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Impact of Rising Logistics Costs on Supply Chain Transformation at Nestlé:

A Qualitative Study of Scotland

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ABSTRACT:

This thesis examines how the long-term rises in logistics costs contribute to transforming the supply chain in a fast-moving consumer goods (FMCG) industry that relies heavily on logistics. Based on the operations of Nestle Purina PetCare in Scotland, the research fills a crucial gap in the literature: despite the wide adoption of research on the dynamics of logistics costs, digital transformation, and supply chain resilience, their combined role as coordinated structural change drivers has been under-researched, especially at the level of product-division in geographically limited contexts.

A single-case study design that is qualitative is used, supported by an interpretivist philosophy and inductive approach. Thematically analysed secondary data sources, such as peer-reviewed articles, corporate reports (e.g., Nestle sustainability reports), industry analyses, policy documents published since 2020, are analysed using thematic analysis. The conceptual framework incorporates the dynamics of logistics costs, supply chain transformation, digitalisation and theory of resilience.

The thematic analysis of secondary sources suggests four interrelated themes. First, logistics cost escalation is driven by fuel price volatility, labour market constraints, third-party logistics dependency, geographic and infrastructure constraints in Scotland, and post-pandemic and geopolitical disruptions. Second, these pressures appear to trigger coordinated strategic adjustments in sourcing (towards total landed cost evaluation), distribution network design (consolidation and collaborative logistics), and inventory management (hybrid lean-buffer approaches). Third, the transformation responses identified include structural network reconfiguration, supplier diversification, operational flexibility development, and sustainability co-benefits arising from efficiency-based improvements. Fourth, digital visibility and predictive analytics function as enabling infrastructure, and resilience capabilities (absorptive, adaptive, recovery, and redesign) appear to be mutually reinforcing outcomes rather than discrete independent goals.

The study contributes an integrative conceptual model of cost-driven supply chain transformation, a product-division analytical perspective, and an interpretive account of digital-resilience interdependence. In practice, it recommends that managers treat logistics cost escalation as a driver of strategic transformation, adopt total landed cost frameworks in sourcing evaluation, and co-develop digital and resilience capabilities as an integrated programme. A key limitation is that the study relies entirely on secondary data, which means the findings represent interpretive analysis based on publicly available sources and cannot confirm internal Nestlé decision-making processes without primary interviews or internal documents. Future research should address this through primary and comparative studies.

KEYWORDS: logistics costs, supply chain transformation, digitalisation, supply chain resilience, FMCG, Nestlé, Scotland, secondary data, thematic analysis.

Contents

Figure

Tables

Abbreviations

3PL	Third-Party Logistics
AI	Artificial Intelligence
CUSUM	Cumulative Sum Control Chart
DC	Distribution Centre
ERP	Enterprise Resource Planning
ESG	Environmental, Social and Governance
FMCG	Fast-Moving Consumer Goods
GMM	Generalised Method of Moments
IV	Instrumental Variable
JIT	Just-In-Time
MNC	Multinational Corporation
NLP	Natural Language Processing
OLS	Ordinary Least Squares
R&D	Research and Development
SCM	Supply Chain Management
SCT	Supply Chain Transformation
TLC	Total Landed Cost
UK	United Kingdom

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1 Introduction

The supply chains have become one of the key determinants of organisational competitiveness, particularly in the industries where efficiency in operations and timely distribution are of primary importance. The conventional supply chain models relied on cost minimisation, lean stock, and the globally based sourcing models. However, recent crises like the COVID-19 pandemic, political and energy market instability, and transport market instability have revealed structural inefficiencies in these efficiency-based models. These shocks have not only increased the uncertainty of operations but have also shown how highly optimised supply chains can be vulnerable to long-term external shocks (Christopher and Peck, 2004; Ambulkar et al., 2015).

More importantly, the rise in the cost of logistics was not a temporary operational problem anymore but a long-term strategic challenge. Under current circumstances, the fuel price fluctuation, labour shortage, and transportation constraints are impacting the core supply chain decision-making, like sourcing strategy, distribution planning, and location of inventory. Rather than choosing to implement cost-cutting mechanisms in an incremental manner, organisations are also being forced to re-appraise their supply chain arrangements in an effort to continue their performance in the face of ever-present cost pressure. This transformation represents a broader movement towards more flexible and adaptable models and finding a balance between cost control and resiliency and flexibility of operations (Milewska and Milewski, 2022; Pellegrino et al., 2021).

This is particularly significant in the fast-moving consumer goods (FMCG) industry, where there is a high turnover of products, deadlines are strict, and distribution channels are extremely complex, and the impact of disruptions in logistics is extremely high (Tukamuhabwa et al., 2015; Pettit et al., 2010). The rise in logistics expenses in such environments directly affects the performance of the operations and the strategic decision-making, and consequently, the transformation of the supply chain is a compulsory organisational response, and not an optional improvement.

It is in this backdrop that the focus of this paper will be the Nestle Purina PetCare supply chain operations in Scotland. This state of affairs provides a relevant background to talk about cost-

based change due to its high logistics intensity and dependence on distribution chains distributed geographically. The article focuses on how strategic supply chain decisions, digital transformation initiatives, and resilience-enhancement processes are affected by long-term logistics cost pressures in this specific operational environment (Preindl et al., 2020; Song et al., 2022).

1.1 Global Supply Chain Transformation Context

The world supply chains are experiencing a reorganisation due to continuous economic and operational demands. The traditional supply chain models focused on cost efficiency through global sourcing, lean inventory, and extremely optimised distribution channels. Although these settings have worked in stable environments, recent shocks have revealed their low ability to accommodate chronic shocks. Consequently, efficiency no longer dictates the design of supply chains; the necessity to deal with cost volatility and operational risk is becoming a factor in supply chain design increasingly.

One of the forces behind this change is the fact that the cost of logistics has been rising steadily in the international markets. Inflationary and increased fuel costs, coupled with transportation systems, have played a significant role in increasing the cost of commodity movement, which has influenced procurement, distribution, and inventory decisions at the same time (Diaz et al., 2024). These cost pressures are not transient anomalies but institutional shifts that transform the economic base of supply chain activities. This necessitates organisations to re-evaluate network design, sourcing strategies, and logistics planning strategies instead of the short-term cost control measures (Melnyk et al., 2014; Ralston and Blackhurst, 2020).

This change has created a redefinition of supply chain strategy from less efficient models to more adaptive and resilient setups. It has been found that organisations are adding flexibility, redundancy, and real-time visibility into their supply networks in order to maintain performance in the face of uncertainty (Essuman et al., 2020; Niu et al., 2025). Notably, such transformation does not substitute efficiency goals, but rather redefines them in a more extensive strategic balance that encompasses resilience and responsiveness (Tang, 2006; Thun and Hoenig, 2011). In this respect, there is a repositioning of the supply chains as strategic systems, which have direct impacts on long-term organisational competitiveness.

This change has been felt especially by the fast-moving consumer goods (FMCG) sector. The supply chains of FMCG are characterised by high product turnover, stringent delivery demands, and complex distribution systems, and, therefore, are highly susceptible to changes in logistics costs. With rising logistics costs, the ripple effect is passed quickly through the whole supply chain to service levels, inventory strategy, and distribution efficiency. This renders supply chain transformation not only crucial but also timely in the sustenance of operational performance.

In a broader transformation context, the product divisions that involve high logistics offer a narrow environment where we can study the effects of cost pressures on structural change. An example of such a context is the Nestle Purina PetCare business operations in Scotland, where the distribution is geographically spread, and the high level of dependency on transport increases the vulnerability to volatile logistics expenses. Thus, the worldwide trend to cost-based and resilience-driven supply chain designs is directly applicable to this research since it offers the conceptual framework of the analysis of how the continuous increase of logistics costs affects the supply chain change at the product-line level.

1.2 Logistics Cost Escalation as a Strategic Challenge

The cost increase in logistics has become not a matter of operation, but a strategic limitation that determines the supply chain design and decision-making. Constant rises in fuel costs, energy instability, labour expenses, and service prices are not the standalone drivers of cost; they are indicators of a structural dislocation between the old-fashioned efficiency-based models of supply chain and the present-day logistical realities. Since these pressures have a direct impact on transportation, sourcing, and inventory decisions, logistics costs have become a factor that determines how supply chains are designed and not how they are simply managed.

The volatility of fuel and energy prices has become a core of this change, as it propagates the instability of costs through the systems of transportation and procurement, compelling organisations to consider the place of sourcing and distribution methods (Milewska and Milewski, 2022; Min, 2022; Mohammad et al., 2025). Simultaneously, labour limitations and the growing dependence on third-party logistics solutions diminish the flexibility of operations and increase

the sensitivity to changes in the prices of services. All these pressures inhibit the efficiency of short-term cost management and demand structural changes in supply chain set-ups.

This means that organisations are no longer implementing reactive cost-reduction strategies, but strategic transformation initiatives. These are network re-design, diversification of suppliers, and adoption of digital logistics systems to enhance coordination and cost visibility (Albertzeth et al., 2020; Pellegrino et al., 2021). In this respect, increasing logistics expenses can be seen as a change catalyst, forcing companies to decide between efficiency and resilience and adaptability to stay afloat in the face of extended cost pressure.

