BBA 31

Optimizing Cold Chain Logistics and Transportation Efficiency

A Case Study of Arctic Associates (Walls Distribution Network)

By:

Ali Arshad (01-111221-139)
Shafaf Khan (01-111221-094)
Usama Zahid Paracha (01-111221-211)

(Bachelor In Business Administration)

Supervisor:

Mr. Sabir Ali

Marketing and Business Department

Bahria University – Islamabad Campus

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Names of Student(s):	**Enroll #**
• Usama Zahid Paracha	01-111221-211
• Shafaf Khan	01-111221-094
• Ali Arshad	01-111221-139

Class: Bachelor of Business Administration

Approved by:

_____

Sabir Ali

Supervisor

_____

Qurat Ul Ain Waqar

Research Coordinator

_____

Dr. Aftab Haider

Head of Department

DEDICATION

The research honors the Pakistani logistics workforce which consists of drivers and loaders and fleet managers who endure harsh weather conditions and poor infrastructure and heavy traffic to maintain the country's supply network. The dedication also extends to our parents because they have maintained constant backing through their prayers which served as our academic foundation.

ACKNOWLEDGEMENT

In preparing this project, we were in contact with many people, researchers, academicians, and practitioners who have contributed towards our understanding and thoughts. We want to show our deepest gratitude to our main project supervisor because they provided us with support and direction and valuable feedback and maintained a close relationship with us.

We deeply thank Arctic Associates management for their Business Manager (Operations & Logistics) who granted us site access and shared vital operational details about their business operations. The researchers needed their open disclosure about Twin Cities cold chain distribution problems to conduct this research study.

The library and Research Cell at Bahria University provided academic resources which helped us develop our theoretical framework. The authors thank their families and peers who maintained their support during the extended period needed to collect data and write this research.

ABSTRACT

The research investigates cold chain logistics optimization and transportation efficiency through a qualitative study of Arctic Associates which operates as Walls Ice Cream authorized distribution partner in Pakistan. The frozen food industry depends on precise temperature control because ice cream distribution requires cold chain management to maintain product quality while controlling costs and ensuring customer satisfaction. The research investigates current cold chain systems to determine their operational problems and assess how logistics optimization would benefit developing nations.

The research design used qualitative methods to conduct semi-structured interviews with the Business Manager who oversees operations and logistics at Arctic Associates. The research team collected primary data through interview questionnaires, and they obtained secondary data from academic studies and industry publications and official regulatory documents. The research team used thematic analysis to analyze interview data for identifying essential patterns which included temperature management and route optimization and delivery quality and food waste prevention and operational barriers.

The findings show that disciplined temperature control, flexible route planning, scheduled vehicle maintenance, and strict adherence to Standard Operating Procedures help protect the cold chain. Despite challenges such as traffic congestion, extreme weather, energy instability, and limited infrastructure, Arctic Associates maintains high delivery reliability and low product spoilage.

Cold chain optimization was found to enhance product quality, reduce operational costs, improve retailer satisfaction, and strengthen relationships with Walls. The study concludes that cold chain optimization is both an operational requirement and a strategic necessity for frozen food distribution. While limited by its qualitative, single-case approach, the research provides valuable insights into cold chain logistics in developing countries and highlights directions for future research.

EXECUTIVE SUMMARY

The national food supply chain depends on Pakistan's frozen food sector which operates under three major obstacles that include harsh outside temperatures and unstable power expenses and insufficient distribution networks. The research conducts a detailed qualitative case study of Arctic Associates which serves as Walls Ice Cream (Unilever Pakistan) distribution partner in the densely populated Rawalpindi and Islamabad urban area. The research examines organizational methods for enhancing their cold chain logistics and transportation performance through international quality standards in developing areas.

The research applies the Supply Chain Operations Reference (SCOR) model to analyze the fundamental operations of the distribution network which include Plan and Source and Deliver and Return. The Business Manager at Arctic Associates provided primary data through semi-structured in-depth interviews which combined with secondary data about Pakistan's economic statistics and business standards and official rules.

The research shows that delivery operations between the final destination and customer location remain the weakest point in cold chain protection because they experience temperature fluctuations from traffic delays and vehicle weight restrictions and customers spending time at stores. The research shows Arctic Associates operates at temperatures between -18°C and -22°C according to Walls but the company faces increasing operational expenses because of rising energy costs and unpredictable fuel expenses. Organizations must choose between operating at affordable costs and maintaining quality standards because frozen dessert manufacturing requires flawless quality which limits optimization methods to route optimization and asset management and scheduled maintenance instead of service level adjustments.

The research provides specific solutions which include using affordable IoT temperature tracking systems and route optimization software to protect against the infrastructure related threats that affect Pakistan.

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CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Supply Chain Management (SCM) started as an operational back-office process but it has developed into a strategic business necessity which determines the survival and profitability and competitive advantage of contemporary organizations (Mentzer et al.,2001; Chopra & Meindl, 2016). The wide-ranging field contains Cold Chain Logistics (CCL) which stands as one of its most challenging and expensive and dangerous specializations. The cold chain operates with different requirements than general freight because its breakdowns will cause permanent product deterioration which leads to major financial damage and possible health threats for the public.

The worldwide cold chain logistics industry shows fast growth according to market projections which will reach USD 1,429.5 billion during 2035 (Arifeen, 2012) because people now want more frozen and ready-to-eat products and pharmaceuticals. However, this growth is geographically uneven. The "cold chain gap" exists in Pakistan's developing economy because consumers want temperature-controlled products but the country lacks proper infrastructure to support this demand. The logistics managers in these areas need to handle temperatures above 40°C and they face ongoing power outages and they must navigate through traffic jams which make traditional optimization methods ineffective.

The research investigates how frozen ice cream products move through the supply chain distribution process from distributor warehouses to stores where customers can purchase them. Academic studies identify this stage as the "Last Mile" which proves to be the costliest and least efficient delivery phase because it consumes between 28% and 50% of total transportation expenses (CSCMP, 2013) based on how densely populated the area is and what condition the infrastructure maintains. The delivery process in Pakistan becomes more challenging because bazaar streets maintain their narrow dimensions and daytime operations of heavy vehicles remain impossible and delivery personnel need to stop at numerous small "Kiryanas" (general stores) during their delivery runs.

1.2 Industry Context: The Frozen Food Sector in Pakistan

The Pakistani frozen food market continues to expand rapidly because urban growth becomes more rapid while consumers adopt new eating habits and the rising middle class requires simple product availability (Arifeen, 2012). The market contains three separate segments which include ready-to-cook meals from K&N's and Dawn and Menu and frozen meat/poultry and frozen desserts/ice cream products.

1.2.1 The Ice Cream Segment

The ice cream market in Pakistan operates as an oligopoly because two multinational corporations Unilever (Walls) and Engro Foods (Omore) along with local companies Hico and regional handmade ice cream makers control the market (Unilever Pakistan, 2024). The market competition exists at a high level because businesses face two major challenges from their marketing activities and their product distribution capabilities. Impulse products like ice cream rely heavily on being present in the freezer at the exact moment a consumer desires them. The main factor which determines market share exists as distribution efficiency.

1.2.2 The Unique Challenges of Ice Cream Distribution

Ice cream is a unique commodity in logistics because it has zero tolerance for temperature deviation. The storage temperature ranges of 2°C-4°C works for dairy products and vegetables but ice cream needs to stay at temperatures between -18°C and -25°C according to the WHO (2011). The system will experience "heat shock" when any parameter reaches beyond its defined threshold which will activate three primary issues: The ice recrystallization process results in texture changes and lactose crystallization causes sandiness while the mixture shrinks because of its decreased volume. The product becomes unusable after damage because it cannot regain its original quality through any process of re-cooling. The product suffers an absolute and irreversible loss after damage occurs.

The maintenance of this standard in Pakistan becomes a difficult task because of environmental

and infrastructural challenges which exist in the country.

- Energy Crisis: The frequent power interruptions at cold storage facilities require owners to buy expensive backup power solutions which include diesel generators. The electricity costs which commercial and industrial customers must pay have become unstable because NEPRA conducts periodic rate changes which move cold storage facilities into more expensive commercial electricity categories thus raising their operational expenses (NEPRA, 2025).
- The two cities of Rawalpindi and Islamabad experience major traffic congestion problems. The "Last Mile" requires vehicles to travel through heavy traffic which extends their journey duration while their refrigerated equipment (reefers) must maintain compressor operation at all times.
- The Competition Commission of Pakistan established new labeling standards for frozen desserts and ice cream products which Ghani (2024) states have resulted in product quality deterioration and consumer distrust that requires cold chain systems to meet regulatory requirements and defend corporate reputation.

1.3 Case Company Profile: Arctic Associates

Arctic Associates serves as a dedicated "concessionaire" or authorized distributor for Walls Ice Cream (Unilever Pakistan). The business operates mainly in Rawalpindi/Islamabad territory where it functions as the essential link between Unilever's main logistics network (factory to depot) and the numerous independent retail outlets.

