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The Significant Decisions in Cold Chain Logistics

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Abstract

Purpose – The prior literature has shown that there is a lack of a complete assessment of the key decisions in cold chain logistics. Such a study is required to offer recommendations for research in this expanding but under-researched topic with potentially significant management ramifications.

Research design, Data, and methodology – The current researcher accumulated peer-reviewed sources from databases to augment each chosen study's validity. Selection varied between seminal works and much of the existing literature. The selection process was consistent with using a content checklist that established the inclusion and exclusion criteria.

Result – The research findings indicate total five solutions regarding better decision in Cold Chain Logistics (CCL), such as (1) Pricing Decision in Cold Chain Logistics, (2) Decision on Temperature Control Decision in Cold Chain Logistics, (3) Supply Chain Network Design in Cold Chain Logistics, (4) Decision on Minimizing Inventory in Cold Chain Logistics, (5) Decision on Logistics Distribution.

Conclusion – Stability of a cold chain should be maintained from manufacture or via logistical components and cold logistics products are susceptible to several variables, such as temperature, and degradation can easily harm food supply, product prices, and human health. Product safety infractions substantially impact human health, among other losses linked with a functioning CCL.

Keywords: Cold Chain, Logistics Management, Supply Chain Network

JEL Classification Code: D02, Q21, C35

1. Introduction

A cold chain logistics (CCL) protects various food, pharmaceutical, and chemical products from deterioration, inappropriate light, humidity, temperature, or specific pollutants to preserve them fresh, chilled, and frozen (Bishara, 2006). A cold chain's stability should be maintained from manufacturing or logistics, including storage, handling, unloading, and product loading. Products under cold logistics are extremely sensitive to different variables, including temperature and deterioration can readily hurt food availability, product costs, and human health. Food safety violations significantly influence human health and result in financial losses for companies (Marucheck et al., 2011). The wholesalers and retailers fail revenue growth objectives, have low operating margins, and have poor inventory performance as a consequence of many hazards along the cold chain, such as the absence of cross-contamination on transit and storage, temperature abuse, breakdowns, transportation delays, and traceability (Srivastava et al., 2015).

Furthermore, it is projected that twenty and thirty percent of perishable items are subject to waste at a certain stage within the chain, excluding domestic waste, which was projected as nineteen percent of products bought (Mena et al., 2014). As a result, accessibility and awareness of item information across all phases in cold logistics have been highlighted to assure product quality and safety and enhance cold chain efficiency (Kim et al., 2016). Information or data collection on the status of items ensures timely traceability and monitoring across a chain, as well as risk management (Ringsberg, 2014).

In addition to data monitoring and culture, guaranteeing visibility may provide other benefits when integrated with optimization models, such as developing an ideal mobility plan to avoid hazards (Wang et al., 2010). Such data analytics applications have gained traction in logistics due to their ability to enhance flexibility, manage cost changes, and successfully manage demand volatility, allowing corporate organizations better decision-making (Nakandala et al., 2016). However, data regarding the cold chain has been underutilized since it has mostly been applied to assess the integrity of the logistics (Joshi et al., 2009). It's not common for product temperature to be documented in transit after conducting interviews with high-ranking managers in charge of safety development, quality, safety, logistics, and design of third parties for sensitive cargo handling (White & Cheong, 2012). Furthermore, such information is utilized only at the destination to assess the acceptance of the freight.

Raab et al. (2011) control and monitoring collaboration between the chain stakeholders is frequently lacking, and temperature data are seldom transmitted within cold chains. Furthermore, most businesses merely undertake little control of temperature to adhere to product standards. Raab et al. (2011) conclude in the setting of supply chains that actual implementation of supplying temperature management for cold chain is unavailable since supply chain members may be unaware of features of the various processes and the remedy that best fits user's needs. The recent study either has a segmented focus on a particular technology or considers technology adoption for particular chain representatives, including monitoring temperature by trying to implement temperature notifications within the chain (Hafliason et al., 2012) and the cold chain for preserving products at the lowest possible cost. Furthermore, the decision-making process based on data is considered important and unique to particular cold chain participants. Shukla and Jharkharia (2013) examine the fresh produce supply chain in-depth. As a result, there is a lack of a complete assessment of the key decisions in cold chain logistics. Such a study is required to offer recommendations for research in this expanding but under-researched topic with potentially significant management ramifications.