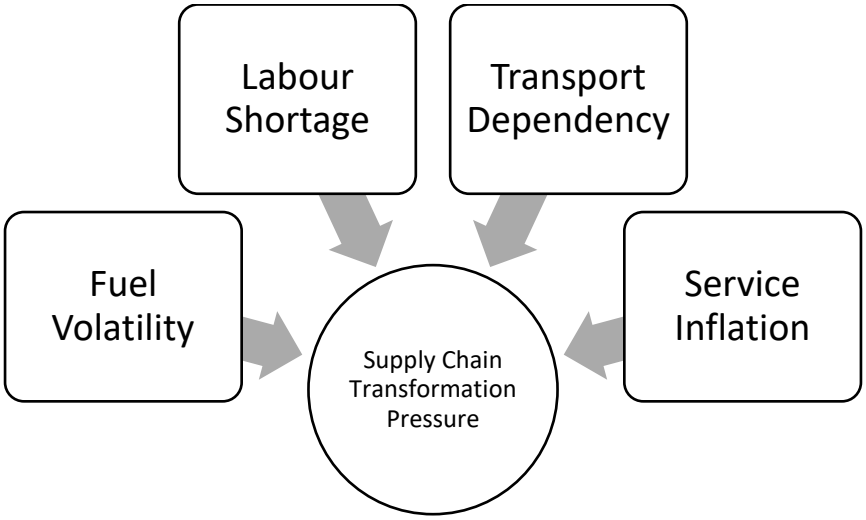

Figure 1.1: Logistics Cost Drivers Framework

Figure 1.1 shows the main factors that have increased the cost of logistics and how they have influenced supply chain decisions. These drivers do not work alone but influence the formulation of strategy through the combined effect that they have on transportation planning, the choice of suppliers, and the design of the distribution network.

The strategic implication of cost increase in logistics is more pronounced in geographically scattered areas like Scotland, where long transportation routes and infrastructure restrictions add more pressure to costs. As empirical evidence shows, regional freight dependencies and a

lack of modal flexibility make a region more vulnerable to cost fluctuations (Akgün et al., 2020). In the case of logistics-intensive FMCG operations, the conditions increase the influence of cost pressures on the supply chain performance. Thus, the Nestle Purina PetCare business in Scotland offers an appropriate background to analyse how the continuous cost increase in logistics leads to supply chain transformation at the product-line stage.

1.3 Research Context: FMCG Supply Chains and Nestlé Scotland

The fast-moving consumer goods (FMCG) industry can be used as a strong example of the cost-driven change in the supply chain because it is highly dependent on the efficient and continuous operation of logistics. FMCG chain supply is typified by high product turnover, delivery schedules, and closely spaced distribution channels. In this situation, logistics performance has a direct effect on operational performance, and thus cost fluctuations have a greater impact than in industries with longer production cycles. Consequently, the logistics cost increase in FMCG settings is no longer an operational problem but reaches the strategic decision-making process.

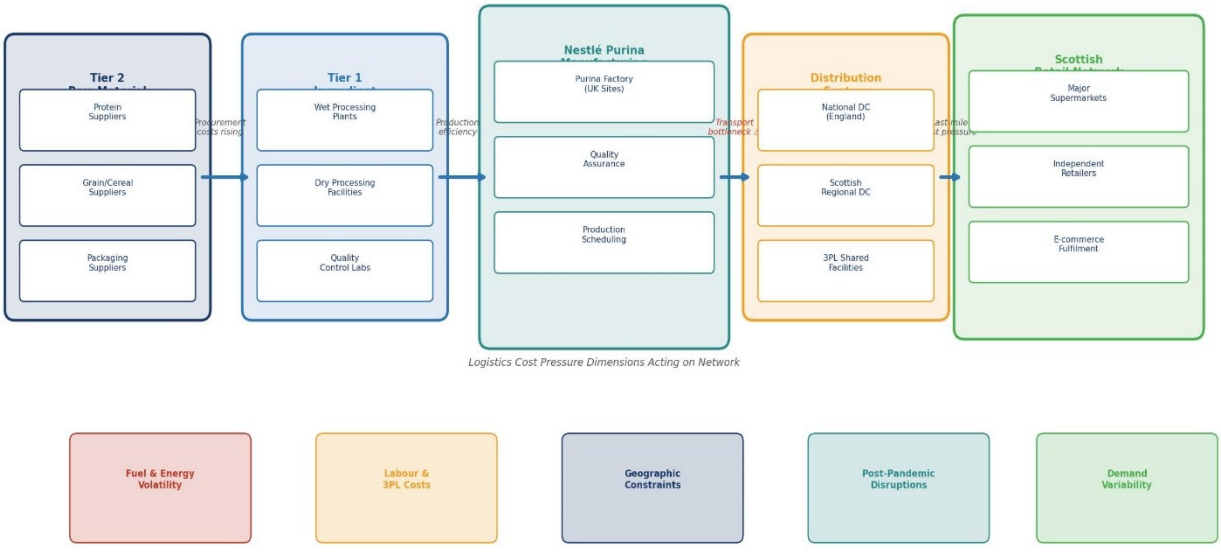

Figure 1.2: Nestlé Purina Supply Network Architect

FMCG supply chains are organizationally complicated, which entails various suppliers, manufacturing plants, regional warehouses, and diverse retailing platforms that are functioning concurrently across markets (Mentzer et al., 2001; Hendricks and Singhal, 2005). This complexity

adds vulnerability to transportation interruptions and price volatility, especially in the presence of high demand variability and service expectations (Asgharizadeh et al., 2023; Neboh and Mbhele, 2021). Logistics costs dominate major strategic choices in these environments, such as sourcing structure, location of inventory, and design of a distribution network. The information sharing and digital integration are also crucial in ensuring the coordination and responsiveness of these interconnected systems (Yang et al., 2022; Flynn et al., 2010; Wiengarten et al., 2016).

Figure 1.3: FMCG Supply Chain Complexity

Figure 1.2 demonstrates the complexity of FMCG supply chains' structure and the numerous nodes and flows that make these chains sensitive to logistics disruptions. This complexity offers an appropriate analytical foundation for studying the effects of cost pressures on supply chain configuration and transformation.

In this industry scenario, Nestle will be a case that is relevant yet analytically constrained. Being a multinational FMCG organisation, its supply chain is associated with the worldwide integrated procurement, production, and distribution systems. According to available reports, Nestle has introduced digital planning systems and logistics optimisation practices to enhance coordination and efficiency in the changing conditions of operation (Nestle, 2023; Supply Chain Digital, 2024). This research is, however, not a generalisation of the whole organisation but of the Purina PetCare division in Scotland.

Nestle Purina PetCare is a logistics-intensive company whose operations and products focus on the product level, which analytically justifies its selection. This division is very sensitive to changes in the costs of logistics and requires a continuous flow of products, coordinated distribution, and

responsive inventory management. The specialisation of the analysis to a product division can also be used to further investigate the effect of cost pressures on supply chain change without the shortcomings of too general organisational analysis.

This case is also relevant due to the Scottish context. The geographic characteristics of logistics, such as the further distance of transportation, the lack of infrastructure, and the dependence on road and port systems, add to the variability of logistics costs (Akgün et al., 2020). All these increase the effects of cost increase on supply chain decisions. As such, the Nestle Purina PetCare business in Scotland offers an environment in which the impacts of the logistics cost pressures on the supply chain transformation may be studied in an intensive and researchable way at a product-line level.

1.4 Problem Statement

The main issue that is explored within the context of this research paper is the lack of knowledge about how the continuous rise in logistics costs contributes to the coordinated organisational-scale transformation of supply chains. As much as the increasing logistics costs are well known, the research literature is inadequate to clarify how the cost pressures are converted into coordinated strategic, structural, and technological adjustments in supply chains.

The existing body of literature focuses on discussing logistics costs, digital transformation, and supply chain resilience as independent areas (Seuring and Müller, 2008; Tang, 2006). Research on logistics costs is more concerned with transportation prices and the cost-effectiveness of the transportation process (Milewska and Milewski, 2022; Diaz et al., 2024), whereas research on digital transformation is centred around the adoption of technologies and data integration (Preindl et al., 2020; Abideen et al., 2021). Likewise, in the literature on resilience, the focus is on the response and recovery abilities in case of disruption (Song et al., 2022; Hohenstein, 2022). Nevertheless, these views are seldom combined to explain how the ongoing cost pressures have a concurrent effect in strategic decision making, network structure, and operational adjustment in one organisational setting.

The fragmentation introduces a serious void in comprehending the organisational response to long-term logistics cost volatility beyond short-term cost management. Specifically, the sparse

empirical evidence exists on how multinational FMCG companies turn cost pressures into consistent supply chain transformation plans, particularly in geographically complicated settings, where logistics constraints are magnified (Niu et al., 2025).

This is of particular concern to logistic-intensive product divisions where product cost sensitivity and distribution responsiveness directly influence operational performance. Because the current literature does not have a clear picture of the role of cost escalation in transformation processes, there are partial explanations of the supply chain adaptation.

Thus, the proposed paper fills this gap by investigating how the continuous increase in logistics costs becomes a supply chain transformation driver in the Nestle Purina PetCare business in Scotland. The study will offer a more comprehensive perspective of how cost pressures affect strategic choices, digital adoption, and resilience-building procedures by targeting a product-level supply chain under a geographically constrained logistics environment.

1.5 Research Aim

The proposed study will explore the impact of the continuous increase in logistics costs on the supply chain change in the Nestle Purina PetCare operation in Scotland, and the issues of strategic decision-making, network setup, and responsive supply chain practice in a logistically intensive environment (Milewska and Milewski, 2022; Pang et al., 2025).

1.6 Research Objectives

The study is guided by the following objectives:

1. To analyse the key drivers of logistics cost escalation affecting the Nestlé Purina PetCare supply chain in Scotland.
2. To examine how rising logistics costs, influence strategic supply chain decisions, including sourcing, transportation, and distribution planning.
3. To evaluate the supply chain transformation responses adopted to manage sustained logistics cost pressures.

4. To assess the role of digitalisation and resilience capabilities in supporting cost-driven supply chain transformation.

1.7 Research Questions

The Research questions are

1. What are the main drivers of logistics cost escalation in the Nestlé Purina PetCare supply chain in Scotland?
2. How do rising logistics costs influence strategic supply chain decisions?
3. What transformation strategies are adopted to respond to sustained logistics cost pressures?
4. How do digitalisation and resilience capabilities support supply chain transformation under cost pressure?

1.8 Research Justification and Significance

The rationale behind this study is the necessity to gain a deeper insight into how the ongoing increase in the costs of logistics affects supply chain change that goes beyond the short-term price control. Although the past studies investigated the cost of logistics, digital transformation, and resilience of supply chains, no studies have focused on the manner in which these factors interact with each other under the constant pressure of cost. This paper attempts to fill this gap by concentrating on the role of cost escalation as an agent of planned strategic and operational change in a recognisable organisational context.