Core Operational Responsibilities:

- Warehousing: Managing a cold storage facility capable of maintaining -25°C to store bulk inventory received from Walls' primary transport. The system needs to track inventory details by FIFO method while it must monitor temperatures at all times.
- Fleet Management: The company uses refrigerated vehicles (reefers) which function as its fleet for conducting secondary distribution operations. The fleet consists of various small and medium-sized vans which were chosen to operate in the restricted street patterns

of the Twin Cities.

- Sales & Merchandising: Ensuring product availability, visibility, and freezer hygiene at retail outlets. The distributor needs to follow the "Perfect Store" standard which Unilever uses as its worldwide retail excellence program.

The distributor operates under the "Concessionaire Model" which gives them exclusive rights to a specific geographic area but demands they spend major funds on building infrastructure (land and cold storage facilities and transportation vehicles). The model demonstrates how distributor interests relate to principal interests because distributors need to reach their sales targets and optimize business operations to succeed.

1.4 Problem Statement

The multinational principal Unilever provides structured support to Arctic Associates yet the company operates in a dangerous business setting. The distribution system faces its main obstacle because its unreliable infrastructure leads to higher maintenance expenses for cold chain systems which endanger both business profitability and supply chain operational stability.

The problem exists in three essential domains which need to be addressed.

1. The distribution network faces thermal integrity risks because it makes many stops at various small retail locations. The process of delivery starts with opening the reefer doors which lets hot outside air (summer temperatures reach 35°C-45°C) into the cargo space. The security system faces its most significant threat through the "door opening" problem which compromises its entire protective system.

2. The current regulatory framework and insufficient transportation infrastructure create operational difficulties which require the fleet to run with restricted hours using small vehicles that consume more fuel than needed for their actual weight of cargo. This increases the cost-per-unit delivered.

3. The operational expenditure (OPEX) faces two major challenges because diesel prices for the fleet continue to rise while electricity costs for cold storage storage facilities increase. The fixed profit margins which distributors maintain according to their principal agreements become less

profitable because of increasing costs unless they achieve better operational efficiency.

The research problem requires Arctic Associates to find the best logistics and transportation variables which will support their required service levels for temperature and availability while preserving their financial performance in Pakistan's difficult market conditions.

1.5 Research Objectives

The research investigates Arctic Associates' cold chain logistics system to identify performance weaknesses and develop cost-effective solutions which maintain product quality.

Specific Objectives:

1. To map the existing cold chain processes from the warehouse to the retailer using the SCOR model framework (Plan, Source, Deliver, Return).
2. The analysis needs to determine which main obstacles and dangerous elements (temperature variations and delivery schedule delays and distribution expenses) affect the present distribution system.
3. The research examines how outside limitations which affect both energy costs and traffic regulations impact operational expenses and delivery operational efficiency.
4. The report will present particular recommendations which assist organizations to enhance their delivery route efficiency and temperature monitoring for better operational results and reduced unnecessary costs.
5. To map Arctic Associates existing cold chain processes using the SCOR model framework

1.6 Research Questions

1. RQ1: The operational model of Arctic Associates follows global industry best practices and SCOR model principles for cold chain distribution to what degree?
2. RQ2: The main internal and external obstacles which impact frozen product delivery efficiency through the "Last Mile" in Rawalpindi/Islamabad need identification.

3. RQ3: What effects do fuel price changes and electricity rate adjustments have on the distribution costs of cold chain logistics operations for the distributor?
4. RQ4: What technological or process interventions can be implemented to reduce spoilage

risks and improve route efficiency?

1.7 Significance of the Study

Academic Significance: The research introduces original findings to the limited academic field which investigates "Cold Chain Logistics in Developing Economies. “Research about cold chain systems in Western countries exists in large numbers but there are no studies which examine the specific conditions of hot temperatures and unstable power supply and different retail distribution patterns which exist in Pakistan. The system connects theoretical models which include VRP and Arrhenius to the unpredictable Pakistani logistics operations.

The research provides distributors such as Arctic Associates with a diagnostic assessment of their business operations. Organizations can directly improve their financial performance through the recommendations which focus on route optimization and cost control. The research delivers complete data about Unilever Pakistan's downstream partners which enables the company to build better support systems and improve its network optimization techniques.

The frozen food industry operates as a growing business sector which creates economic expansion for the nation. The NEPRA tariffs along with other regulatory impacts serve as an advocacy platform which industry stakeholders employ to push for improved industrial policies.

1.8 Operational Definitions

The supply chain system known as Cold Chain operates through a continuous process which maintains specific temperature levels during all storage and distribution steps.

- Last Mile Delivery: The delivery process reaches its conclusion at this stage because goods travel from distribution centers or facilities to their ultimate destination which is the retailer.
- Reefer: A refrigerated vehicle which serves to transport temperature-sensitive goods.
- Eutectic Plates: The delivery truck industry uses passive cooling systems which contain phase-change liquid plates that freeze during nighttime operations to produce cooling power for the following day while minimizing the requirement for engine-driven

compressor operation.

- The SCOR Model functions as an organizational management system which helps businesses improve their supply chain decisions by implementing better communication networks.
- Load Shedding: Deliberate shutdown of electric power in parts of a power-distribution system, generally to prevent the failure of the entire system when the demand strains the capacity of the system.

CHAPTER TWO: RELEVANT STUDIES AND THEORIES

2.1 Theoretical Framework: The SCOR Model

The Supply Chain Operations Reference (SCOR) model which the Supply Chain Council (Supply Chain Council, 2012) created functions as the main theoretical framework for this research. The SCOR system enables organizations to describe their supply chains through five fundamental processes which include Plan and Source and Make and Deliver and Return. It allows organizations to assess and improve their supply chain reliability, responsiveness, agility, cost, and asset management efficiency.

The distribution entity Arctic Associates needs to perform its operations through this particular organizational structure.

Table2.1

Mapping SCOR Processes to Cold Chain Functions

SCOR Process	Definition	Application at Arctic Associates (Cold Chain)
Plan	Balancing aggregate demand and supply to develop a course of action.	Route planning, fleet scheduling based on seasonality (summer vs. winter demand), and inventory forecasting.
Source	Procuring goods to meet planned or actual demand.	Receiving bulk ice cream from Walls' factory, verifying temperature upon receipt, and transferring to cold storage.
Deliver	Providing finished goods to meet customer demand.	Order management, transportation management (fleet operations), and distribution to retail outlets (Last Mile).
Return	Returning or receiving returned products.	Managing "Reverse Logistics" for spoiled, damaged, or expired stock. In cold chain, returns often imply wastage due to temperature abuse.

Application to Case: The research applies to the SCOR model to break down all operational activities of Arctic Associates. The "Deliver" process metrics "On-Time in Full" (OTIF) and "Perfect Order Fulfillment" help us measure their performance against industry-defined benchmarks. The frozen sector needs to concentrate on its "Return" process because high return rates show that the cold chain system failed to maintain its integrity.

The SCOR (Supply Chain Operations Reference) model is applied in this study to systematically map and analyze the cold chain logistics operations of Arctic Associates. The model breaks down supply chain activities into four relevant processes for this case: Plan, Source, Deliver, and Return. At Arctic Associates, the Plan process involves demand forecasting, route planning, and fleet scheduling based on seasonal demand fluctuations. The Source process refers to receiving ice cream products from Walls' manufacturing facilities, verifying temperature compliance, and transferring inventory into cold storage under FIFO principles. The Deliver process represents the most critical stage, encompassing refrigerated transportation, last-mile delivery, route optimization, and strict temperature control during retail deliveries. Finally, the Return process addresses reverse logistics, including the handling of spoiled, damaged, or expired products, which directly indicates cold chain failures. By mapping these activities using the SCOR framework, the study establishes a structured understanding of Arctic Associates' cold chain operations and identifies performance gaps related to transportation efficiency, temperature integrity, and cost control.

2.2 Cold Chain Logistics Management (CCLM)

Standard logistics operates with different methods than cold chain logistics because it needs to preserve the freshness of perishable items during delivery. The quality of frozen food depends on both the duration of storage and the storage temperature. The cold chain system depends on its most vulnerable point for its entire strength because any temperature deviation will shorten product shelf life and make the product dangerous for consumption (WHO, 2011; Defra, 2010).

The "Last Mile" Vulnerability:

Academic research indicates that the last mile delivery process functions as the most vulnerable link which exists in the entire supply chain system. The retail development stage in developing

nations features multiple independent stores which operate as "mom-and-pop" businesses while the roads remain in poor condition and retailers do not have receiving facilities. The process requires delivery vehicles to find street parking where they face direct sunlight while staff must move packages by hand which leaves them vulnerable to heat from the environment. The combination of hot temperatures and high humidity in densely populated tropical cities leads to faster food spoilage which demands additional power to keep food at desired temperatures.