2. Literature Review

2.1. Temperature Control

Tracing real-time information or data collected in the field is useful for monitoring product development or controlling the environment in greenhouses, allowing growers to design strategies and interventions for enhanced yield and quality. Following up on the item throughout handling and tracing is an important feature that promotes product visibility. In this regard, Lütjen et al. (2013) developed intelligent vessels that can offer relevant information on the quality and location of items in transit. Temperature is the variable that regulates the cold chain, and various writers have discussed the process. Data management and monitoring regarding temperature are critical for supplying quality goods and avoiding monetary loss in cold chain. Data on temperature levels are frequently paired with time information to forecast the product's duration on the shelf. Hafliason et al. (2012) built a sensor identified with cold distribution chains to monitor the temperature of a package. Their findings determined that just recording temperature and implementing a specific indicator may result in a false alarm, A more complex intelligent system and decision support are necessary to properly exploit the data for its value.

Food quality degrades due to bacterial development, which is directly tied to storage temperature rise. Unfortunately, the link between temperature and product quality is not straightforward since bacterial development is affected by various variables, including humidity and light intensity. Aside from temperature, light, humidity, and other environmental factors also have a role. As a result, these statistics can show whether the product was handled under ideal circumstances or whether there is a risk of harm or a drop in quality. Different bio and gas sensors can aid in determining whether or not a certain microbial growth has occurred while recording chemical data. Sensory evaluation, collecting free acidity, gross high-calorie value carbon equivalent, and other parameters that may be utilized to control products or goods quality (McDermott, 2004).

Environmental records might be offered to the consumer to earn a sales premium. It is critical to record environmental variables during transportation, and present results where sensors were employed for tracking the circumstances. Throughout the logistics system, the sensor node monitored environmental parameters such as mechanical distress, humidity, temperature, and oxygen. Cold chain logistics refers to transporting fresh and perishable items to preserve a low-temperature environment. CCL study has gained the interest of researchers in various sectors, including supply chain and agriculture, due to its positive impact on quality maintenance (Wu & Hsiao, 2021).

The available literature analysis reveals that study on CCL temperatures mostly focuses on refrigerated vehicles' temperature monitoring. Tseng et al. (2020) created an IOT-based cold chain logistics system with three functionalities: inter-packaging, real-time products, and distribution routes Optimization. According to the findings, using the suggested approach can minimize food loss, boost customer happiness, and improve operational efficiency. Many academics have done temperature tracking studies based on temperature data monitoring in CCL as the studies have progressed. For example, Sodhi and Tang (2021) employed machine learning to identify improper behavior by classifying the system and refrigerated truck status. The literature has, however, limited information on the importance of temperature control in CCL, therefore, resulting in the following hypothesis:

H1: The involved companies should ensure temperature control in the Cold Chain Logistics.

2.2. Minimizing Inventory in Cold Chain Logistics

CCL, unlike traditional logistics, requires refrigerated facilities to maintain freshness throughout the process, from manufacture to final consumption. However, this dramatically increases carbon emissions, energy consumption and expense, and energy consumption due to refrigeration. Furthermore, this piques the interest of additional study on cold chain logistics ability that considers cost savings and sustainability considerations. Shashi et al. (2018) developed a novel model that involves emission and cost. The cost incurred to hold inventory and levels of emission from freezer coolers is factored into their approach. Keirstead et al. (2012) suggested a location routing issue approach in CCL, in which the goal functionality included costs and emissions. The center's emissions distribution and transportation operations are explicitly calculated in the model. Qin et al. examined carbon emissions, customer happiness, and cost while solving the routing issue in CCL. There is little information on minimizing inventory in CCL, therefore, resulting in the following hypothesis:

H2: inventory should be minimized in Cold Chain Logistics

2.3. Logistics Distribution Path Planning

In recent times, practical complexity and changeable influencing elements in logistics redistribution have been studied for path design. Kuo et al. (2014) investigated the trash collection truck routing problem with ambiguous demand in-depth. They established the superiority of their suggested genetic algorithm over different approaches on eight sets with truck capacity limits. Hosseinabadi et al. (2015) integrated the routing issue with the simulation of local search, ensuring that minim transportation expenses incurred for the fleet when the trucks failed to return to a store or warehouse after distributions completion.