The importance of the research is that it offers a supply chain transformation perspective on a product level, with a concentrated view on the supply chain in an environment that is logistics-heavy in FMCG. Through the analysis of one instance in a geographically bounded environment, the research provides a more concrete insight into the way the pressures of costs are converted into viable reactions of transformation.

1.8.1 Academic Contribution

The research will add to the literature because it will relate the cost escalation of logistics with the supply chain transformation, digitalisation, and resilience in a single case scenario. Instead of suggesting a general theoretical improvement, it offers a combined empirical view of the interaction of these themes on the product-line level within an FMCG supply chain (Essuman et al., 2020; Preindl et al., 2020).

The research is also valuable as it is changing the analytical approach of the general organisational discourse to a more narrowed product-level analysis that is under-explored in scientific studies. This would enable a better insight into the impact of cost pressures on the adaptation of supply chains in geographically complex settings.

1.8.2 Practical Contribution

The research provides feasible knowledge to supply chain managers working under cost-sensitive conditions. It emphasises the impact of increasing logistics prices on sourcing, transportation planning, and distribution network design, and how organisations can react to this through structural change and digital coordination.

The findings can be specifically useful to managerial decision-making because they can demonstrate the effectiveness of digital tools and adaptive strategies in enhancing cost visibility, operational flexibility, and responsiveness amidst prolonged cost pressure. This renders the study pertinent to organisations that aim at achieving efficiency and resilience in supply chains that are logistics-intensive.

1.8.3 Policy Relevance

The research has constrained yet pertinent implications for regional logistics and infrastructure planning. Transportation dependency and infrastructure limitations play an important role in determining the cost of logistics in geographically dispersed regions like Scotland (Akgün et al., 2020).

The study sheds light by identifying the impact of these limitations on supply chain choices at the firm scale that can be used to shape the debate on transport efficiency, regional freight planning,

and the resilience of logistics systems. But these implications are contextual and secondary to the main organisational concern of the study.

1.9 Scope and Delimitations

This research paper has a narrow spectrum to ensure analytical precision and viability. It analyses one case study: the Nestle Purina PetCare supply chain operations in Scotland. It analyses only a single product division and not the whole organisation, which allows a further, more specific analysis of cost-based supply chain change at the product-line level in an environment of high logistics intensity FMCG. The geographical concentration in Scotland is an indication of an environment where dependency on transportation and spreading distribution networks heightens vulnerability to cost pressure in logistics.

The research is based on secondary qualitative data, which encompasses the corporate reports, industry analyses, and scholarly literature. The method enables strategic-level evaluation of supply chain change but restricts the availability of operational details and internal decision-making procedures. Consequently, these results are interpretive and not primary data in their empirical meaning and might not be able to reflect the practices of firms in a comprehensive way.

The scope is also limited to strategic and structural elements of supply chain change, such as sourcing, distribution design, and adaptation mechanisms. Out of the research scope are operational optimisation, quantitative cost modelling, and firm-wide financial performance analysis.

Such limitations make the analysis focused; nevertheless, it diminishes the depth and generalisability of the results. The use of secondary data and a single case scenario implies that findings are context-dependent and might not be immediately applicable in other industries and geographical locations.

1.10 Thesis Structure

Five chapters are structured in this thesis. Chapter 1 presents the research background, problem statement, research aim, objectives, and significance of the study. Chapter 2 analyses the literature on the topical issues of cost escalation in logistics, transformation of the supply chain,

digitalisation, resilience, and sustainability, and formulates the conceptual framework of the research.

Chapter 3 presents the research methodology, such as the case study research design, source of data, and method of analysis. Chapter 4 focuses on the results of the supply chain transformation in the Nestle Purina PetCare business operation in Scotland under the growing logistics cost pressures. Lastly, Chapter 5 will involve the discussion of the key findings, theoretical implications, managerial implications, limitations of the study, and future research directions.

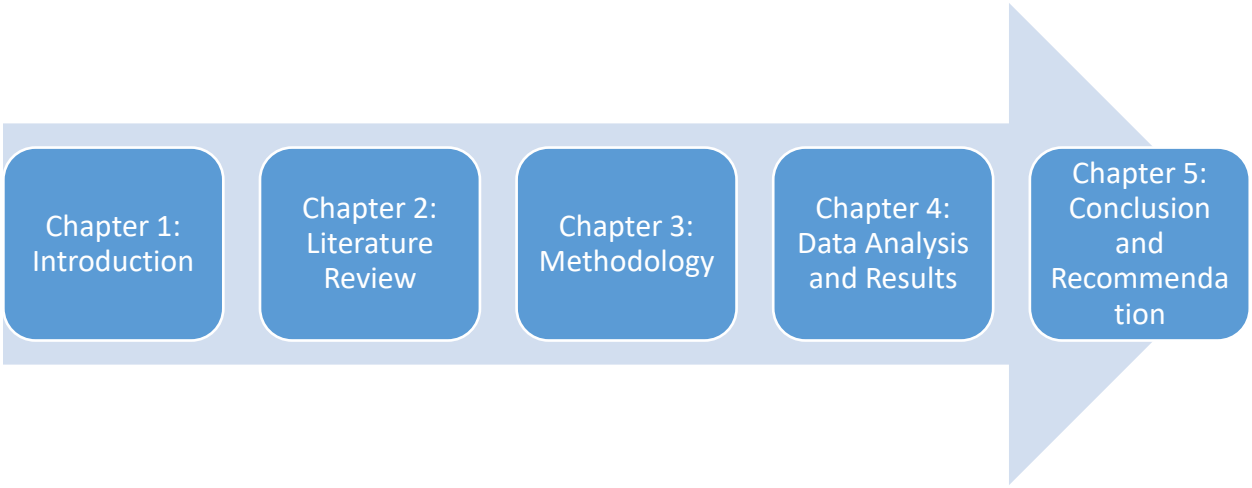

Figure 1.4: Thesis Structure Overview

2 Theoretical Framework and Literature Review

The continual logistics cost pressures, technological change, and operational resilience are increasingly defining the supply chain transformation. Nevertheless, the current studies tend to analyse these three dimensions, logistics cost dynamics, digital transformation, and resilience, separately, which restricts a multifaceted view of their interplay in the process of bringing organisational change. This chapter takes an integrative approach to analysis to overcome this weakness.

Instead of introducing discrete ideas, the chapter critically analyses the structural force of the increasing cost of logistics that connects and impacts strategic adaptation, digital capability development, and resilience-building in supply chains. The literature has thus been structured in the way it does to show how the pressures on costs are interdependent with the responses to the transformation, beyond descriptive accounts to a more related theoretical argument.

This argument is built up in the chapter through the synthesis of major theoretical approaches, such as logistics cost dynamics, supply chain transformation, digitalisation, and resilience. These views are not viewed as distinct themes but are seen as complementary processes that explain the restructuring of supply chains in organisations in the face of continuous cost pressure. Specific focus is placed on the way in which the increase in costs redefines decision-making in terms of sourcing, distribution, and network architecture, and how digital and resilience capabilities facilitate these changes.

The last section of the chapter summarises these findings to outline a specific research gap and define the conceptual framework that this study will follow. This framework shows a combined perception of cost-based supply chain transformation that gives the theoretical framework to the Nestle Purina PetCare case in a geographically dynamic logistics environment.

2.1 Introduction to the Theoretical Framework

This section outlines the theory that is used in the study of cost-oriented change in the supply chain. Instead of applying one theoretical perspective, the study uses a combined method to

describe the effects of long-term logistics cost pressures on organisational responses and reconfiguration of the supply chain.

The model is built around four views, which are interrelated, such as logistics cost dynamics, supply chain transformation, digital transformation, and supply chain resilience. Why have these specific perspectives been selected? They all outline the key processes through which the cost pressures can be translated into strategic and operational change. The source of pressure is the logistics cost dynamics, and structural and strategic changes can be described with the use of the transformation theory. Enabling capabilities also include digitalisation and resilience to enable adaptation to uncertain times.

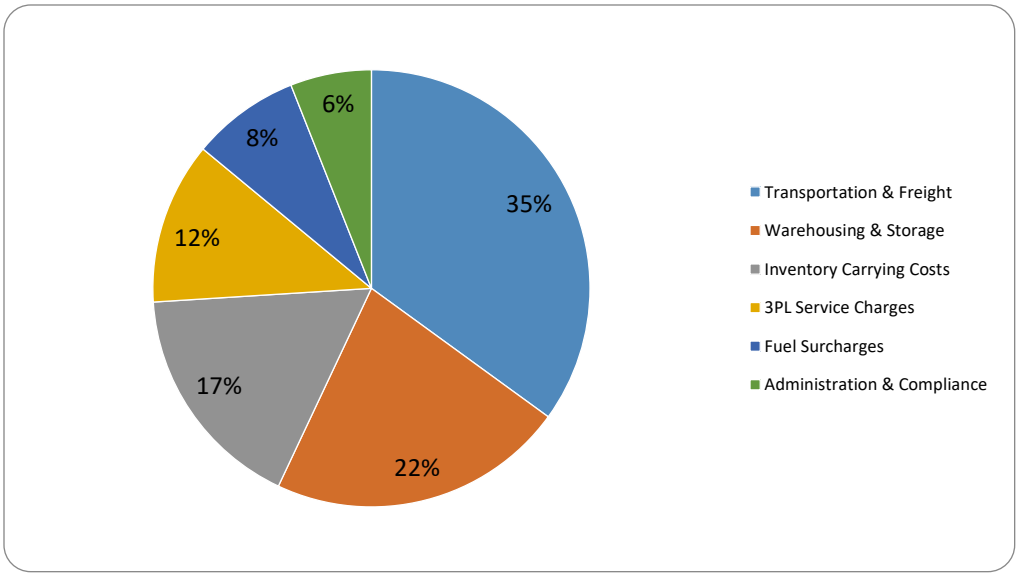

Figure 2.1: Logistics Cost Components (%)

A blend of such perceptions presents a more comprehensive explanation of supply chain transformation than a purely theoretical approach. It emphasises cost increase and the interaction of technological and organisational capabilities to change supply chain design and decision-making. The framework provides a rational analytical foundation for the study of cost-based change in supply chain environments that are logistics-intensive.