2.3 The Vehicle Routing Problem (VRP) in Perishable Logistics

The Vehicle Routing Problem (VRP) stands as a core problem which falls under combinatorial optimization within the field of optimization problems. In the context of cold chains, it becomes the Cold Chain Vehicle Routing Problem (CCVRP)(Hsu et al.,2007; Chopra & Meindl, 2016). The main goal extends beyond reducing travel distances because it requires organizations to reduce their total operational expenses which consist of.

1. Transportation Cost: Fuel and driver wages.
2. The cost of refrigeration depends on the amount of energy needed to keep temperatures stable during transportation which grows longer with each passing day.
3. The product value inside the refrigerated truck decreases through time because of internal degradation which causes damage to the products.

The 2024 and 2025 research added "Carbon Emissions" and "Energy Consumption" to these models because reefer units need to burn large amounts of fuel. The route optimization system at Arctic Associates serves two essential purposes because it minimizes fuel usage and allows for on-time delivery of products before heat damage affects their products. Research shows that automated route planning systems produce superior results than human-created plans because they minimize delivery costs and boost delivery speed which aligns with the needs of this research.

2.4 Temperature Kinetics and Shelf Life: The Arrhenius Model

Effective temperature control is fundamental to frozen food logistics because product quality degradation is directly influenced by temperature fluctuations. To explain the scientific basis of this relationship, the Arrhenius equation is commonly used in food science to model the effect of temperature on the rate of chemical and physical degradation processes (Van Boekel, 2008; Singh & Heldman, 2014).

The model shows that temperature increases at any level will trigger a significant rise in degradation rate which results in fast product quality deterioration when temperatures rise. The fast deterioration of frozen products like ice cream becomes visible through three main physical transformations which include ice recrystallization and texture deterioration and deterioration of sensory attributes.

The Arrhenius model from cold chain logistics shows that brief temperature changes which occur during transportation will result in lasting damage to product quality. The delivery delay exposure to high temperatures will decrease product stability levels before the product gets stored in frozen conditions. Studies about ice cream stability show that ice cream develops permanent structural damage when it endures multiple or extended periods of temperature changes which leads to

unhappy customers and damage to brand reputation (Van Boekel, 2008).

The scientific evidence confirms that exact temperature control and rapid delivery systems and strict handling protocols need to be maintained for operational requirements. The system enables the Logistics Manager to execute Standard Operating Procedures exactly while he optimizes delivery paths because Pakistan faces severe traffic issues and hot climate which complicates temperature management. The maintenance of continuous cold chain conditions stands as a scientific necessity which protects product quality and extends shelf life.

2.5 The Pakistani Context: Infrastructure and Regulatory Landscape

The operational environment of Pakistan contains distinct elements which differ from what Western military studies usually present.

Energy Crisis and Tariffs:

The nation of Pakistan experiences ongoing power supply deficiencies. "Load shedding" (planned power outages) forces cold storage operators to rely on backup diesel generators, which produce electricity at a significantly higher cost per unit than the grid (NEPRA, 2025). The NEPRA faces criticism because it places cold storage facilities under "Commercial" instead of "Industrial" tariff categories. The commercial tariff implementation which started in late 2024 and 2025 led to increased business costs which caused companies to sue the government and organize street protests.

Traffic and Regulatory Bans:

The cities of Islamabad and Rawalpindi enforce complete vehicle restrictions for heavy traffic during their peak daytime hours which span from 7 AM until 11 PM because of security requirements and VIP events. This compels distributors to either use fleets of smaller, less efficient vans (which are exempt from some bans) or operate during night/early morning windows, which may not align with retailer operating hours.

Fuel Price Volatility:

The expenses for logistics operations directly relate to current fuel price levels. The High-Speed

Diesel (HSD) market in Pakistan underwent significant price fluctuations during the last months of 2024 and throughout 2025 because this fuel functions as a vital power source for transportation vehicles and backup power systems (Global Petrol Prices, 2025). The unsteady fluctuations in product costs make it difficult for distributors to estimate their expenses while developing their business financial plans.

2.6 Competitor Analysis and Market Structure

The market is an oligopoly dominated by Walls (Unilever) and Omore (Engro Foods) (Unilever Pakistan, 2024).

- **Walls**: The system operates through a "Concessionaire" model which uses third-party distributors Arctic Associates for wall management as their distributors. Walls operates an advanced cold chain system which focuses on achieving flawless store operations and maintaining distributor adherence to company standards.
- **Omore**: The company introduced its products through independent distributors when it entered the market in 2009. The company Omore operates with limited cold chain capabilities than Walls but provides customers with affordable pricing and extensive freezer network.
- **Hico** operates as a heritage brand which established itself in 1952 to handle its limited distribution network from a single location. Hico faces challenges in scaling up to the extensive reach of Walls due to limited resources for cold chain investment.

The Competition Commission of Pakistan (CCP) has introduced new rules about "frozen dessert" and "ice cream" product labels which require businesses to improve their product quality to protect their brand reputation. The distributor upholds product quality through their vital operations because Unilever and Engro need to provide high-end products to customers following the negative public reaction.

The research literature together with theoretical frameworks enable us to create a conceptual framework which demonstrates how cold chain logistics elements affect operational methods to

produce distribution results for frozen products.

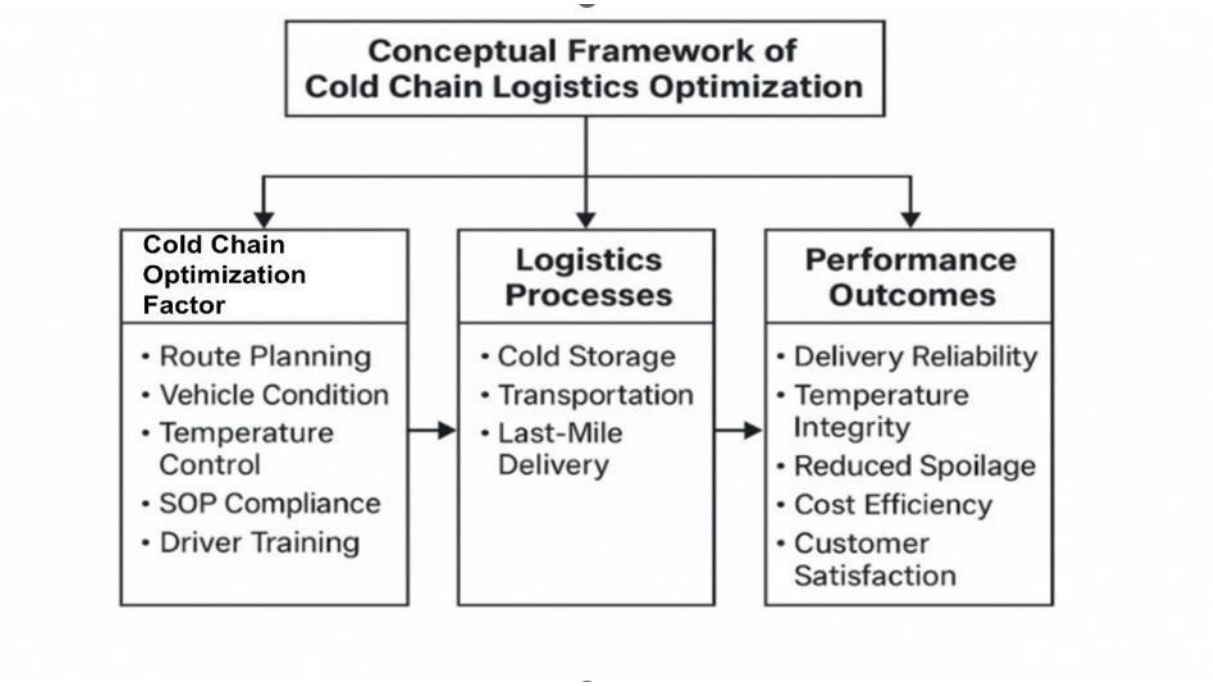


Figure 2.6: Conceptual Framework of Cold Chain Logistics Optimization

The framework shows how route planning and vehicle condition and temperature control and Standard Operating Procedure compliance and driver training affect logistics operations which include cold storage and transportation and last-mile delivery. The combination of these processes leads to performance results which include reliable delivery and proper temperature maintenance and minimized food waste and lower expenses and happier customers.

CHAPTER THREE: METHODS AND TECHNIQUES

3.1 Research Design

The research design of this study employs qualitative case study methods to analyze Arctic Associates' efficient cold chain logistics and transportation operations as their authorized Walls Ice Cream distribution partner. The research benefits from case study methodology because it allows researchers to observe operational processes as they exist in their natural business environment (Yin, 2018). The complete analysis of cold chain logistics needs to understand how transportation systems work with temperature management and human actions and natural environment elements which quantitative methods fail to measure.

