economies. *Business Process Management Journal*, *25*(5), 887–907. https://doi.org/10.1108/BPMJ-01-2018-0004

Al Theeb, N., Smadi, H. J., Al-Hawari, T. H., & Aljarrah, M. H. (2020). Optimization of vehicle routing with inventory allocation problems in Cold Supply Chain Logistics. *Computers and Industrial Engineering*, *142*(May 2019). https://doi.org/10.1016/j.cie.2020.106341

Ali, I., Nagalingam, S., & Gurd, B. (2018). A resilience model for cold chain logistics of perishable products. *International Journal of Logistics Management*, *29*(3), 922–941. https://doi.org/10.1108/IJLM-06-2017-0147

Ambuko, J., Wanjiru, F., Karithi, E., Hutchinson, M., Chemining'wa, G., Mwachoni, E., Hansen, B., Wasilwa, L., Owino, W., & Nenguwo, N. (2018). Cold chain management in horticultural crops value chains: Options for smallholder farmers in Africa. *Acta Horticulturae*, *1225*, 85–91. https://doi.org/10.17660/ActaHortic.2018.1225.9

Ashok, A., Brison, M., & LeTallec, Y. (2017). Improving cold chain systems: Challenges and solutions. *Vaccine*, *35*(17), 2217–2223. https://doi.org/10.1016/j.vaccine.2016.08.045

Aworh, O. C. (2020). Food safety issues in fresh produce supply chain with particular reference to sub-Saharan Africa. *Food Control*, *123*(October 2020). https://doi.org/10.1016/j.foodcont.2020.107737

Azira, B., Norhayati, M. N., & Norwati, D. (2013). Knowledge, Attitude and Adherence to Cold Chain among General Practitioners in Kelantan, Malaysia. *International Journal of Collaborative Research on Internal Medicine & Public Health*, *5*(3), 157–167.

Azira, B., Norhayati, M. N., & Norwati, D. (2014). Optimal Temperature of Cold Chain and its Associated Factors among General Practitioners in Kelantan, Malaysia. *International Journal of Collaborative Research on Internal Medicine & Public Health*, *August*.

Bernama. (2016, May 24). Malaysians waste 15,000 tonnes of food daily. *The Star*, *May*, 4–6. http://www.thestar.com.my/news/nation/2016/05/24/malaysians-waste-15000-tonnes-of-food-daily/

Bremer, P. (2018). Towards a reference model for the cold chain. In *International Journal of Logistics Management* (Vol. 29, Issue 3, pp. 822–838). Emerald Group Publishing Ltd. https://doi.org/10.1108/IJLM-02-2017-0052

Cavendish, M. (2020). *The Malaysian Logistics Directory*. Marshall Cavendish Business Information Private Limited. Retrieved March 26, 2020, from http://www.msialogistics.com/company/list

Chaudhuri, A., Dukovska-Popovska, I., Subramanian, N., Chan, H. K., & Bai, R. (2018). Decision-making in cold chain logistics using data analytics: a literature review. *International Journal of Logistics Management*, *29*(3), 839–861. https://doi.org/10.1108/IJLM-03-2017-0059

Chye, F. Y., Abdullah, A., & Ayob, M. K. (2004). Bacteriological quality and safety of raw milk in Malaysia. *Food Microbiology*, *21*(5), 535–541. https://doi.org/10.1016/j.fm.2003.11.007

De, A., & Singh, S. P. (2021). Analysis of fuzzy applications in the agri-supply chain: A literature review. *Journal of Cleaner Production*, *283*, 124577. https://doi.org/10.1016/j.jclepro.2020.124577

Department of Commerce, U. S. (2016). *2016 Top Markets Report Cold Supply Chain*. International Trade Administration. Retrieved December 18, 2019, from

https://legacy.trade.gov/topmarkets/pdf/Cold_Chain_Malaysia.pdf. Accesed

Gligor, D., Tan, A., & Nguyen, T. N. T. (2018). The obstacles to cold chain implementation in developing countries: insights from Vietnam. *International Journal of Logistics Management*, *29*(3), 942–958. https://doi.org/10.1108/IJLM-02-2017-0026

Goedhals, G. L., Stander, C., & Van Dyk, F. (2017). Maintaining cold chain integrity: Temperature breaks within fruit reefer containers in the Cape Town Container Terminal. *Southern African Business Review (2008)*, *21*(1), 362–384.

Guion, L. A., Diehl, D. C., & Mcdonald, D. (2011). Conducting an In-depth Interview. *EDIS*, (8).

Hanjeet, K., Lye, M. S., Sinniah, M., & Schnur, A. (1996). Evaluation of cold chain monitoring in Kelantan, Malaysia. *Bulletin of the World Health Organization*, *74*(4), 391–397.