2.2 Key Theories and Concepts

The theoretical framework is developed in this section by combining four main perspectives, which include logistics cost dynamics, supply chain transformation, digital transformation, and

supply chain resilience. These viewpoints are not considered as separate themes but rather as interlinked elements as to why long-term logistic cost pressures contribute to organisational change.

The dynamics of logistics costs are placed as the main cause of pressure, which acts upon strategic decision-making in supply chains. The supply chain transformation theory describes how organisations react to a change in their structure and operation by reconfiguring it. Digital transformation and resilience are factored in as enabling capabilities, enabling adaptation to cost volatility. Collectively, these views constitute a rational construct where cost escalation is the driving force, and transformation, digitalisation, and resilience are the response mechanisms of the organisation.

With this combined method, cost-driven supply chain change can be better understood without pieces of the puzzle, and make a definite analytical connection between cost pressures and organisational responsiveness.

2.2.1 Logistics Costs in Supply Chains

The issue of logistics costs is a decisive variable in defining the supply chain performance in terms of operational effectiveness and strategic decision-making. Historically, these costs were considered to be variables of operations control and were managed by such optimisation strategies as lean inventory and global sourcing. Recent literature, however, has shown that there has been a change in this school of thought whereby logistics costs are more influenced by external and structural factors as opposed to internal efficiencies.

The transport-related expenses continue to form the larger portion of the logistics expenditure and are thus very sensitive to the fluctuations in fuel and energy prices. The empirical data indicate that changes in energy prices have a direct impact on the transportation costs, which subsequently impact the procurement strategy, inventory placement, and network design (Milewska and Milewski, 2022; Min, 2022; Mohammad et al., 2025). These variations in costs spread through supply chain operations, and as they do so, the conventional methods of optimisation become limited, and the decisions made ought to be more adaptive.

This has resulted in a reconsideration of the efficiency-resilience trade-off in supply chain management. Although cost minimisation is essential, highly optimised systems do not have the flexibility to react to disruption and cost fluctuations. Studies have shown that flexibility, redundancy, and adaptive logistics approaches are useful in enhancing long-term performance even though short-term cost is hiked (Essuman et al., 2020; Pellegrino et al., 2021; Albertzeth et al., 2020). This implies that logistics cost cannot be seen solely as an efficiency measure but as a strategic variables that define supply chain design.

Geographical variables also enhance the dynamics of logistics costs by interfering with transportation dependence and infrastructure limitations (Brusset and Teller, 2017; Cheng and Lu, 2017). Logistics systems are more vulnerable to cost fluctuations and operational risks in areas with scattered markets and low modal flexibility (Akgün et al., 2020). The states make supply chains more vulnerable to external cost drivers, which supports the necessity of adaptive network designs.

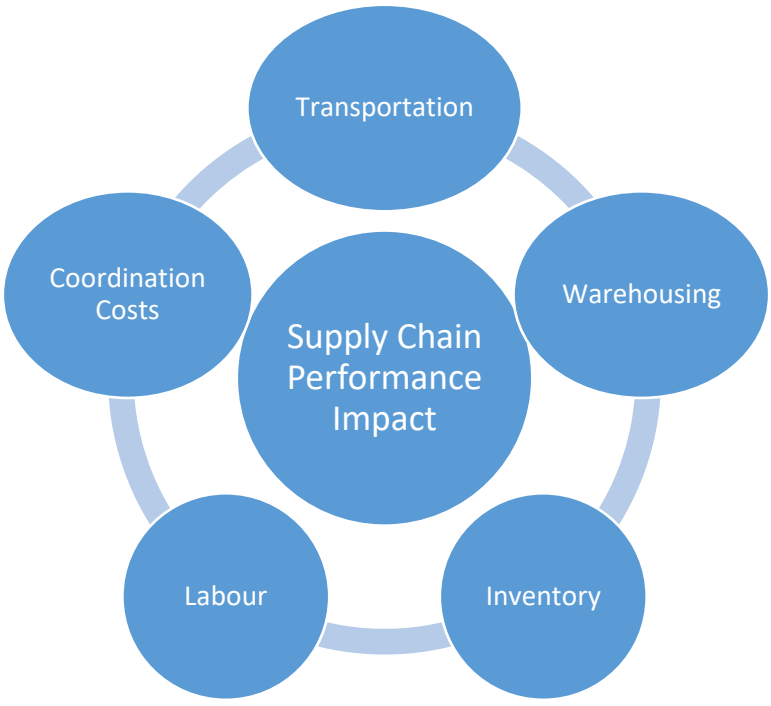

Figure 2.2: Logistics Cost Structure

Figure 2.1 depicts the structural makeup of logistics costs and their influence on regions of the supply chain decision. Cost components do not exist independently, but they interact and simultaneously affect sourcing, transportation, and distribution decisions.

Overall, the logistics cost in contemporary literature is deemed to be one of the structural forces of supply chain change. The existing cost pressure reveals the efficiency-based models and compels organisations to restructure supply networks, diversify their sourcing policies, and deploy digital coordination mechanisms (Niu et al., 2025). This viewpoint defines logistics cost escalation as one of the main stimuli of strategic supply chain change.

2.2.2 Supply Chain Transformation

Supply chain transformation can be defined as the fundamental changes in supply chain structure, capabilities, and decision-making processes to sustain external pressure. It contrasts with incremental operational improvement, which concentrates on efficiency improvements in the existing systems (Scholten and Schilder, 2015; Kochan and Nowicki, 2018). Transforming, on the other hand, means reshaping supply chain design to ensure performance in dynamic cost and risk environments.

Conventional supply chain paradigms were focused on efficiency based on lean operations, international sourcing, and the reduction of costs. Although these models perform well in stable environments, they have proven to be structurally constrained in the case of long-term upheavals and volatility of costs. It has been indicated that efficiency-based systems tend to be less flexible to handle long-term uncertainty, and thus organisations have to implement transformation-oriented strategies, which can strike a balance between efficiency and adaptability and resilience (Niu et al., 2025). This change is especially applicable in logistics-intensive settings where the pressure of cost has a direct impact on the supply chain performance.

It is possible to conceive supply chain transformation with four interrelated dimensions:

Structural transformation entails a redesign of the physical structure of supply networks, which consist of the location of facilities, distribution channels, and transportation routes. This usually involves regionalisation, diversification of suppliers, and reconfiguration of networks to become

less exposed to cost volatility and disruption (Asgharizadeh et al., 2023). These changes are long-term strategic adjustments as opposed to cost optimisation in the short run.

Operational transformation is aimed at ameliorating internal operations like inventory management, demand planning, and logistics execution. With pressure on costs, organisations focus on responsiveness and flexibility in their operations to allow them to adjust to transportation and distribution decisions in real-time. The studies show that adaptive logistics implementation minimises the effects of disruption and enhances operational stability (Albertzeth et al., 2020; Pellegrino et al., 2021).

The technological change focuses on the implementation of digital technologies that make visibility, coordination, and decision-making easier. Predictive analytics and real-time tracking systems allow organisations to predict changes in costs and optimise the logistics planning process (Preindl et al., 2020; Abideen et al., 2021; Yang et al., 2022). These are essential capabilities in the management of complicated supply networks with prolonged cost pressure (Swafford et al., 2006; Guðláugsson et al., 2022).

Strategic transformation entails wider choices regarding sourcing strategies, alliances, and distribution forms. Increased logistics expenses are pushing companies to rethink the selection of suppliers, the mode of transport, and dependencies within the network. A more conspicuous focus on diversification and joint logistics approaches is an indicator of a transition to risk-sensitive and cost-adjustive supply chain creation (Hohenstein, 2022; Kim and Kim, 2024).

Figure 2.3: Structural Transformation

These dimensions of transformation are presented in Figure 2.2, and this demonstrates the interaction between the structural, operational, technological, and strategic changes in transforming the supply chain systems. These dimensions do not exist in one dimension but help each other to adapt to the long-term cost pressure.

On the whole, supply chain transformation is an organisational response to the structural changes in the operating environment in a systemic manner. It is not only efficiency optimisation but also integrated configurations, which are cost control, flexibility, and resilience combinations. Such a difference is critical in the light of the response of organisations to the relentless rise in logistics costs.

2.2.3 Cost-Driven Supply Chain Adaptation Theory

The conceptual lens applied in this study is cost-driven supply chain adaptation, as opposed to a formally defined, standalone theory. It uses the experience of logistics cost dynamics, strategic adaptation, and supply chain resilience literature to give an explanation of how enduring cost pressures cause structural and strategic reconfiguration in supply chains.

Available literature shows that increased logistics expenses, which are fuel, infrastructure bottlenecks, and operational shocks, are not limited to operational issues but serve as an indicator of the misfit between existing supply chain configurations and evolving environmental factors (Milewska and Milewski, 2022). In this sense, cost escalation acts as an agent of organisational change where firms need to re-examine sourcing policies, inventory policies, and distribution network structures.

This lens is based on larger arguments of strategic adaptation, which argues that organisations change their structures and processes due to the persistence of external pressures. The adaptation in the context of the volatility of logistics costs is the shift toward structural restructuring rather than cost reduction in the short term. It has been demonstrated that mere efficiency-seeking reactions, including reduction of costs or services, tend to decrease the flexibility of the system and make it more susceptible to interruption (Essuman et al., 2020). Consequently, organisations are becoming more and more resilient and flexible in their response strategies.

Adaptation is thus an aspect of coordinated changes in supply chain design and capabilities (Luthra and Mangla, 2018; Shekarian and Mellat Parast, 2021). They are network redesign, diversification of transportation and sourcing choices, and implementation of digital planning systems to enhance visibility and decision-making in case of uncertainty (Albertzeth et al., 2020; Preindl et al., 2020). These changes are indicative of a transition of reactive cost management to proactive system reconfiguration.