The research design uses qualitative methods to study operational problems and managerial choices and performance management systems in detail. The research employs qualitative methods to study present logistics operations because it needs to assess current practices for developing better systems. The method allows researchers to collect data in different ways while providing complete insights about actual cold chain management systems that operate under various real-world conditions including traffic congestion and extreme weather and insufficient infrastructure and electricity disruptions.

The research investigates Arctic Associates as a single case to study the temperature-dependent supply chain which requires perfect cold chain management to stop food waste and monetary damage. The research provides operational knowledge about business logistics management through its study of one organization that operates in real business environments.

3.2 Research Approach

The research uses qualitative methods to study actual organizational environments by analyzing their operational systems and management approaches and their logistical difficulties. The qualitative research method allows researchers to study cold chain logistics operations by conducting in-depth analyses of operational components which control the system. The research method works well for supply chain studies because it demonstrates how operational systems

connect with human decisions and environmental elements.

The research shows that cold chain operations depend on multiple elements which include route optimization and temperature management and driver conduct and infrastructure quality and brand standard adherence. Researches use qualitative methods which include manager interviews from logistics planning and control to enhance their understanding of complex systems because these systems cannot be measured through structured surveys and statistical models.

The qualitative research method allows researchers to modify their data collection procedures when they discover fresh problems which appear during their investigation. The researcher conducted field research at Arctic Associates to study their logistics management system which provided access to operational difficulties and risk reduction strategies and cold chain delivery enhancement programs. The research method of qualitative analysis uses exploratory techniques which generate findings that stem from the research environment and produce exact results.

Moreover, the qualitative approach supports the integration of primary data obtained through interviews with secondary data from academic literature and industry practices. The research achieves better validity through triangulation because it unites managerial results with established theories and industry-based standards which stem from cold chain logistics and transportation efficiency.

3.3 Data Collection Method

The research data for this study emerged from semi-structured interviews which scientists commonly employ during qualitative case study investigations. The research method enables researchers to obtain detailed information while they can study essential operational problems which emerge through interview interactions. The specific needs of cold chain logistics require semi-structured interviews as the best approach to collect essential and detailed information.

The Business Manager who oversees operations and logistics at Arctic Associates participated in this interview. The research team chose this person to serve as their key informant because he actively participates in all aspects of cold chain operations including route optimization and fleet monitoring and warehouse management and Walls' quality and temperature standards

enforcement. The manager position of the respondent provided him with complete knowledge about company operations which enabled him to create strategic plans.

The research team created a pre-designed structured interview questionnaire which served as a guide for collecting data. The survey contained questions which focused on essential aspects of cold chain management including operational procedures and transportation speed and temperature maintenance methods and delivery quality and food waste control and operational difficulties and plans for enhancement. The questionnaire established a defined format yet the semi-structured approach enabled researchers to request additional information and confirm understanding of participants' responses which resulted in more detailed and reliable data collection.

The research team collected data through interview responses and they analyzed this information using observational data. The company trained staff about delivery operations and route optimization methods and temperature management techniques based on management guidelines. All data was collected for academic purposes only, and confidentiality of the organization and respondent was maintained throughout the research process.

3.4 Sampling Technique

The research design used purposive sampling as its method to select participants for this qualitative case study investigation. The research method of Purposive sampling requires researchers to choose participants who have direct knowledge and experience and authority about the research subject. The research method proved suitable because the study aimed to understand cold chain logistics operations at a particular organization rather than making population-wide generalizations.

The selection of the respondent was based on managerial responsibility and direct involvement in logistics decision-making. The Business Manager at Arctic Associates proved to be the best participant for this study because he directly managed all aspects of cold chain operations and transportation planning and fleet management and warehouse operations and Walls' quality and temperature standards compliance. This position provided access to strategic as well as operational-level information required for the study.

The research objectives received data that was both information-rich and directly relevant through the implementation of purposive sampling. The collection of data from unqualified personnel who lack operational expertise in cold chain logistics would have produced less reliable and less relevant results. The research results became more valid because the study focused on a single essential decision-maker.

The research uses a single participant for its foundation although this matches the case study method which focuses on obtaining detailed information instead of working with numerous participants. The respondent performs a wide range of operational duties which enables us to study cold chain logistics practices at Arctic Associates even though the sample size is small.

JUSTIFICATION OF SAMPLE

The study involved one key respondent, the Business Manager (Operations & Logistics) at Arctic Associates. The respondent was sufficient due to his direct oversight of all cold chain, transportation, and warehouse operations.

3.5 Research Instrument (Questionnaire Design)

The research instrument of this study used a structured questionnaire which participants completed through semi-structured interview sessions. The questionnaire contained particular questions which aimed to obtain specific data about cold chain logistics and transportation efficiency at Arctic Associates. The research design followed the study objectives while considering the actual conditions which frozen product delivery operations encounter. Data were collected using a questionnaire composed of open-ended questions that addressed key aspects of cold chain logistics, including organizational background, cold chain processes, transportation practices, temperature management, delivery performance, spoilage and waste, operational challenges, performance monitoring, and future improvement strategies. The open-ended questioning method enabled participants to share their entire experiences because it did not restrict their responses to particular answer options.

The questionnaire achieved better content validity through its development process which involved thorough analysis of previous studies about cold chain logistics and supply chain efficiency and transportation management. The research study investigated essential problems which included temperature integrity and last-mile delivery issues and route optimization and logistics performance assessment methods to achieve complete analysis of the research subject. The

research framework combined theoretical rigor with practical data collection through this literature-informed method.

The survey followed a logical sequence which started with general organizational information before progressing to more specific operational and analytical questions. The research team conducted semi-structured interviews which followed their established format to discover new findings that appeared during the study. The researchers achieved better data through flexible design methods which produced more reliable research findings.

3.6 Data Analysis Method

The research team performed a qualitative thematic analysis on their semi-structured interview data through the method which Braun and Clarke (2006) described. The research team chose thematic analysis because this method enables them to identify and understand patterns and themes which exist in their qualitative data. The research method works best for logistics and supply chain management case studies because it reveals operational and managerial knowledge which stems from actual business practices.

The research started by completely understanding all information present in the interview transcripts. The research team organized the collected responses into sections which matched the research goals about cold chain management and transportation optimization and temperature control and delivery performance and spoilage prevention and operational challenges. The researchers established their initial codes through these data points which became the starting point for their subsequent analytical work.

The research team analyzed these themes by applying theoretical frameworks which the literature review established for cold chain logistics principles and transportation efficiency theories and supply chain performance models. This theory-driven interpretation linked empirical findings to existing academic knowledge, enhancing the study's analytical depth and demonstrating how current operational practices influence overall system performance.

The research team used descriptive analysis to study operational data which contained delivery performance data and temperature management outcomes and product deterioration statistics. The research bases its findings on descriptive analysis of operational data instead of statistical methods which enables researchers to compare different cold chain performance indicators. The research employed dual analytical methods which integrated data-based results with theoretical foundations

to produce its results.

SWOT and PESTLE analyses were used as qualitative strategic analysis tools to support findings and develop recommendations. SWOT was used to evaluate internal and external organizational factors, while PESTLE assessed macro-environmental influences affecting cold chain logistics.

3.7 Ethical Considerations

The research process followed ethical principles to protect both the academic worth and the research credibility and integrity of the study. The research needed business organization data so the team worked to defend sensitive information while getting necessary approval and handling data with care.

The researcher explained the research objectives to the participant before starting the data collection process. The participant was informed that the research was being conducted strictly for academic purposes as part of a Bachelor of Business Administration Final Year Project. The research team started participant interviews after participants gave their consent to start data collection. The respondent was assured that no sensitive or proprietary information would be disclosed.

The research maintained confidentiality through its use of generic financial data instead of revealing actual numbers and it avoided showing both internal system images and all confidential operational information. Information provided by the respondent was presented in an aggregated and descriptive manner, ensuring that the organization's competitive position and internal policies were not compromised. The research team disclosed operational details only when essential for the study but this approach did not affect the research findings or their accuracy.