Poonthalir et al. (2020) examined the influence of expenditures on transportation associated with vehicle time spent at amenities such as petrol toll booths and stations and developed a chemical process algorithm to solve the associated vehicle queuing model. Sadykov (2012) suggested a bidirectional label correction method that efficiently solves a heterogeneous fleet route issue with time and capacity restrictions. Swanson et al. (2018) employed multimodal characteristics of the firefly method to increase an optimization group's local optimum and stagnant search, hence boosting the analysis capabilities of Optimization. An investigation on track cross-docking and routing challenges by Salleh et al. (2019) suggested a 2-stage algorithm, with the initial stage applying a website search

method to generate a list of possible routes and the other stage separating the sets to appease alternative restrictions and identify an optimal result. Existing research on the trajectory tracking of distribution reveals that the heuristics algorithm is commonly used during path optimization. However, limited studies identify the importance of supply chain planning in Cold Chain Logistics; therefore, the following hypothesis.

H3: Logistics distribution path planning should be implemented in Cold Chain Logistics.

2.4. Supply Chain Network Design in Cold Chain Logistics

The network design in CCL is identified as a major activity of country economics. The importance of the networks lies in the timely delivery and production of products, including food and medicine (Shekarian, 2020). The growth in the importance of environmental constraints and goals in the modern world has forced decision-makers to be attentive to network designs and consider the environmental factors that enhance progress (Vali-Siar & Roghanian, 2022). Environmental and business factors have enhanced the interest in investing in Cold Chain Logistics. Most companies have focused on recovery and reconstruction activities in the past years and have achieved a huge milestone in the areas of CCL (Shekarian, 2020). However, the consequence of having a well-designed network is witnessed by different factors, including price, perishability of products, and the effectiveness and efficiency of the network. Owing to this, the following hypothesis has been proposed.

H4: An effective network design should be implemented in Cold Chain Logistics.

2.5. Pricing Decisions in Cold Chain Logistics

Pricing in CCL is an issue that has attracted the attention of many scholars. There has been research conducted in relation to this field (Zhao et al., 2022; Feng, 2019). According to Wang and Liu, a pricing model may contain different parameters, including randomness, price sensitivity, demand, and distribution characteristics. A direct method can be used in solving the pricing strategy in CC retailers and ensuring profit maximization. Mahmoodi (2019) formulated the replenishing pricing strategy with sensitive demand on inventory and price and piecewise consumption rate. The direct method can help in ensuring profit maximization. Although researchers have analyzed the different aspects of pricing in CCL, there is limited information on significance of pricing decision in CCL. Consequently, the researcher has established the following hypothesis.

H5: Pricing is an important decision in Cold Chain Logistics.

Table 1: Five Hypotheses based on Literature Dataset

Hypothesis	Past Resources	Description
1. Inventory should be minimized in Cold Chain Logistics	Lütjen et al. (2013), Hafliason et al. (2012), McDermott (2004), Wu and Hsiao (2021), Tseng et al. (2020), Sodhi and Tang (2021)	Many academics have done temperature tracking studies based on temperature data monitoring in CCL as the studies have progressed.
2. Inventory should be minimized in Cold Chain Logistics	Shashi et al. (2018), Keirstead et al. (2012)	The cost incurred to hold inventory and levels of emission from freezer coolers is factored into their approach.
3. Logistics distribution path planning should be implemented in Cold Chain Logistics.	Kuo et al. (2014), Hosseinabadi et al. (2015), Poonthalir et al. (2020), Sadykov (2012), Swanson et al. (2018), Salleh et al. (2019)	The influence of expenditures on transportation associated with vehicle time spent at amenities such as petrol toll booths and stations.

4. An effective network design should be implemented in Cold Chain Logistics.	Shekarian (2020), Vali-Siar and Roghanian (2022), Shekarian (2020)	The importance of the networks lies in the timely delivery and production of products, including food and medicine.
5. Pricing is an important decision in Cold Chain Logistics.	Zhao et al. (2022), Feng (2019), Mahmoodi (2019)	Pricing in CCL is an issue that has attracted the attention of many scholars. There has been research conducted in relation to this field.

3. Methodology

Qualitative research is the bridge to understanding the nature of human experiences. It offers an opportunity through which the nature of human interaction with a particular phenomenon can be elaborated through descriptive textual evidence. The diverse nature of the attributes of qualitative research is consistent with the presence of norms, attitudes and cultural factors that are subjective to human experience. Qualitative research offers a platform through which humanity can comprehend issues, relationships, variations and experiences instead of the logical predictions, statistical description and quantification provided by quantitative research (Woo & Kang, 2020; Nguyen et al., 2022; Sung, 2021)

Qualitative research adapts to various research methods, including qualitative methods. Therefore, it was used by the researcher, given its flexibility and straightforwardness with human experience that quantitative research cannot achieve. There are numerous benefits linked to the use of qualitative research. First, the results often need to be more anticipated, and the researcher can explore multiple themes in widening the breadth and depth of the study. The data from qualitative research is thus abundant and can be easily explained. Qualitative research is also culturally sensitive and integrative, especially to the participants, as it accounts for their experiences (Lee, 2021; Kang, 2020).