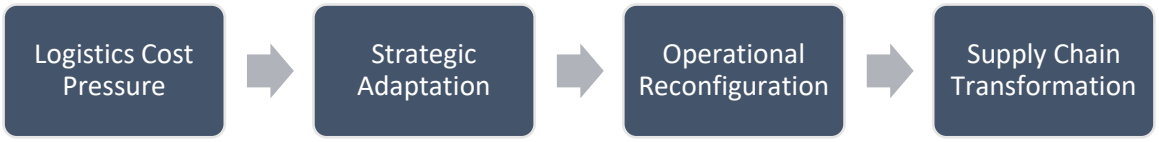

Figure 2.4: Cost-Driven Adaptation Model

Figure 2.3 depicts this process of adaptation, in which the pressures of logistics costs start strategic and operational changes that culminate in a larger change in the supply chain. Adaptation is not linear but iterative, where cost pressures keep on influencing organisational decisions and capabilities.

On the whole, cost-based adaptation offers an effective analytical lens that can be used to explain supply chain transformation as a continuous reaction to structural cost pressures. It points to the value of long-term logistics cost increase as a catalyst to supply chain system redesign to more adaptable, computer-enabled, and robust forms.

2.2.4 Digital Transformation in Supply Chains

Digital transformation is an enabling mechanism where organisations react to the long-term pressure on logistics costs. Digitalisation is analytically important, instead of reflecting overall technological development, as it enhances visibility, coordination, and decision-making in a situation of volatile costs. In this regard, digital capabilities do not remove the cost of logistics but enable organisations to control it more efficiently by enhancing responsiveness and optimisation.

Digital transformation has also brought in one of the main contributions in the form of increased supply chain visibility. Real-time monitoring of inventory, transportation flows, and logistics processes allows identifying disruptions earlier and makes routing and scheduling decisions more efficient, which in turn leads to direct savings in unnecessary logistics expenses (Carton et al., 2022). The enhanced information exchange among supply chain partners also enhances the coordination and enables organisations to react to the changes in the transportation costs and demand conditions more efficiently (Yang et al., 2022).

Predictive analytics takes this a step further by making it possible to facilitate proactive decision-making. Through the appraisal of large quantities of operational data, organisations could predict impending demand shifts, possible disruptions, and price fluctuations to make changes in sourcing, inventory placement, and distribution planning before the cost increase becomes a reality (Islam and Ikbal, 2022; Patrick et al., 2022). This minimises the use of reactionary responses and enhances cost control in logistics-heavy settings.

Cost-based adaptation is also supported by digital planning systems and integrated platforms, which facilitate alignment of decisions made by the supply chain functions. The technologies linked to Industry 4.0 support dynamic changes in sourcing and transportation policies, enhancing the compatibility between operational choices and fluctuating cost situations (Preindl et al., 2020; Abideen et al., 2021). The cross-functional integration of procurement, production, and distribution systems increases the agility of an organisation and minimises inefficiencies that come with a fragmented decision-making process (Oubrahim et al., 2023).

In general, the digital transformation is a vital point of contact between cost pressures in logistics and supply chain transformation. It allows organisations to absorb and react to the volatility of costs by enhanced visibility and predictability, as well as coordinated planning. Digitalisation, therefore, is not a phenomenon on its own but rather an essential element of cost-based supply chain adjustment.

2.2.5 Supply Chain Resilience Theory

The concept of supply chain resilience can be defined as the way in which organisations survive and recover performance in the face of long-term disruption and cost unpredictability. Unlike the

efficiency-oriented models, which concentrate on cost reduction, resilience emphasises how supply chains can absorb the shock, adapt to the new environment, and sustain their operations. Resilience is not the only protective mechanism in the situation of increasing logistics costs, but it is also an essential product of successful supply chain change.

The four capabilities of resilience are usually defined in terms of four interconnected abilities, namely, absorption, adaptation, recovery, and long-term redesign.

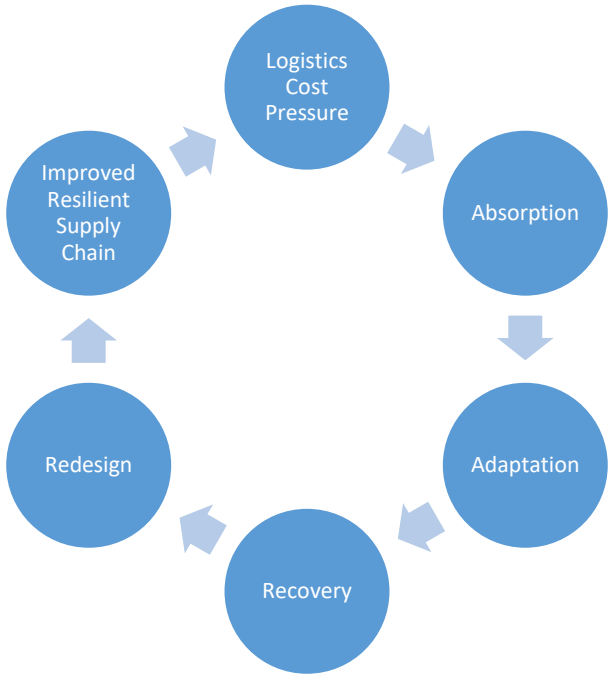

Figure 2.5: Supply Chain Resilience Capabilities under Logistics Cost Pressure

Absorptive capability means that in cases of short-term discontinuity, e.g., transport delays or unexpected cost rises, it can continue to operate. It is affirmed by processes like inventory flexibility and diversified logistics plans, which minimise the effects on the immediate performance (Song et al., 2022). Nonetheless, absorptive capacity cannot be relied upon in the long-term cost pressure.

Adaptive capability refers to the ability to adapt sourcing strategies, transportation modes, and supplier relationships to the varying cost conditions. It allows organisations to transition towards less rigid operational setups than short-term stability (Hohenstein, 2022).

Recovery capability is concerned with the restoration of performance following disruption via coordination and collaboration among the actors of a supply chain. Strong information exchange and coordinated logistics strategy can contribute to high-speed recovery and minimise the effects of the disruption (Kim and Kim, 2024).

Redesign capability is the long-term reformulation of the supply chain networks with the purpose of minimizing vulnerability in the future. This involves redesigning the distribution systems and introducing flexibility in logistics networks so that organisations maintain performance despite the constant cost volatility (Essuman et al., 2020; Ataburo et al., 2024).

These resilience capabilities and the way they shape the responses in supply chains are depicted in Figure 2.4.

In general, resilience cannot be perceived as a goal per se, but as a result of transformation. The persistent increase in logistics costs reveals the vulnerabilities in the current supply chain designs, compelling organisations to incorporate flexibility, digital coordination, and adaptive network designs. In that regard, resilience is a result of cost-based transformation processes, which support the connection between the pressure on logistics costs and long-term supply chain reconfiguration.

2.2.6 Sustainability within Cost-Driven Logistics Transformation

This study views sustainability as a by-product of the cost-based supply chain transformation, and not a goal in itself. The topicality of sustainability can be explained by the fact that it is directly related to the cost of organizations' logistics, in particular the operations of transportation and distribution, when the consumption of energy forms a significant part of operational costs and has an impact on environmental indicators.

The increasing cost of logistics, particularly fuel and energy costs, provides organisations with the incentive to achieve efficiency in a manner that will also lower emissions. Such alignment indicates that indirect pressure on costs can be used to motivate environmentally-friendly practices. To illustrate, the efficiency of transport decreases fuel use, thus having a beneficial effect on logistics expenses and carbon emissions (Li et al., 2020).

This is further strengthened by transport optimisation. There are route consolidation, load optimisation, and modal adjustments, which lower the unnecessary transport activity, enhancing cost-efficiency and reducing the environmental impact (Stroumpoulis and Kopanaki, 2022). Digital logistics systems facilitate such adaptations through improving the accuracy of planning and minimising wastefulness like empty miles, directly connecting sustainability results to cost-driven operational efficiency.

Moreover, supply chain redesign: regionalisation and network reconfiguration may also be used to shorten the transportation distances and enhance the effectiveness of coordination. These transformations are commonly carried out to control the cost volatility but also help to decrease emissions and to make the logistics systems more sustainable (Oubrahim et al., 2023).

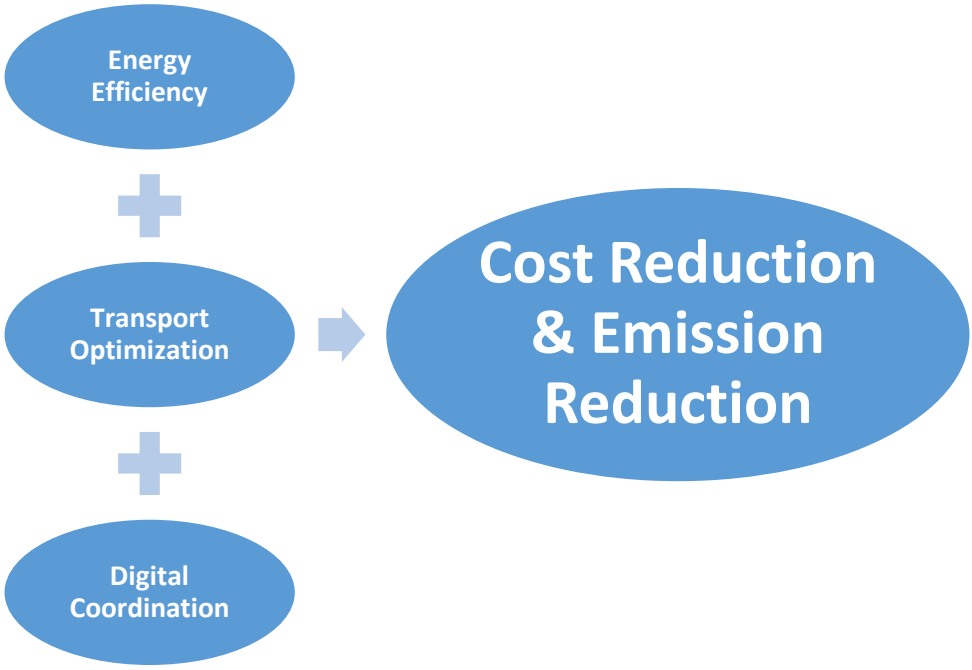

Figure 2.6: Sustainable Logistics Transformation

Figure 2.5 illustrates how the pressure of logistics costs is influencing the enhancement of efficiency and sustainability results on the basis of coordinated operational and structural changes.