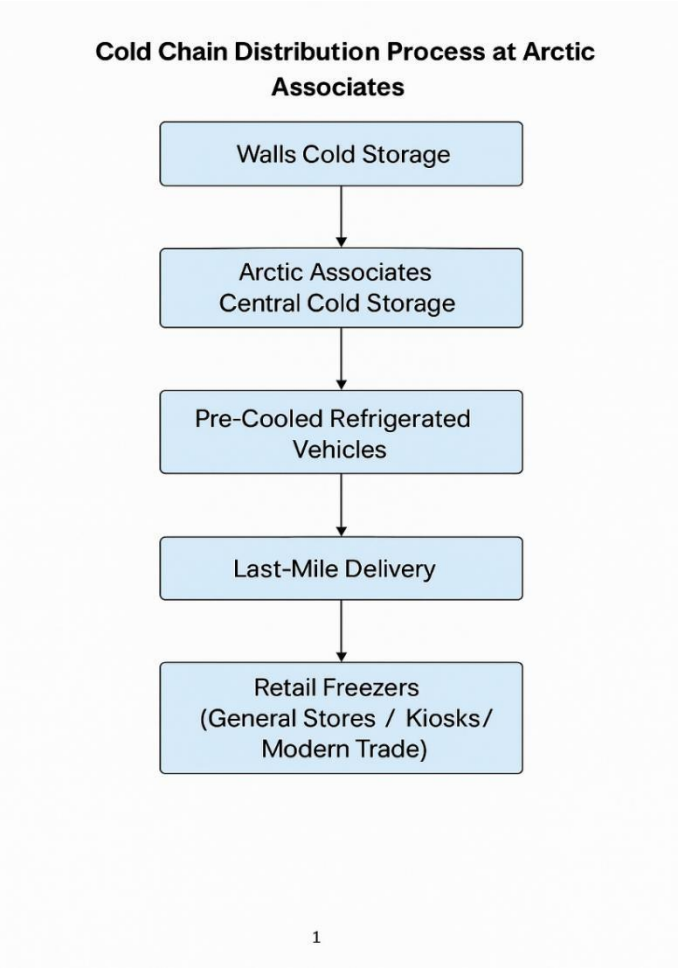
The researcher verified all secondary data sources from academic journals and books and industry reports through proper APA referencing style citation. The research team avoided plagiarism through their correct paraphrasing of information and their proper use of published literature. The research findings became more reliable because the study used ethical research methods which met both academic standards of Bahria Business School and research ethics.

CHAPTER FOUR: ANALYSIS AND FINDINGS

4.1 Overview of Cold Chain Operations at Arctic Associates

The cold chain operations at Arctic Associates operate through a temperature-controlled system which provides fast and efficient frozen product delivery across their service region. The authorized distribution partner Walls Ice Cream requires Arctic Associates to store their products in a warehouse which maintains cold temperatures for both storage and transportation until the final delivery step. The operational design shows that ice cream products need precise temperature control because hot environments with limited facilities create conditions which make them susceptible to temperature changes.

The central cold storage facility begins cold chain operations by keeping frozen products at temperatures between −18°C and −22°C. Inventory is managed using a First-In, First-Out (FIFO) system to reduce the risk of quality deterioration. The refrigerated trucks need to be pre-chilled before dispatch because this process helps keep the temperature stable during the loading process. The loading process takes place at insulated docking facilities which help reduce workers' contact with outside temperatures because summer heat conditions require special attention to refrigeration system performance.



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The delivery vehicles operate with diesel-powered refrigeration units which maintain temperature stability during all stages of transportation through their insulated cargo compartments. The company bases its delivery routes

on three factors which include outlet density and delivery speed requirements and delivery distance between locations. The delivery schedule operates with flexibility because it needs to handle traffic congestion and weather conditions and changes in market customer needs.

The last stage of cold chain operations which is known as last-mile delivery stands as the weakest link in the entire system. The risk of temperature deviations increases because customers tend to open doors while retail locations need extended unloading times and staff members need to handle products throughout longer periods. The company Arctic Associates established complete Standard Operating Procedures (SOPs) which control door-opening methods and demand instant product relocation to retail freezer storage facilities. The system maintains compliance through active supervisor monitoring which works together with retail partners who maintain close coordination.

The cold chain operations of Arctic Associates follow the Deliver phase which is part of the Supply Chain Operations Reference (SCOR) model. The system operates through three core functions—transportation planning, temperature monitoring, and delivery control—to ensure product quality and operational continuity. The preventive controls system establishes operational stability through its structured framework yet external factors can cause interruptions to normal business activities.

4.2 Delivery Performance and Transportation Efficiency Analysis

The delivery performance serves as a crucial performance metric which enables cold chain logistics to evaluate transportation efficiency because delayed deliveries will increase refrigeration needs and fuel consumption while endangering temperature maintenance. The delivery performance at Arctic Associates gets its main assessment from three factors which include following scheduled delivery times and finishing routes on schedule and receiving feedback from retailers. The research shows that delivery operations finish their tasks on schedule because the company uses optimized routes and standardized operational procedures throughout its entire network.

The delivery time for average customers depends on the distance of their delivery route and the number of outlets they need to visit and the current traffic situation. The delivery pattern in urban areas with heavy foot traffic needs brief stops which occur regularly but semi-urban delivery routes need extended routes between fewer delivery stops. The delivery process follows its scheduled timeline because logistics supervisors use their flexibility to modify delivery paths and make rapid choices. The system maintains delivery reliability because it adjusts its operations based on unpredictable road and traffic conditions.

The main reason for occasional delivery delays stems from traffic congestion and weather conditions and inadequate road conditions and small equipment problems. The performance of cold chain operations becomes worse because of traffic congestion which creates additional problems. The longer duration of travel operations requires more refrigeration time which results in higher fuel costs and operational expenses. The research results confirm transportation efficiency theory because they show that supply chain operations which require quick delivery face increased logistics costs because of route congestion that causes delivery delays. Route optimization functions as a core system which improves delivery operational efficiency. The outlet clustering system at Arctic Associates employs delivery priority data with location information to eliminate unnecessary delivery routes which shortens the total distance drivers must travel. This approach reflects Vehicle Routing Problem (VRP) principles by improving service quality while lowering transportation costs.

The research data shows that route optimization programs have achieved two main goals by making delivery times more consistent and by creating reliable schedules which function well under high demand conditions. The delivery performance tracking system monitors performance by using delivery reports which supervisors and retailers evaluate through feedback. The system bases its performance assessment on time windows instead of traditional deadlines which allows flexible operations while preserving service quality consistency. The method works best for Pakistan's cold chain distribution system because it handles the many unpreventable external interruptions which occur in this environment.

The research shows Arctic Associates achieves transportation efficiency through its scheduled system which uses flexible execution methods together with continuous performance tracking. The

implemented measures help organizations maintain operational control but delivery delays continue to occur because of insufficient infrastructure and environmental restrictions. The research results establish a base which will be used to study temperature compliance and spoilage patterns in the following part of this chapter.

4.2.1 Thematic Analysis of Interview Data

The researchers used thematic analysis to analyze qualitative data which they obtained through semi-structured interviews. The method allowed managers to group their responses into separate categories which revealed common patterns which delivered important insights about cold chain management and transportation efficiency at Arctic Associates. The researchers applied theme organization to convert unstructured interview data into structured categories which allowed them to conduct thorough analytical assessments.

The research team evaluated interview responses through coding which focused on essential logistics operations including temperature management and route optimization and delivery problems and expense optimization and product quality maintenance. The researchers organized their first set of codes into essential categories which represent the main elements that determine cold chain operational success. The researcher applied this method to study statements which revealed persistent operational patterns which exist throughout the entire logistics system.

The research identified essential factors which determine cold chain success through its thematic analysis. The research identified four essential factors which affect cold chain operations through its analysis of last-mile delivery risks and operational standards and transportation performance and product quality maintenance. The analysis organizes interview data into themes which establish a direct connection between managerial insights and the research results presented in the following sections of this chapter.

Table 4.1 presents a summary of the thematic coding derived from the interview responses.

Interview Dimension	Sample Interview Evidence (Paraphrased)	Initial Code	Final Theme
Cold chain management	Temperature must be maintained from warehouse to retail without interruption	Temperature Maintenance	Cold Chain Discipline
Transportation efficiency	Traffic congestion and road conditions increase delivery time and fuel usage	Delivery Delay	Transportation Constraints
Route planning	Routes are adjusted daily based on demand, traffic, and weather conditions	Route Flexibility	Transportation Optimization
Last-mile delivery	Frequent door openings during unloading increase temperature exposure risk	Handling Exposure	Last-Mile Vulnerability
Temperature control	Vehicles are pre-cooled and unloading time is strictly controlled	Thermal Control	Temperature Integrity
Spoilage and returns	Product returns are rare and mainly linked to temperature deviation	Product Loss	Quality Preservation
Cost management	Fuel consumption increases during congestion and extreme heat	Cost Pressure	Operational Cost Sensitivity
Fleet maintenance	Preventive maintenance reduces breakdowns and refrigeration failures	Equipment Reliability	Operational Continuity

SOP compliance	Drivers follow strict SOPs for loading, transportation, and unloading	SOP Adherence	Operational Control
Training	Drivers are trained in temperature handling and emergency response	Skill Development	Human Resource Capability

4.3 Temperature Control and Compliance Analysis

The primary requirement for frozen product logistics demands temperature control because short periods of temperature fluctuation will harm both product quality and brand reputation. The temperature compliance system at Arctic Associates depends on three elements which include reliable equipment and strict procedures and ongoing surveillance during all storage and transportation operations. The required temperature ranges for frozen products, between –18°C and –22°C, is consistently emphasized across all operational stages.