Industrial Consumer - Tenaga Nasional Berhad. (2020). Tenaga Nasional Berhad. Retrieved October 4, 2020, from https://www.tnb.com.my/commercial-industrial/for-industrial/

Kaipia, R., Dukovska-Popovska, I., & Loikkanen, L. (2013). Creating sustainable fresh food supply chains through waste reduction. *International Journal of Physical Distribution and Logistics Management*, *43*(3), 262–276. https://doi.org/10.1108/IJPDLM-11-2011-0200

Khan, A. U., & Ali, Y. (2021). Sustainable supplier selection for the cold supply chain (CSC) in the context of a developing country. *Environment, Development and Sustainability*, *0123456789*. https://doi.org/10.1007/s10668-020-01203-0

Khan, M. I., Khan, S., & Haleem, A. (2019). Analysing barriers towards management of Halal supply chain: a BWM approach. *Journal of Islamic Marketing*. https://doi.org/10.1108/JIMA-09-2018-0178

Laraswati, M., Guritno, A. D., Kristanti, N. E., & Suwondo, E. (2016). Analysis of logistics cost structure of fish cold supply chain in Java Island. *AIP Conference Proceedings*, *1755*(July). https://doi.org/10.1063/1.4958553

Leung, I. (2017, May 17). *Why Alibaba chose Malaysia over Singapore as logistics hub - Tech Wire Asia*. Retrieved December 12, 2019, from https://techwireasia.com/2017/05/alibaba-chose-malaysia-singapore-logistics-hub/

Melis, R. B., Mc Carthy, U., Ruiz-Garcia, L., Garcia-Hierro, J., & Robla Villalba, J. I. (2018). New trends in cold chain monitoring applications - A review. *Food Control*, *86*, 170–182. https://doi.org/10.1016/j.foodcont.2017.11.022

Naidu, S. (2017, April 18). What a waste: Malaysia's Struggle with Excess Food. *Channel NewsAsia*, 1–7. Retrieved March 22, 2020, from https://www.channelnewsasia.com/news/asia/what-a-waste-malaysia-s-struggle-with-excess-food-8735458

Nier, R. D. J., Wahab, S. N., & Daud, D. (2020). A Qualitative Case Study on the Use of Drone Technology for Stock Take Activity in a Third-Party Logistics Firm in Malaysia. *IOP Conference Series: Materials Science and Engineering*, *780*(6). https://doi.org/10.1088/1757-899X/780/6/062014

Qi, L., Xu, M., Fu, Z., Mira, T., & Zhang, X. (2014). C2SLDS: A WSN-based perishable food shelf-life prediction and LSFO strategy decision support system in cold chain logistics. *Food Control*, *38*(1), 19–29. https://doi.org/10.1016/j.foodcont.2013.09.023

Rahman, N. A. A., Mohammad, M. F., Rahim, S. A., & Noh, H. M. (2018). Implementing air cargo halal warehouse: insight from Malaysia. *Journal of Islamic Marketing*, *9*(3), 462–483. https://doi.org/10.1108/JIMA-09-2016-0071

Rodrigue, J.-P., & Notteboom, T. (2016). *The Cold Chain and its Logistics*. The Geography of Transport Systems; Routledge. Retrieved March 20, 2020, from https://transportgeography.org/?page_id=6585

Roso, V., Vural, C. A., Abrahamsson, A., Engström, M., Rogerson, S., & Santén, V. (2020). Drivers and barriers for inland waterway transportation. *Operations and Supply Chain Management*, *13*(4), 406–417. https://doi.org/10.31387/oscm0430280

Salin, V., & Nayga, R. M. (2003). A cold chain network for food exports to developing countries. *International Journal of Physical Distribution and Logistics Management*, *33*(10), 918–933. https://doi.org/10.1108/09600030310508717

Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A Skill-Building Approach, 6th Edition* (7th editio). John Wiley & Sons.

Shankar, A. C. (2019, May). Tasco to see better days after cold chain, consumer logistics venture. *The Edge Financial Daily*. Retrieved July 22, 2020, from https://www.theedgemarkets.com/article/tasco-see-better-days-after-cold-chain-consumer-logistics-venture

Shashi, Cerchione, R., Singh, R., Centobelli, P., & Shabani, A. (2018). Food cold chain management: From a structured literature review to a conceptual framework and research agenda. *International Journal of Logistics Management*, *29*(3), 792–821. https://doi.org/10.1108/IJLM-01-2017-0007

Shi, P., & Yan, B. (2016). Factors affecting RFID adoption in the agricultural product distribution industry: empirical evidence from China. *SpringerPlus*, *5*(1). https://doi.org/10.1186/s40064-016-3708-x