Overall, sustainability in this respect is not considered as a separate strategic agenda but rather as a predetermined result of cost-oriented transformation. This perception will assist in ensuring that sustainability is not introduced at the cost of the core objective of the research, which is the cost of logistics increment and the redesign of the supply chain.

2.3 Review of Relevant Literature and Research Gap

The literature available gives a considerable amount of research on the individual aspects of supply chain management, but these studies are analytically disjointed. Surveys on the cost of logistics are mostly related to transportation economics, fuel price volatility, and cost-effectiveness, but there is a paucity of studies that examine how the persistent cost pressure affects the overall organisational change (Milewska and Milewski, 2022; Diaz et al., 2024). By contrast, the digital transformation research focuses on technological potential, including the visibility, data integration, and optimisation, yet it generally assumes that these advances are self-sustaining and not reactions towards cost-based limitations (Preindl et al., 2020; Abideen et al., 2021).

Equally, the literature on resilience has focused on the response to disruption, recovery, and the capacity to adapt without necessarily connecting these capabilities to long-term cost pressures as a structural change agent (Song et al., 2022; Hohenstein, 2022). Although all streams present important insights, they are divergent in their focus and level of analysis, which leads to a lack of integration across cost dynamics, technological adaptation, and resilience-building in a single explanatory framework.

This fragmentation is made apparent when comparing these streams' conceptualisation of supply chain change. Efficiency and cost control, capability improvement, and stability and recovery are the key points of the logistics cost studies, digital transformation research, and resilience literature, respectively. Yet, few studies directly discuss the impact of prolonged logistics cost increase on creating such dimensions within the same organisational environment. Consequently, the links between the pressure of costs and the planned supply chain change have not been adequately articulated.

Another weakness is the level of analysis. The available literature takes an industry-level or conceptual approach and is not very informative on how transformation processes occur at a particular organisational level. This is especially true in FMCG supply chains, whereby the intense distribution and time sensitivity increase the effects of changes in the cost of logistics. Where the geographical setting is limited, such as in Scotland, other influencing factors, such as dependency on a transport system and infrastructure restrictiveness, compound exposure to cost volatility (Akgün et al., 2020). Yet, only empirical research seldom investigates the influence of these contextual conditions on cost-oriented transformation on the product-line level in multinational organisations.

According to this analysis, the gap in the research may be formulated as follows:

There exist few combined insights into the role of sustained logistics cost growth as an engine of orchestrated supply chain renewal, connecting structural change, digital capacities, and resilience, in a given organisational and geographical environment.

The present paper fills this gap by examining Nestle PetCare operations in Scotland as a case study in its supply chain operations. With a combination of logistics cost dynamics, digital transformation, and resilience viewpoints under one analytical framework, the study offers a product-level analysis on how cost pressures lead to supply chain transformation in a logistics-intensive FMCG environment.

2.4 Summary and Implications for the Research

This chapter has critically assessed the literature on the logistics cost dynamics, transformation of supply chain, digitalisation, resilience, and sustainability. The discussion indicates that these themes are well elaborated in each case, but they are not combined to describe how the continuous increase in logistics costs promotes well-coordinated transformation of the supply chain. The current literature is inclined to examine cost efficiency, technological capability, or resilience separately, restricting the possibility of a holistic picture of the interaction of these facets in the context of unremitting cost pressure.

A research gap that the review discerns, thus, is the absence of an organisation-level account of the simultaneous influence of logistics cost escalation on structural change, the development of digital capabilities, and resilience within supply chains. This is especially applicable to logistics-intensive FMCG settings and geographically limited settings, where cost pressures are more acute.

To counter this, the paper constructs a conceptual framework where the cost increase in logistics is the main force of change. Cost pressures initiate strategic and operational changes in sourcing, distribution, and network design, whereas digitalisation and resilience are enabling functions that facilitate adaptation. Sustainability is not a driver, but a result of efficiency-based modifications.

Figure 2.7: Conceptual Framework Model

This framework is shown in Figure 2.6, which represents the correlation of cost pressures, transformation processes, and performance outcomes. The framework offers an ordered foundation for examining the way organisations react to persistent logistics cost instability by coordinated supply chain re-configuration.

The empirical analysis of the Nestle Purina PetCare case in Scotland is directly informed by this theoretical base. The second chapter presents the research methodology that is applied to test these relationships in a particular organisational and geographical setting.

3 Research Methodology

In this chapter, the methodological framework, which has been implemented to examine the effects of increasing logistics costs on supply chain change in the Nestle Purina PetCare business in Scotland, is described. In Chapter 2 of this thesis, a research gap was identified and revealed as the lack of organisational-level analysis integrating the cost increase in logistics with digitalisation and resilience; this chapter presents a systematic way in which the research aims to fill this gap.

The methodological choices are informed by the exploratory and context-dependent nature of the research problem. The transformation of supply chains under continuous logistic cost pressure is non-linear and not wholly technical in nature; instead, it is interdependent strategic, structural, and technological processes that need to be analysed interpretively. According to the literature on qualitative research, methodological consistency among the research aims, epistemological position, and analysis methods is necessary to guarantee coherence and validity (Lim, 2025; Bhangu et al., 2023; Surawy-Stepney et al., 2023).

Qualitative methods have become increasingly appreciated in supply chain studies as useful ways to study the complex organisational processes and gain context-specific understanding that cannot be sufficiently covered in quantitative data (Gammelgaard and Flint, 2012; Donkor et al., 2024). It is especially applicable in this research, where the aim is to learn how cost escalation impacts transformation processes and not to determine cost effectiveness. Moreover, the research takes a qualitative approach based on a case study with secondary data.

The chapter is organised in the following manner. It initially gives the research philosophy and approach upon which the study is based. It then supports the qualitative case study design and the purported Nestle Purina PetCare in Scotland. The chapter also outlines the secondary qualitative data and data collection process, and the thematic analysis. Lastly, it deals with problems of credibility, ethical concerns, and methodology.

3.1 Description of the Research Task

Nestle Purina PetCare in Scotland has been chosen on the basis of its analytical relevance to the purpose of the research and not on convenience. In qualitative research, the selection of the cases depends on the degree to which the case would yield substantial information on the phenomenon being studied. In this respect, the selected case can be viewed as a situation where the impact of logistics costs on supply chain decision-making is both influential and significant concerning the processes of cost-driven transformation (Donkor et al., 2024).

The FMCG supply chains offer a proper empirical environment because of their sensitivity to changes in logistics costs. High product turnover, time-sensitive distribution, and complex network structures are the characteristics of these supply chains that increase the effects of cost volatility on operational performance and strategic decision-making. Such environments, as recent studies point out, are especially susceptible to shocks and financial constraints, and they are in constant need of change and innovation (Niu et al., 2025).

The geographical location of Scotland also enhances the analytical importance of the case. The nature of the region has been dispersed markets and a high level of dependency on transportation infrastructure, which would expose them to the volatility in the logistics costs. This set of circumstances makes the operating environment cost-sensitive, and organisations are forced to react to external pressures to ensure efficiency and service levels remain high. The Scottish setting, therefore, offers a natural environment for examining the behaviour of logistics cost escalation, catalysing structural and strategic adjustment in supply chains.

The analytical accuracy of the research is improved by concentrating on the Nestle Purina PetCare division at the product level. Instead of looking at the whole organisation, which can be obscured by particular transformation mechanisms, a more detailed analysis of supply chain processes and responses is possible when focusing on the product level. This is in line with emerging studies that highlight the need to analyse supply chain transformation context-specifically and operationally to understand its nature (Dwidienawati et al., 2025). Moreover, the case also indicates the industry trends in terms of digitalisation and resiliency, offering both contextual richness and theoretical applicability.

3.2 Research Design and Approach

The research takes the inductive form of research, in which inferences are formed as a result of data analysis, as opposed to testing some hypotheses. Inductive reasoning is especially suitable in exploratory studies aimed at gaining insight into the complex and changing relationships, including the role of logistics costs increase, digital transformation, and supply chain resilience (Surawy-Stepney et al., 2023). The inductive approach, in contrast to deductive approaches, does not start with that, but rather lets patterns and themes be generated by the data. This is in line with the aims of this research that seek to examine the manner in which organisations react to the long-term pressure of logistics costs.

The research philosophy used in this study is interpretivist, which is suitable for analysing the complex organisational phenomena like supply chain transformation in the face of sustained pressure of logistics cost. Interpretivism is founded on the idea that organisational realities are socially constructed and contextualised and need to be interpreted and not measured (Lim, 2025). The notion of logistics cost increase in the specified study is not only a quantifiable economic parameter but the structural force behind strategic decision making, operation transformation, and redesigning of a supply chain.

This research uses a qualitative case study design to review the transformation of supply chains where logistics costs have continued to pressure the organisations in a case study. The choice of this design is based on the necessity to consider complex and interrelated organisational processes that cannot be meaningfully separated or measured. Therefore, qualitative case study research is especially suitable for exploring the modern organisational problems when the scope of the phenomenon and its context are not well delimited (Stroumpoulis et al., 2024; Donkor et al., 2024).

The study uses a single-case study design with a case study on Nestle Purina PetCare in Scotland. Although a multiple-case design could be more effective in providing a wider range of comparative data, a single-case design is more appropriate in achieving the depth of analysis and theoretical elegance. To ensure analytical clarity and methodological rigour, the case is limited in scope. The organisational focus is restricted to Nestle Purina PetCare, the industry environment

is identified as FMCG, the geographical concentration is Scotland, and the analytical focus is on the relationship between logistics cost increase and supply chain change.