The case study results show that temperature changes during transportation occur infrequently and they remain brief in duration. The company reached this result through various operational controls which used pre-cooled refrigerated vehicles and insulated loading areas and particular unloading procedures to defend products from external temperature variations. The vehicles run with diesel-powered refrigeration units and insulated cargo bodies which provide continuous cooling during traffic delays and extended delivery times.

The process of last-mile delivery creates temperature compliance problems because customers need to open their doors multiple times while retailers handle the packages which extends the time until the packages reach their final destination. The Standard Operating Procedures at Arctic Associates require door opening times and immediate product movement to retail freezers because these procedures help reduce potential risks. The training program for drivers teaches them to maintain temperature stability instead of rushing with deliveries because the company values quality above all else. The system maintains compliance through two operational systems which perform supervisory checks and retailer coordination.

The operating environment of refrigeration systems experiences elevated summer temperatures

which produce higher refrigeration requirements that lead to increased fuel usage. The interview results show that temperature monitoring needs to happen more often when ambient temperatures rise because the situation needs complete process control to stop temperature changes. The observed results match the temperature degradation theory which demonstrates that external temperatures above freezing point will speed up thermal stress development to cause frozen product quality degradation. The company Arctic Associates has kept its temperature-related return rates at a minimum because it has established successful control systems.

Arctic Associates operates under food safety and cold chain guidelines from Walls which the company enforces through internal audits and staff training and regular facility inspections. The team performs regular temperature compliance data reviews through weekly and monthly performance evaluations which allow them to take immediate action when temperature deviations happen. The research shows that Arctic Associates temperature control systems function properly in difficult environmental and infrastructure situations.

4.4 Spoilage and Wastage Analysis

The effectiveness of cold chain operations becomes apparent through product spoilage and wastage which leads to major financial losses when frozen products are distributed. The supply chain of Arctic Associates maintains low levels of spoilage and returns because their temperature control systems and route planning and handling procedures work well together. The system tracks all waste output at all times because it affects both business expenses and merchant trust in the system.

The main elements which lead to product spoilage and return incidents include short temperature changes and wrong cargo management during receipt of shipments and occasional machine failures. The delivery process becomes more susceptible to these incidents because delivery times extend because of power outages and traffic congestion and when delivery areas experience harsh weather conditions. The organization uses preventive maintenance practices and emergency response procedures which successfully reduce the number of spoilage incidents and their resulting severity.

The logistics team performs performance assessments through their scheduled work activities

which include waste data documentation and waste management data evaluation. The collected data helps management teams to detect current problems while they monitor driver route performance and their adherence to Standard Operating Procedures. purposes because it enables operational success and creates strategic value which helps maintain customer loyalty and enhances distributor reputation across the Walls distribution network.

4.5 SWOT Analysis of Arctic Associates

The SWOT analysis evaluated Arctic Associates' internal capabilities and weaknesses together with outside elements which affect its cold chain logistics business operations. The evaluation process creates a strategic framework which shows the current market position of the company for frozen product distribution.

Strengths

The main strength of Arctic Associates exists because of its partnership with Walls Ice Cream which provides the company with exact operational direction and established quality standards and market expertise. The company follows disciplined cold chain practices through its temperature control systems and scheduled maintenance of refrigerated vehicles and established Standard Operating Procedures (SOPs). The system allows users to establish multiple delivery routes which together with their logistics knowledge provides reliable service throughout active urban regions. The company achieves consistent service quality through its driver training program and scheduled performance checks which minimize product spoilage and waste.

Weaknesses

The company maintains operational excellence but it has specific internal barriers which affect its performance. Organizations cannot use basic logistics tools because these tools do not provide real-time monitoring capabilities and they cannot process complex performance data for analysis. The expensive nature of advanced technology systems which include real-time temperature tracking systems and fleet optimization software makes their quick deployment impossible. The organization depends on individual managerial oversight for its operations which creates potential continuity risks when essential staff members become unavailable. The last part of delivery

operations creates operational difficulties because delivery staff must enter buildings repeatedly while customers face longer wait times because store personnel need to assist them.

Opportunities

The company Arctic Associates has multiple chances to improve its cold chain operations. Organizations can improve their operational decision-making through better visibility which results from using affordable digital monitoring tools and route optimization solutions. The increasing frozen food demand from urban and semi-urban consumers enables businesses to create new distribution systems while they build more retail locations. The last-mile handling operations will achieve higher efficiency because retailers will organize their activities and their staff members will participate in training programs. The company needs to keep its relationship with Walls because it will help them develop better operational methods and introduce innovative technological solutions which will create sustainable business growth.

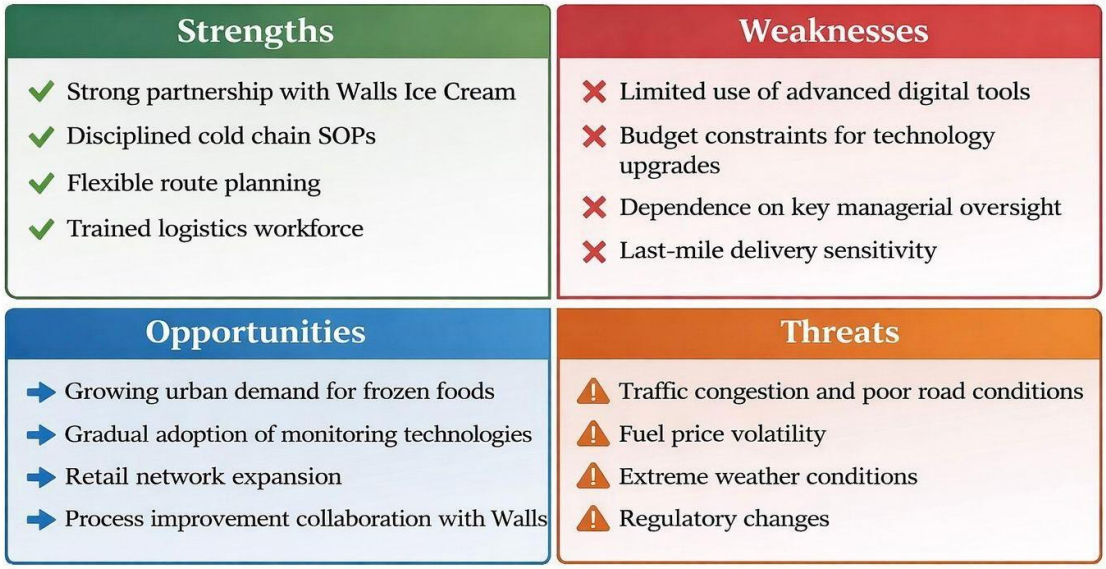
Threats

The organization faces its primary external threats because of its built environment together with its natural surroundings. The combination of traffic congestion and poor road conditions and hot temperatures and power system instability creates higher operational risks which also drive up business expenses. Fuel price volatility and rising energy costs further impact transportation efficiency. The company needs to address compliance issues which stem from regulatory inspections and new food safety regulations and competition policy modifications. The organization needs to develop flexible operational methods which will help them handle these uncontrollable elements.

Overall, the SWOT analysis highlights that while Arctic Associates possesses strong operational capabilities and strategic partnerships, sustained performance depends on managing infrastructural constraints and gradually strengthening technological and organizational resilience. Overall, the SWOT analysis highlights that while Arctic Associates possesses strong operational capabilities and strategic partnerships, sustained performance depends on managing infrastructural constraints and gradually strengthening technological and organizational resilience.

Table4.2

SWOT Analysis of Arctic Associates



4.6 PESTLE Analysis of Cold Chain Operations in Pakistan

To better understand Arctic Associates' operating environment, a PESTLE analysis was conducted to assess the political, economic, social, technological, legal, and environmental factors affecting cold chain logistics and transportation efficiency in Pakistan. The research investigates which outside factors affect the countrywide distribution of frozen products.

Political Factors

The cold chain operations face direct influence from government policies which regulate food safety and control energy prices and construct transportation infrastructure. The Competition Commission of Pakistan along with food safety departments exercises regulatory control which impacts how products are labeled and affects their quality standards and their availability in the market. The process of infrastructure development becomes delayed because of political instability which also leads to policy changes that create problems for future logistics planning.

Economic Factors

The current economic conditions determine the success level of logistics operations in their operational tasks. The cost of transportation and refrigeration operations rises because of rising fuel prices and unstable exchange rates and expensive energy costs. The operating margins of distributors face challenges because of inflation which restricts their capacity to acquire modern technological solutions. The growing economy together with shifting urban development patterns drive up frozen food consumption which creates opportunities for business growth but also generates financial difficulties.

Social Factors

The growing number of consumers who want to change their lifestyle and move to cities and their increasing interest in buying frozen food products with brand names has created higher needs for dependable cold chain distribution systems. The increasing customer need for dependable product quality and non-stop availability requires distributors to maintain their cold chain operations at all times. The logistics execution process follows retailer instructions which need both quick delivery services and reliable freezer systems.