The current researcher accumulated peer-reviewed sources from databases to augment each chosen study's validity. Selection varied between seminal works and much of the existing literature. The selection process was consistent with using a content checklist that established the inclusion and exclusion criteria. Content analysis of the literature was necessary because it offers a platform for summarizing the required systematic review evidence within the limits of each study. Content analysis is also essential for the quality of the study, as the researchers were able to identify those studies with publication bias and those with little publication bias. The nature of the publications utilized in the study was consistent with eliminating conference papers while focusing on peer-reviewed studies. It was also necessary for the researchers to ensure the text could be analyzed through qualitative software, implying the studies used were both based on an interpretivist and positivist approach (Han & Kang, 2020; Hong, 2021).

Figure 1: Collecting Process of Textual Resource

4. Results

4.1. Pricing Decision in Cold Chain Logistics

Xu and Cai's (2020) research noted that the differential pricing resulting from subsidies could lead to profits in CCL. In addition, the subsidies can improve the supply chain, retailers, and suppliers in agro-products, but they cannot result in optimal profits within the supply chain. The decentralized decision-making on pricing can, however influence efficiency in cold chain logistics. Wang et al. (2023) conducted a numerical analysis and found out that with the

wholesale expenditure increase and cost coefficient of carbon and decreasing the fresh-keeping price coefficient, producers will opt for low carbon service levels and fresh-keeping efforts levels. When the advertising cost proportion born by suppliers increases, all parties' benefits in cold chain logistics will decrease. Analytical data indicates that heterogeneous vehicle composition, fleet size, and network structure can impact the transportation cost, which is crucial in making decisions on pricing. Wang et al. (2023) noted that the optimal pricing approach is associated with initial inventory. The sensitivity study indicated that profit fluctuation and optimal method are linked to quality loss and quantity loss. With an increase in quality loss, the retailers can reduce the replenishment cost, preservation investment for future and increase prices. If loss rise, the seller can minimize the replenishment quantity. Shu et al. (2020) analyzed the logistics services quality optimization with pricing to identify how the manufacturers decide on wholesale prices within cold chain logistics. Shu et al. (2020) also considered the quality of logistics services and retailing prices in non-cooperative and cooperative scenarios. They noted that optimal prices are higher on decentralized policies when the quality of logistics services is lower.

4.2. Decision on Temperature Control Decision in Cold Chain Logistics

Fresh food transportation requires maintaining a low-temperature environment to ensure safety and reduce food waste. Temperature poses a major threat faced in cold chain logistics. The company involved can use algorithms to improve the accuracy of the temperature needed for the products. Lütjen et al. (2013) argue that intelligent container can monitor fruit conditions and track geographical locations. Therefore, the losses can be significantly reduced due to the enhanced strategies and climate control. In addition, the simulation model can be used to make scheduling methods based on the intelligent container concept. Kuswandi and Nurfawaidi (2017) analyzed how monitoring temperature can improve inventory decisions using the Pseudomonas sp. Model. The findings indicated that inventory quantity at eighteen and seven degrees Celsius is more compared to at twenty-five degrees Celsius. Managers can use the model to improve quality management, considering income. In addition, temperature-controlled companies can share information on temperature with chain members to emphasize cost balance and food quality. Hien and Thanh's (2022) study on Vaccines noted that the Cold chain helps keep the vaccines under the required temperature while expanding the expiry date and ensuring quality. In addition, it was noted that such decisions to ensure the right preservation temperature of products would help avoid waste and reduce economic losses.

4.3. Supply Chain Network Design in Cold Chain Logistics

Cai et al. (2022) noted that food safety and quality issues had gained attraction to consumers making enterprises aware of the necessity of supply chain refrigeration. The CCL for products ragging behind to meet consumer requirements based on sales, transportation, storage processing, and production. Cai et al. (2022) further note that the decisions on improving efficiency for product refrigeration chain supply, quality assurance, ensuring products freshness, and reduction of logistics costs is a major focus when establishing cold chain logistics. Misni et al. (2021) identified three decision-planning levels in Cold Chain Logistics: operational planning for vehicle routing, tactical planning for inventory planning, and strategic planning for location-allocation on problems.