Methodological Element	Description
Research Philosophy	An interpretivist approach focusing on understanding organisational responses to logistics cost pressures.
Research Approach	An inductive approach to develop insights from secondary qualitative data
Research Design	Qualitative single-case study
Case Study	Nestlé Purina PetCare (Scotland)
Data Type	Secondary qualitative data
Data Sources	Academic literature, corporate reports, industry reports, policy data
Data Analysis Method	Thematic analysis
Research Focus	Impact of logistics cost escalation on supply chain transformation.

Table 3.1: Research Design Overview

3.3 Data Collection Methods

In this paper, the researcher will only use secondary qualitative data in analysing the level of supply chain transformation at the strategic level. The application of secondary data can be explained by the fact that the research is based on the organisational responses, structural changes, and dynamics on the industry level and not on individual-level behaviour. Secondary data allows for analysing the available data of various reliable authors and identifying the patterns and relationships under different conditions (Irvine, 2024).

The use of secondary data is especially suitable in this research as it will allow gaining access to extensive and longitudinal information on supply chain strategies and practices. The evidence base, which comprises corporate reports, industry analyses, and academic literature, is rich in both theoretical perspective and real-world organisational response. It is particularly relevant in the study of supply chain transformation, where primary organisational data is frequently unavailable, and where the strategic decision is reported in sources available to the general public.

The major means of working with secondary data is document analysis. Document analysis as a methodology of qualitative research enables the methodical study of written documents to gain useful information about the organisational practices and strategies (Bowen, 2009). The academic literature is one of the main elements of the data sources, as it gives the theoretical basis of the research. Another important source of data is corporate documents that provide organisation-specific information about the supply chain strategies and transformation initiatives.

Industry publications and professional reports are used to supplement academic and corporate data in giving sector-level views on the trends in logistics, cost dynamics, and supply chain practice. Lastly, policy and regional information offer information on the external environment within which the case is conducted. A report on transport infrastructure, freight systems, and regional logistics conditions will be necessary when making decisions regarding the supply chain, considering geographical and infrastructural factors.

In order to achieve analytical rigour and relevance, the study uses explicit inclusion and exclusion criteria when selecting secondary data. Sources published after 2020 are only considered, and the chosen sources should show direct relevance to the supply chain management, logistics, or transformation processes. On the other hand, sources are filtered out in cases where they do not have methodological rigour, empirical basis, or pertinence to the research topic.

Criteria Type	Inclusion Criteria	Exclusion Criteria

Time Frame	Sources published from 2020 onward to ensure relevance to current logistics and supply chain dynamics.	Sources published before 2020, unless considered foundational or highly cited
Relevance	Direct relevance to supply chain management, logistics cost escalation, digitalisation, resilience, or transformation.	General business or management sources with no direct link to supply chain or logistics
Source Type	Peer-reviewed journal articles, reputable industry reports, corporate documents (e.g., Nestlé reports), and policy publications	Non-peer-reviewed sources, blogs, opinion pieces, or unverified online content
Methodological Rigor	Studies with clear methodology, empirical evidence, or strong theoretical grounding	Sources lacking methodological transparency, empirical support, or academic credibility
Data Quality	High-quality, credible, and widely cited sources from recognised publishers or institutions	Redundant, duplicate, or low-quality sources with questionable credibility
Contextual Fit	Sources relevant to FMCG, logistics-intensive industries, or similar supply chain environments	Sources focused on unrelated industries with no transferable insights.

Table 3.2: Data Inclusion and Exclusion Criteria

The data collection is a structured and iterative process that aims at providing transparency, consistency, and analytical consistency. In qualitative secondary research, data collection is not linear and is characterised by the constant improvement of the sources according to the new knowledge (Irvine, 2024).

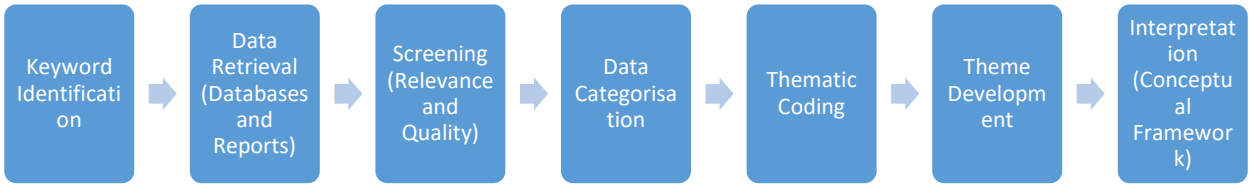

Figure 3.1: Data Collection and Analysis Process

It starts with identifying the major search terms based on the research goals and conceptual framework. After this, the topical sources are found in the academic databases, corporate repositories, and industrial platforms. The screening phase is a critical assessment of every source according to the inclusion and exclusion criteria. The identified data is further classified into the research objectives and research topic. Lastly, the pertinent data is pulled out and aligned to the conceptual framework, to make sure that the information directly leads to answering the research questions.

3.4 Data Analysis Methods

The analysis method that the study uses is thematic analysis as the main method of analysing secondary qualitative data. Thematic analysis is generally accepted as a versatile and rigorous method of analysis that allows for determining patterns, relationships, and recurring notions in various data (Sheikhattar et al., 2022; Hussain et al., 2023). The thematic analysis is especially appropriate in the framework of this study since the information will be obtained through various sources such as academic literature, corporate reports, and industry reports.

The thematic structure of analysis is based on the themes directly derived from the research objectives and conceptual framework. The themes are not considered as separate categories but as dimensions that are interconnected in terms of supply chain transformation. The analysis is aimed at determining how logistics cost increases are a propelling force that shapes strategic decision-making, operational changes, and the creation of digital and resilience capabilities. This method aligns with the current literature that argues that holistic analysis is essential in a supply

chain research study where various dimensions can interact concurrently (Dwidienawati et al., 2025).

The analysis is systematic and iterative to provide depth and consistency. It starts with familiarisation of the data, where the researcher interacts with the materials gathered to form an initial impression of the main concepts and patterns. This phase is very important in qualitative studies, as it prepares the ground for further coding and interpretation. The second phase is a coding of the data, in which the appropriate parts of information are determined and tagged based on their analysis value. This is then followed by the coding of the codes into larger themes, which are patterns of repetition among various sources. The refinement stage involves critical evaluation of themes to ascertain coherence, relevance, and conformity to the research objectives. Lastly, the conceptual framework that was created in Chapter 2 is applied to the interpretation of the themes, which allows the combination of empirical evidence and theoretical knowledge.

An advantage of this research is that the research questions, data sources, and method of analysis are clearly matched. All research questions are answered with specific data and analytical procedures. The study of logistics cost drivers relies on industry and academic sources to extract the main factors contributing to the cost increase. The process of strategic decision-making is investigated by studying corporate documents and literature, which makes it possible to analyse the way in which organisations react to cost pressures.

3.5 Reliability, Validity, and Ethical Considerations

Qualitative research is assessed based on the standard of trustworthiness instead of the conventional validity and reliability. This research embraces four important dimensions of trustworthiness in order to make sure that the methodology is rigorous. There is also credibility in using more than one source of data, and triangulation of findings was possible. The combination of academic literature, corporate reports, and industry reports allows for minimising the threat of bias and increasing the credibility of interpretations (Mugoni et al., 2024).

Reliability is provided by the clear and systematic research process. The methodological consistency is assured due to the clear description of data collection and analysis procedures, and it gives a reason to judge the reliability of the study. The issue of confirmability is resolved by basing the findings on the reported evidence, instead of subjective assumptions. Secondary data can be traced, so the readers can check where the information and interpretation were taken. The contextualisation of the case in detail supports transferability as the readers are able to evaluate how the findings can be applied to other similar supply chain contexts.

The research is conducted in accordance with the existing ethical principles of research that make use of secondary data. The research is not human-participated, and so the problem of informed consent and confidentiality is not directly relevant. Nevertheless, the issue of ethical responsibility is still at the centre of the research process. All sources are represented in the study without distortion or the selective use of data. There are proper citation and reference practices that are adhered to give credit to the original authors as well as to uphold academic integrity. Such practices comply with the ethical principles of qualitative research that stress openness, responsibility, and honesty in the usage of secondary data (Phillips et al., 2024).

In spite of the advantages, the research is prone to certain methodological drawbacks that should be remembered. The use of secondary data limits access to the internal organisational processes and decision-making mechanisms that could limit the level of insight into managerial views. The lack of primary data, i.e., interviews or surveys, further restricts the opportunity to confirm the results with the input of the organisation. The fact that the single-case design is used also restricts the generalisability of the findings. Lastly, qualitative analysis is interpretive, thus bringing about the possibility of researcher bias.

3.6 Description of the Research Process

The methodology framework of the study has been presented in this chapter, which offers a way of researching supply chain change in the face of logistics cost pressures in a coherent and analytically justified manner. This research is based on the interpretivist philosophy and takes an inductive approach, which is underpinned by a qualitative single-case study design. Thematically,

secondary data is collected and analysed to find patterns and relations through the use of thematic analysis in order to identify trends and relationships across sources.

The link between research questions, data, and analysis is a key strength of the research design. Such alignment will take care of the coherence of the methodology, but it will also make its purpose-driven. All research questions are answered with specific data and analytical procedures. This systematic consistency increases the internal coherence of the study and makes the analysis further oriented towards answering the research goals. It also portrays the best practices in qualitative research, in which methodological coherence is paramount in generating credible and meaningful results (Bhangu et al., 2023).

The methodological options provide adherence to the research aims and allow conducting a thorough study of the impact of logistics cost increase on strategic and operational change. The following chapter contains the findings of this analytical framework, with a particular emphasis on the empirical evidence of the case picked.