Technological Factors

Technology advancement brings about fresh challenges which simultaneously produce possible beneficial outcomes. The market provides sophisticated cold chain monitoring systems which include GPS tracking and route optimization but these solutions are inaccessible because they need substantial financial resources and expert knowledge to operate. Basic systems remain the preferred choice for numerous distributors because they fail to solve the present-day difference between available technology features and distributor implementation procedures. The main challenge for development involves the slow process of technology implementation.

Legal Factors

The operations of cold chain systems must follow all applicable food safety regulations and quality standards and labor laws and transportation rules. Businesses must follow temperature regulations and maintain proper hygiene standards and correct product labeling requirements according to the law. The company faces three types of consequences when it fails to meet its obligations which

include paying penalties and suffering from negative brand perception and losing business with its brand partners. Organizations function through systems which rely on their knowledge of legal systems and their ability to execute these rules.

Environmental Factors

Environmental conditions pose some of the most significant challenges to cold chain logistics in Pakistan. The operation of refrigeration systems becomes more demanding because hot outside temperatures during summer season raise both their cooling requirements and their need for fuel. Transportation operations become unstable because climate variability and extreme weather events create problems which affect both schedule maintenance and infrastructure dependability. The environmental movement requires both energy-efficient refrigeration systems and sustainable delivery methods according to its principles.

The PESTLE analysis shows that Pakistani cold chain logistics functions under multiple difficult elements which exist in the broader business environment. Organizations can expand their markets through economic development and changing social patterns but they need adaptable strategies to manage their infrastructure needs and environmental issues and regulatory compliance.

Table 4.3

PESTLE Analysis of Cold Chain Operations in Pakistan

FACTOR	KEY IMPLICATIONS
POLITICAL	Food safety regulations and energy policies affect operations
ECONOMIC	Fuel price volatility and inflation increase logistics costs
SOCIAL	Growing demand for branded frozen foods raises quality expectations
TECHNOLOGICAL	Limited adoption of advanced tracking and monitoring systems
LEGAL	Compliance with food safety and labeling regulations is mandatory
ENVIRONMENTAL	High temperatures increase refrigeration load and spoilage risk

CHAPTER FIVE: DISCUSSION AND PROJECT BENEFITS

5.1 Operational Benefits of Cold Chain Optimization

The cold chain optimization at Arctic Associates has brought about major advancements in their logistics and transportation operational efficiency. The system provides better operational reliability because it maintains better temperature control throughout storage and delivery operations to reach final distribution points. The research data in Chapter Four shows that operational management system enhancement occurs through planned route optimization and pre-cooled vehicles and the rigid execution of Standard Operating Procedures (SOPs).

The new routing system allows delivery vehicles to visit more outlets during their scheduled time because it reduces unneeded driving and removes duplicate delivery routes. The system now provides products with better reliability because traffic and environmental factors can no longer interrupt its operations. The system enables users to make route changes on a daily basis through its analysis of customer needs and traffic conditions which results in enhanced operational speed and better service delivery.

The system operates with better efficiency because it unites warehouse management with store delivery control and transportation management. The most susceptible part of the cold chain exists at the last delivery stage but scheduled operations together with proper vehicle loading and unloading procedures help protect temperatures. The combined system has achieved better temperature control and it now operates with greater stability in its overall process.

The logistics performance benefits from preventive maintenance programs which integrate with vehicle supervision systems that operate through established protocols.

The proactive identification and resolution of small mechanical and refrigeration problems at Arctic Associates has successfully minimized both equipment failures and delivery delays. The system now operates with better continuity during its most demanding times which occur during summer months.

The cold chain optimization system at Arctic Associates has improved their daily business operations through its enhanced process management which delivers faster response times. The

operational advantages established in this section serve as the basis for additional financial and quality and strategic benefits which will be explored in the following sections of this chapter.

5.2 Cost Efficiency and Financial Benefits

The cold chain optimization at Arctic Associates brought two main advantages to logistics operations through improved cost management and better financial control. The study reveals that better transportation methods and temperature management systems have decreased multiple essential expenses which frozen goods distribution operations face.

The system provides the main financial benefit through its ability to minimize fuel waste because it creates the most efficient delivery paths and enhances vehicle operating performance. The delivery times have become shorter because of the improved route clustering method which also reduces the time vehicles spend idle according to Chapter Four. The system has reduced fuel usage because it prevents extended engine operation which would otherwise raise both fuel expenses and refrigeration system demands during busy times.

The company needs to decrease its product return rates and spoilage-related losses which represent a major cost efficiency challenge. The company achieves minimal product damage from temperature changes because it maintains exact temperature levels during all storage and transportation operations. The distribution of frozen products benefits from small decreases in product spoilage because these reductions lead to substantial financial gains because the products have high value and businesses maintain thin profit margins. The enhanced temperature control system defends business profits by preventing avoidable financial losses from happening.

The financial benefits of preventive maintenance emerge because it helps decrease the occurrence of major vehicle failures and refrigeration system breakdowns. The organization now identifies equipment wear at its start which allows them to perform maintenance before equipment failures happen thus preventing both repair emergencies and delivery delays. The company operates a preventive maintenance system which improves vehicle reliability and minimizes future maintenance expenses.

The delivery system now provides better reliability which decreases all costs that result from

retailer dissatisfaction including re-deliveries and emergency replenishments and relationship management work. The company achieved better planning accuracy because its improved on-time delivery performance reduced the requirement for emergency operational responses.

The cold chain optimization system at Arctic Associates enables the company to reduce its logistics expenses while preserving its present service levels. The financial advantages demonstrate that supply chain operations which use disciplined methods and efficiency-based approaches will create lasting cost reductions for temperature-controlled distribution networks.

Metric	Value
Reefer Fuel Consumption (Avg)	1.5 Liters / Hour
Diesel Price (Dec 2025)	PKR 265 / Liter
Fleet Size	10 Vehicles
Daily Optimization Saving	1 Hour per vehicle
Daily Savings	1.5 L * 10 * 265 = PKR 3,975
Monthly Savings (26 days)	PKR 103,350

Analysis: Even a modest saving of 1 hour of run-time per day across a small fleet yields over 1 Lakh PKR in monthly savings. This validates the manager's focus on "Route optimization" as a key cost control measure.

5.3 Quality Improvement and Customer Satisfaction Benefits

The main achievement of cold chain optimization programs leads to better quality because frozen goods require specific temperature control to maintain their quality during distribution. The distribution network at Arctic Associates achieved better product quality through their implementation of controlled temperature systems and their strict product handling procedures.

The research in Chapter Four shows that maintaining temperatures between –18°C and –22°C prevents quality deterioration and texture changes and melting which occur during ice cream transportation.

The implementation of better temperature control throughout storage and transportation and final delivery stages has decreased the number of temperature-related product defects and customer return cases. Retailers who receive high-quality products from their suppliers will avoid freezer complaints and stock losses and customer dissatisfaction when customers buy their products. The distributor maintains reliable operations which strengthens retailer confidence about their ability to preserve brand quality standards during peak heat periods that create the most dangerous time for cold chain failures.

The retail industry has better customer satisfaction because delivery services now operate with improved reliability. The delivery of products on schedule within established timeframes helps retail stores keep their stores fully stocked which protects them from running out of products and losing potential customers. Retailers who run dependable replenishment systems achieve improved freezer storage management and promotional success which leads to better retail operational performance and higher sales results.

The brand upholds its market standing through superior product quality during distribution because it upholds Walls' brand identity. The quality of ice cream requires complete focus because any small deviation from perfection will result in decreased customer satisfaction. Arctic Associates maintains brand equity through its commitment to cold chain performance stability which also builds customer confidence about product quality.

The organization needs to perform better quality control because this improvement will decrease the requirement for returns handling and emergency equipment replacements and retailer dispute settlements. The program established permanent business relationships between distributors and retailers through its work to build dependable cooperative bonds between them. The optimization of cold chain operations has brought better operational performance and higher customer satisfaction which strengthens Arctic Associates' role as a dependable distribution partner for Walls.

5.4 Strategic and Long-Term Benefits for Walls Partnership

The cold chain optimization system at Arctic Associates delivers significant strategic benefits and long-term value to its partnership with Walls Ice Cream. The market competition together with its strict quality requirements make Walls need its distribution network to achieve temperature control and safe product delivery and protect its brand reputation. The distributor level needs to maintain efficient cold chain logistics because this supports the entire supply chain strategy of Walls.

The system provides brands with their main strategic benefit through brand identity defense. The quality of ice cream products becomes vulnerable to temperature changes because these changes can damage the products rapidly. The controlled cold chain system at Arctic Associates operates as a continuous process to maintain product quality standards which Walls established. The company maintains brand consistency through its operations which protects customer satisfaction and company reputation during hot weather conditions.

The dependable functioning of cold chain systems allows businesses to improve their market performance because it results in better product availability and store display at retail outlets. The company can keep its freezer stock at its best levels because quick delivery services help prevent stock outs which would result in lost sales.