SMEBIZ. (2019, March 4). *Malaysia Well Positioned for Regional Logistics Hub • MDBC*. The Star. Retrieved October 5. 2020, from https://www.mdbc.com.my/malaysia-well-positioned-for-regional-logistics-hub/

Talib, M. S. A., & Hamid, A. B. A. (2014). Halal logistics in Malaysia: A SWOT analysis. *Journal of Islamic Marketing*, *5*(3), 322–343. https://doi.org/10.1108/JIMA-03-2013-0018

Talib, M. S. A., Hamid, A. B. A., Zulfakar, M. H., & Jeeva, A. S. (2014). Halal logistics PEST Analysis: The Malaysia perspectives. *Asian Social Science*, *10*(14), 119–131. https://doi.org/10.5539/ass.v10n14p119

Tan, X. Y., Misran, A., Daim, L. D. J., Ding, P., & Pak Dek, M. S. (2020). Effect of freezing on minimally processed durian for long term storage. *Scientia Horticulturae*, *264*(December 2019), 109170. https://doi.org/10.1016/j.scienta.2019.109170

Tan, Y., & Li, C. Y. (2018). Logistics in Malaysia Market overview and M&A trends. In *Pricewaterhouse Coopers Advisory Services Sdn. Bhd.* (Issue October).

Tieman, M. (2011). The application of Halal in supply chain management: In-depth interviews. *Journal of Islamic Marketing*, *2*(2), 186–195. https://doi.org/10.1108/17590831111139893

Tieman, M., & Ghazali, M. C. (2014). Halal Control Activities and Assurance Activities in Halal Food Logistics. *Procedia - Social and Behavioral Sciences*, *121*(March 2014), 44–57. https://doi.org/10.1016/j.sbspro.2014.01.1107

Tsai, K. M., & Pawar, K. S. (2018). Special Issue on Next-Generation Cold Supply Chain Management: Research, Applications and Challenges. *International Journal of Logistics Management*, *29*(3), 786–791. https://doi.org/10.1108/IJLM-08-2018-340

Vass, T. de, Shee, H., & Miah, S. (2021). IoT in Supply Chain Management: Opportunities and Challenges for Businesses in Early Industry 4.0 Context. *Operations and Supply Chain Management: An International Journal*, *14*(2), 148–161. https://doi.org/10.31387/oscm0450293

Vatumalae, V., Rajagopal, P., & Kaliani Sundram, V. P. (2020). Warehouse Management System of a Third Party Logistics Provider in Malaysia. *International Journal of Economics and Finance*, *12*(9), 73. https://doi.org/10.5539/ijef.v12n9p73

Zhang, D., Zhu, P., & Ye, Y. (2016). The effects of E-commerce on the demand for commercial real estate. *Cities*, *51*, 106–120. https://doi.org/10.1016/j.cities.2015.11.012

Mohd Faizal Abu Hassan is a lecturer for Logistics and Supply Chain Management at Commerce Department of Polytechnic Sultan Haji Ahmad Shah. He is now pursuing his Master's Degree in Maritime Studies from Universiti Malaysia Terengganu under Dr. Abdul Hafaz Ngah supervision and received BBA in Transport from Universiti Teknologi MARA. Mohd Faizal Abu Hassan can be contacted at: faizalhassan.poli@1govuc.gov.my.

Dr. Abdul Hafaz Ngah is a senior lecturer at Faculty of Business, Economy and Social Development, Universiti Malaysia Terengganu. He received a PhD in Technology Management focusing on Halal supply chain from Universiti Malaysia Pahang, Master in Education from Universiti Teknologi Malaysia and a BBA from Universiti Kebangsaan Malaysia. His research primarily on logistics and supply chain management with specialisation on halal supply chain, halal marketing, technology adoption, tourism and consumer behaviour. Abdul Hafaz Ngah is the corresponding author and can be contacted at: hafaz.ngah@umt.edu.my.

Dr. Mohamed Syazwan Ab Talib is an Assistant Professor of Logistics Management at the UBD School of Business and Economics, Universiti Brunei Darussalam. He holds a PhD in Management from Universiti Teknologi Malaysia, an MBA from Universiti Selangor and a BBA from Universiti Teknologi MARA. He was a Senior Lecturer in Marketing at Azman Hashim International Business School, Universiti Teknologi Malaysia and formerly a Lecturer in Logistics Management at the Faculty of Business and Information Science, UCSI University. His research and teaching focus primarily on logistics and supply chain management with specialisation on halal principles, distribution and standards. Mohamed Syazwan Ab Talib can be contacted at: syazwan.talib@ubd.edu.bn.