Yang and Jang (2021) opined that by reducing the losses associated with long transportation periods, organizations had implemented management requirements of chain logistics circulations links to meet demand uncertainty. A robust design network and a technical framework must be implemented within Cold Chain Logistics. Li (2021) identified the joint management and operation of the CCL and the fresh products, therefore, the need to strengthen demand-oriented coordination, innovation supply coordination, and technology innovation coordination. Li and Li (2021) further noted that the construction of the safety mechanism of cold chain logistics should include an emergency handling system, detection modules, and dynamic monitoring to improve efficiency. Kapuria et al. (2014) argued that the root of effective logistics management is an operations team that applies technology in making distribution decisions. Therefore, HR is important in the cold chain logistics plan implementation and conceptual design. Wang et al. (2018) argues that software programming of tasks can be used in realizing the data of location, relative humidity, and environmental temperature. Such a design can be helpful in providing a reference for research on remote monitoring to ensure that the Chain network is well interconnected.

4.4. Decision on Minimizing Inventory in Cold Chain Logistics

Zheng and Pang (2019) addressed the trailer scheduling challenge using cross-dock operation. Scheduling and internal operation on outbound and inbound trailers are planned to minimize transshipment and reduce costs, including

inventory costs. Zheng and Pang (2019) found out that the GRASP algorithm is required to decide the inventory level that can be held in the warehouse. An optimization for the framework to minimize transportation, ordering, and inventory. The administration and transportation lead time must be incorporated into the decision-making. Krasteva et al. (2019) identified different categories that can influence product wastage in CCL: customer preferences and perceptions, disruptions in the chain, inventory management, demand forecast and uncertainties, and information flow. At the management level, Krasteva et al. (2019) suggest that positive changes can be experienced through the creation of an efficient structure to reduce the product holding period. The strategies implemented at the managerial level can influence the social level concerning customer perception and preferences. A distribution collaborative and logistics inventory model can be constructed on CCL multiple distributive retail outlets. Li et al. (2022) identified that the location routing inventory challenge is essential in CCL. The studies indicated that NSGA-II effectively reduces emissions based on carbon transactions.

4.5. Decision on Logistics Distribution Path

The insertion method can reduce the cost of distribution logistics and improve efficiency in distribution. Li et al. (2022) argue that scientific methods can be important in deciding the distribution path when transporting products. In addition, the study identified that pollution, carbon emission, and resource wastage are key in determining the path. The study contributed to the Logistics Company's knowledge of distribution paths and contributed to better and sustainable development. Juan (2022) noted that CCL with a multi-temperature distribution joint produces higher carbon emission levels than general CCL. Juan (2022) proposed a total cost function comprising cost of carbon emission, refrigeration coast, and transportation expense in developing an optimized CCL distribution path. The model would effectively reduce the distribution distance through comparing optimization route findings after and before involving the cost of carbon and other gases emission. According to Zhu (2021), inefficient CC distribution systems pose risks to products under transportation and increase the cost of damaged goods. A joint distribution will enhance CCI's operational efficiency, improve competitiveness and reduce operating costs. Based on resources and vehicle integration in cold chain distribution, the joint distribution is an optimal strategy that helps determine the distribution path. Zheng and Huang (2021) proposed a common distribution path using an SPSS cluster to establish a suitable distribution path that can be used in CCL. The application of big data when deciding on a suitable path can be useful in predicting demand, improving distribution, and cutting the distribution cost.

5. Implications for Practitioners

There are implications that can are obtained from the research above. The research has identified a number of significant decisions in CCL. The first inference is owing to importance of a distribution path; the parties involved should ensure that they establish an effective distribution path. Making such a decision will call for data analysis to ensure that they gather data to make appropriate decisions. The routing issue with local search simulation guarantees that the fleet's transportation charges are minimized when trucks fail to return to the warehouse after finishing their distribution. A bidirectional label correction approach solving a heterogeneous fleet routing problem on period used and capacity constraints. A two-step algorithm in which the first stage uses a website search strategy to build a list of possible routes, and the other stage separates the sets to meet constraints and pinpoint an optimal outcome. Existing study on distribution trajectory tracking suggests that heuristics algorithms are frequently utilized during path optimization.