The company leads the market because it achieves full store inventory which enables Walls to succeed in high-traffic shopping locations and protect its market dominance. The system provides reliable operations which become essential during times when supply chain pressure reaches its maximum point.

The business relationship between Arctic Associates and Walls will create trust which will result in prolonged business stability because of their proven success in cold chain management. The brand needs to perform fewer corrective actions and audits and operational escalations because the distribution team executes their responsibilities reliably. Our operational confidence allows us to establish long-term business partnerships which make Arctic Associates a dependable strategic business ally instead of a service-based company that operates through single deals.

The long-term implementation of proper cold chain management enables businesses to expand their operations. The company Walls achieves better market expansion through its product

development and market entry initiatives when it works with distributors who have established The Walls distribution network achieves strategic flexibility and growth readiness through Arctic Associates' disciplined logistics practices which operate within cold chain distribution systems. The optimization of cold chain operations helps distributors and brands to achieve better alignment because their operational results directly support their organizational targets. The strategic alliance between Walls and Arctic Associates serves as a vital element which enables sustainable market dominance because it safeguards brand worth through its ability to deliver premium products which maintain their high-quality standards and remain affordable for customers.

CHAPTER SIX: LIMITATIONS AND CONCLUSION

6.1 Limitations of the Study

The research delivers vital information about Arctic Associates' cold chain logistics and transportation efficiency yet it includes particular limitations which need identification to achieve an accurate comprehension of the results. The research maintains its validity because researchers understand its restricted scope which results from these study limitations.

The research study contains a major restriction because it uses qualitative case study methods to analyze one organization which operates in a particular business environment and geographic location. The research method enables deep cold chain operation analysis at Arctic Associates but the results do not apply to all cold chain distribution companies or business sectors. The operational methods and physical facilities and official rules which govern businesses differ substantially between different geographic areas and business entities.

The research faces a major obstacle because scientists cannot obtain all necessary data because privacy regulations enforce strict confidentiality rules. The research used managerial insights together with descriptive operational data because cold chain operations require protection of sensitive information so it avoided using specific cost data and temperature records and system performance statistics. The research limitation which prevents statistical analysis follows ethical

research standards and shows common industrial case study conditions which researchers face when they study actual business settings.

The research study faced various environmental and structural obstacles because of its working conditions. Organizations cannot control external elements which include traffic congestion and extreme weather conditions and road quality and power instability. The operational environment included these elements but their unpredictable behavior made it impossible to determine their exact performance results.

The research depended on information which a single key respondent provided but this approach could lead to biased results because of personal opinions. The respondent maintained complete operational control while understanding cold chain logistics at a deep level yet depending on a single management approach restricts the introduction of different perspectives. The respondent holds a strategic and operational role in the organization which allows him to see all logistics operations that exist within the company.

The research findings remain valid because these study restrictions point to specific areas which need careful analysis during interpretation. The research establishes guidelines for future investigations which need to combine different case studies with performance data and multiple stakeholder groups to develop better understanding of cold chain logistics optimization.

6.2 Recommendations for Improvement

The research results and analysis in Chapter Four produce various operational recommendations which will boost Arctic Associates' cold chain logistics and transportation operations. The organization can execute these recommendations because they present functional solutions which match its financial resources and operational structure to solve its present-day infrastructure and environmental problems.

Strengthening Temperature Monitoring Practices

The system shows only occasional temperature deviations but better temperature monitoring systems will help decrease the chances of errors. Arctic Associates needs to improve their real-time temperature tracking system through either purchasing new monitoring devices or by

conducting regular manual temperature assessments during their transportation activities. The installation of additional monitoring systems will improve our ability to detect system problems because refrigeration systems operate at their highest point during summer months.

Further Optimization of Route Planning

The current route optimization system has shown positive results but further improvements can be made through periodic route performance data analysis to optimize delivery routes according to traffic conditions and store locations. The system for time-based delivery optimization which focuses on high-risk routes during hot weather will reduce delivery duration while protecting staff from outside environmental exposure during their last delivery stop.

Focused Training and Skill Development

The cold chain system depends on driver vehicle operation skills and their ability to handle their vehicles for its overall system integrity. The organization needs to run standard operating procedure refresh training sessions which will teach staff members about loading and unloading procedures and emergency response and temperature management protocols. The organization should make quality standards its top priority because this approach will produce better compliance results and operational stability.

Preventive Maintenance and Fleet Upgrades

The organization should continue to focus on preventive maintenance because this method decreases equipment failures which stops delivery delays from happening. The long-term solution involves a step-by-step process to update the fleet through the installation of better-insulated vehicles which use more efficient refrigeration systems to achieve better performance at affordable operating expenses. The selection of investments needs to focus on equipment reliability and operating conditions of the local area instead of choosing systems with complex features that prove too expensive to operate.

Improved Retailer Coordination

The delivery process becomes more efficient when retailers join forces with delivery operations to minimize the time needed for last-mile delivery. The delivery process will become more efficient through proper communication about delivery timeframes and freezer preparation and unloading

methods which will reduce door-open duration and temperature exposure. The improvement of retailer cooperation will boost cold chain operations through better performance without requiring any extra financial expenses.

Data-Driven Performance Review

The management team needs to focus on three essential operational practices which include delivery performance maintenance and temperature compliance and spoilage trend monitoring. Developing simple performance dashboards or summary reports can support quicker decision-making and continuous improvement. Organizations can achieve vital operational efficiency improvements through analyzing their current operational data systematically even when they do not have advanced ERP systems.

6.3 Conclusion

The research evaluated Arctic Associates' cold chain logistics and transportation efficiency because they operate as Walls Ice Cream's authorized distribution partner to evaluate their operational methods and temperature control systems. The research employed qualitative case study methods to obtain extensive data about warehouse delivery systems which operate under difficult environmental and infrastructure circumstances.

The research shows Arctic Associates operates an efficient cold chain system because they use established operating protocols and planned delivery routes and maintenance schedules and strict temperature management systems.

The organization succeeds in keeping temperatures stable and delivering products reliably despite working in a dangerous setting which includes hot temperatures and heavy traffic and restricted infrastructure. The research shows that frozen product distribution success depends on operational managers who enforce discipline in their operations and handle distribution coordination.

The research on delivery performance and transportation efficiency demonstrated that delivery times become shorter when routes are optimized for flexible execution which also reduces fuel usage and refrigeration system operation. The quality of products and the prevention of spoilage depend on temperature control methods which operators use during their last delivery stage. The

study results show that spoilage and returns occur rarely because the current cold chain system functions well while demonstrating that frozen food logistics need to reduce the duration of temperature exposure.

The research demonstrated that cold chain optimization creates strategic benefits in addition to its operational performance improvements. The improvement of logistics operations leads to better cost management and higher retailer contentment and better connections between distributors and brands. The reliable cold chain execution provided by Arctic Associates enables Walls to protect its brand while keeping its market position and maintaining its market standing in the competitive market. The research results demonstrate that cold chain logistics requires strategic focus because it functions as a core supply chain infrastructure.

The research contains two primary limitations because it employs qualitative research methods and because researchers lack access to complete quantitative data The research results stay within the established boundaries of the study. The research demonstrates that fundamental operational enhancements will generate major performance improvements through basic systems which do not require advanced digital technology. The research results provide vital information which distributors need to operate successfully in their specific business environments.

The success of frozen product distribution depends on cold chain optimization because it establishes environmental conditions which support sustainable business operations. The Arctic Associates case shows that successful cold chain logistics require three vital elements which include temperature stability and optimized delivery planning and rigid operational protocols. The development of these areas results in improved product quality and decreased operational risks which create enduring value for brand partners together with their customers. The research provides fresh knowledge about cold chain logistics which operates in developing countries while showing potential areas for additional studies about temperature-controlled distribution systems.

CHAPTER 7: REFERENCES

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ANNEXURE A

INTERVIEW QUESTIONNARE

1. What is your role and responsibility in managing cold chain logistics and transportation at Arctic Associates?

2. What temperature range is maintained during storage and transportation of ice cream products?

3. How is temperature monitored and controlled during transportation and last-mile delivery?

4. What are the main challenges faced in maintaining cold chain integrity during deliveries?

5. How are delivery routes planned and adjusted to handle traffic congestion and operational delays?

6. What impact do fuel prices and electricity costs have on cold chain transportation efficiency?

7. At which stage of the distribution process is the risk of temperature deviation highest, and why?

8. What Standard Operating Procedures (SOPs) are followed to minimize product spoilage and wastage?

9. How are spoiled or damaged products handled and managed through the return process?

10. How does Arctic Associates ensure delivery performance and on-time order fulfillment?

11. What internal strengths and weaknesses affect cold chain logistics operations at Arctic Associates?

12. How do external factors such as regulations, infrastructure, and weather conditions impact operations?

13. What technological or operational improvements can enhance cold chain efficiency in the future?

14. How can coordination with retailers be improved to reduce last-mile delivery risks?