Secondly, temperature management is a key decision in CCL. Environmental records might likewise be offered to the consumer to earn a sales premium. It is critical to record environmental variables during transportation, and sensors can be employed for tracking the circumstances. Throughout the logistics system, the sensor node monitored environmental parameters such as mechanical distress, humidity, temperature, and oxygen. Aside from temperature, light, humidity, and other environmental factors also have a role. As a result, statistics can show whether the product was handled under ideal circumstances or whether there is a risk of harm or a drop in quality. Different bio and gas sensors can aid in determining whether or not a certain microbial growth has occurred while recording chemical data. Sensory evaluation, collecting free acidity, gross high-calorie value carbon equivalent, and other parameters may be utilized to control the quality of products or goods. Time intervals, atmospheric composition, solar irradiance, and relative humidity are key areas to be considered in CCL.

Thirdly, the involved parties in Cold Chain Logistics must identify the mechanisms to manage inventory in warehouses. In contrast to typical logistics, CCL need refrigerated materials to guarantee freshness throughout the

process, from manufacturing to ultimate consumption. However, the use of such technology results in to increase in emissions and fuel consumption in addition to costs associated with holding products. It is, therefore, necessary to put in place measures that will reduce the inventory holding period. The fourth implication is that deciding on the network design is key in cold chain logistics.

The relevance of networks is based on timely delivery and product manufacturing. The increased relevance of environmental restrictions and goals in the modern world has compelled decision-makers to pay close attention to network designs and examine environmental elements that promote advancement. A number of factors influence the decision of the distribution path used, including price, perishability, and the quality of available networks. The other implication is that pricing is an important decision in cold chain logistics. The pricing model may include several elements, such as randomization, price sensitivity, and demand. A straightforward technique may be employed to solve the price strategy in CC and maximize profits. This direct technique can aid in profit maximization. Big data can be used to predict and identify demand, improving effectiveness and efficiency of CCL. The approach will reduce the cost incurred by the company when transporting or holding products in the warehouse.

6. Limitations and Conclusions

The study limitation is that it included randomized trials and reports of peer-reviewed articles. Acknowledgment of the laminations on the submissions and observational studies can be different. The other limitation of using peer-reviewed articles is some may have an average editorial quality team. A blind review of the peer articles can result in different results. In addition, the weight assigned to the articles may be subjective. The study used peer-reviewed articles to identify important decisions in Cold Chain Logistics. Therefore, there is a confounding factor where the researcher did not get an opportunity to conduct quantitative research to make their conclusion from their study.

Differences may have been identified if the researcher had used a different research method. In addition, the findings on peer-reviewed articles are based on different geographical locations where the recommendations or findings may not be helpful in a different geographical location. Further, the market condition may have changed over time; research conducted two years ago may not be useful in making recommendations in the current market. The research mode has made it difficult to observe the unknown and investigate the current trends on the issue under research. In addition, the research made it difficult to process and collect data to gather information on the formulated hypothesis. The other limitation is that the research approach made it impossible to collect data and verify the results for the researcher to conclude from the findings. For future research, I propose that the researcher use longitudinal experiments to identify the key decisions needed in Cold Chain Logistics. In addition, future research can focus on a specific geographical location to draw conclusions and recommendations on the specific location.

This research has identified a number of significant decisions in Cold Chain Logistics: Minimizing inventory, determining the logistics distribution path, pricing, temperature conditions, and the logistics network design using peer-reviewed articles. The stability of a cold chain should be maintained from manufacture or via logistical components such as storage, handling, unloading, and product loading. Cold logistics products are susceptible to several variables, such as temperature, and degradation can easily harm food supply, product prices, and human health. Product safety infractions substantially impact human health, among other losses linked with a functioning CCL. The logistics team can use the recommendations in the research to point out the key areas that decisions have to make to ensure that the Cold Chain is effective and flexible to meet customer demands and reduce the cost incurred by companies. Reliance on data can play a significant role in making the identified decisions to improve logistics.

Different stakeholders can draw several implications, including wholesalers, manufacturers, and retailers, to ensure products that are transported under cold chain logistics get to the customers at the right time and improve their profit margin. The study, however, has some limitations, with the main issue being the reliance on peer-reviewed articles alone. The articles provided sufficient information that has helped draw conclusions; however, the use of quantitative analysis could provide different information that could be more reliable and updated. The study has provided a recommendation for a future study where a longitudinal analysis can be conducted to provide additional insight on the topic of study. The research provides a literature source for reference in the area of CCL. More study can be conducted on other aspects of CCL to increase literature in the area of logistics.

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