4 Results and Analysis

The results contained in this chapter form the analytical heart of the thesis. They are the direct result of thematic analysis of the secondary qualitative data that is performed in the framework of the methodology that is set in Chapter 3, and are assessed with references to the cost-driven supply chain adaptation framework that was developed in Chapter 2. The chapter is organised on the basis of four research questions that form the background of the study; each question is discussed in the form of a related analytical theme. Such a structure guarantees the logical organisation of the empirical account, the traceability of each theme to a particular research objective, and the overall discussion of the cumulative findings with respect to the overall research goal about the effect of increased logistics costs on supply chain transformation at Nestle Purina PetCare in Scotland.

The chapter relies on a consciously diverse body of evidence, including peer-reviewed scholarly sources written within the past 2020-2025, publicly available organisational reports prepared by Nestle, third-party industry studies, and local logistics and policy reports, to make sure that the findings are based on both theoretical considerations and empirically reported organisational practice. Secondary qualitative data is especially best fit to investigate the strategic-level phenomena such as those investigated here, as the transformation processes of interest are conveyed in publicly available corporate communications and supported by the scholarly literature on the topic of FMCG supply chains and management of logistics costs (Irvine, 2024; Mugoni et al., 2024; Donkor et al., 2024). The variety of sources of data also facilitates analytical triangulation, further enhancing the validity of the interpretive inferences made based on any one theme.

The analytical design of the chapter implies the integrative logic of the conceptual framework: the four themes, logistics cost drivers, strategic decision impacts, transformation strategies, and enabling capabilities are not separate phenomena, but aspects of the same cost-driven transformation process. Readers are thus urged to read the themes sequentially as opposed to disaggregated, understanding that the organisational reactions to the pressures recorded in Themes 1 and 2 are the changes in digital and resilience enabling structures in Theme 4, and that

the strategies of transformation in Theme 3 are being implemented via the infrastructure created by the digital and resilience enabling structures in Theme 4 (Dubey et al., 2022; Ivanov and Dolgui, 2021; Kamalahmadi et al., 2022).

In this chapter, the author presents the results of a systematic thematic analysis of secondary qualitative data, conducted according to the methodology described in Chapter 3. Based on the literature, corporate reports, industry studies, and policy reports, four interrelated themes have been identified that collectively answer the four research questions of this study. They are: (1) what are the key reasons behind logistics cost increase in the Nestlé Purina PetCare supply chain in Scotland; (2) how increased costs affect the strategic supply chain decision-making; (3) which strategies may be implemented to address this through supply chain transformation; and (4) what are the enabling roles of digitalisation and resilience. Collectively, the themes form a consistent empirical narrative of cost-driven supply chain change at the product-division level in a geographically constrained environment with a high level of logistics intensity.

The results are organised in thematic and not source-based format, which follows the inductive approach and thematic analysis approach described in Chapter 3 (Sheikhattar et al., 2022; Hussain et al., 2023). Each of the themes is discussed on the basis of the synthesis of various data sources, and the main patterns are justified by mentioning Nestlé-specific evidence that is publicly available. The chapter has tables and figures to show organised summaries of the findings.

4.1 Theme 1: Drivers of Logistics Cost Escalation

The initial research question is as follows: What are the primary causes of logistics cost increase in Nestlé Purina PetCare's supply chain in Scotland? Thematic analysis of the secondary data revealed that there were four key, interrelated drivers, namely: the volatility of fuel and energy prices; limitations in the labour market and reliance on third-party logistics (3PL); Scotland-specific geographic and infrastructure factors; and post-pandemic and geopolitical shocks to global supply chains.

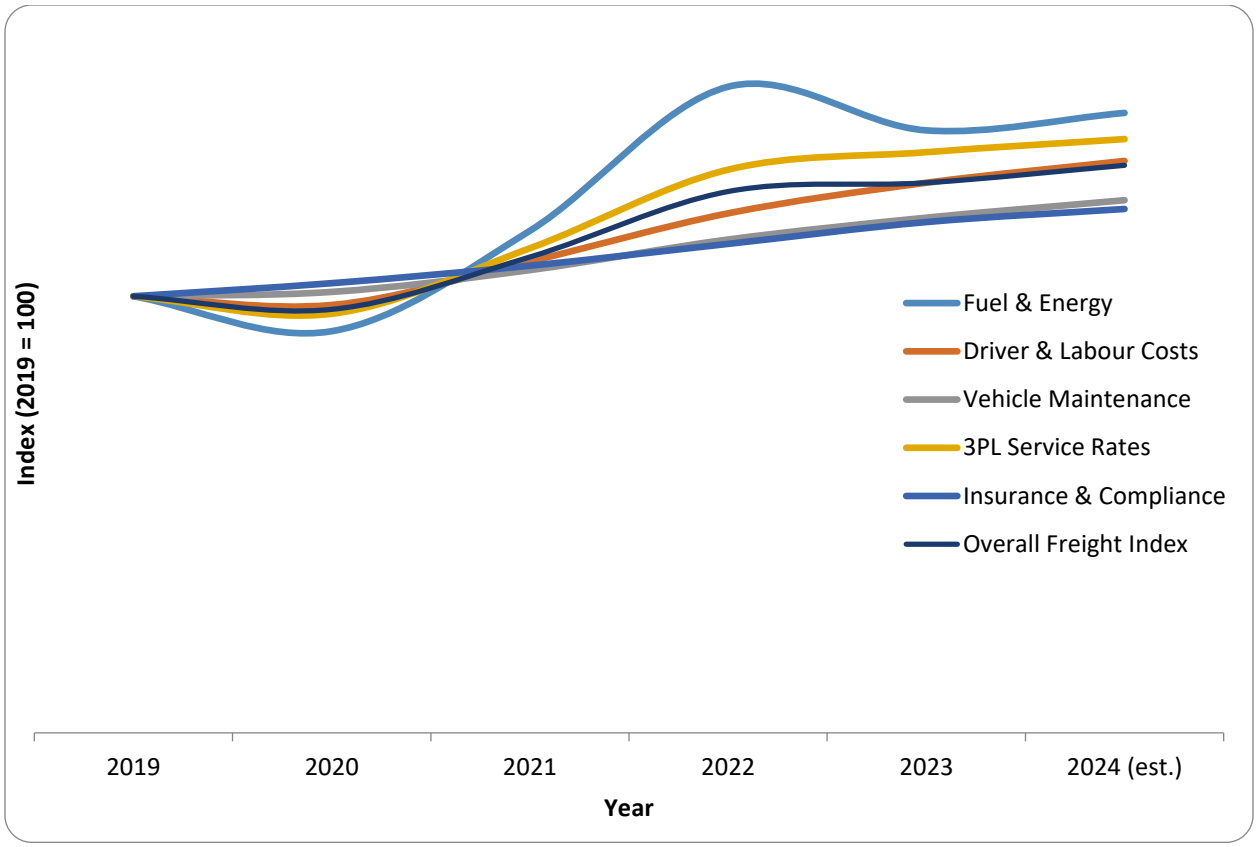

Figure 4.1: UK Road Freight Cost Components Index

4.1.1 Fuel and Energy Price Volatility

The most regularly reported factor in the increase of logistics costs in the secondary sources of data reviewed is fuel and energy prices. As shown in the literature, transportation costs, as the most significant part of the overall logistics spend, are structurally sensitive to energy price changes (Milewska and Milewski, 2022; Min, 2022). During the post-2020 era, pandemic-driven supply shocks, Eastern European geopolitical conflict, and increasing policies on energy transition led to more volatility in the fuel market than ever before, and had direct implications on the cost of freight, warehousing, and distribution (Choi, 2021; Nikolopoulos et al., 2021).

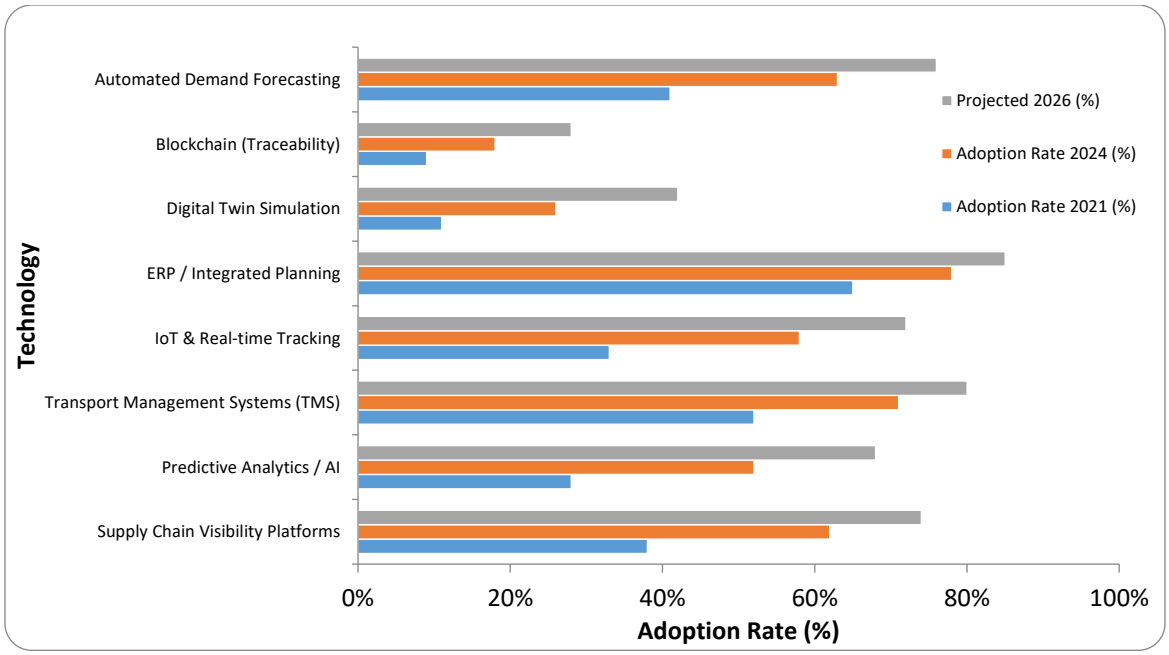

Figure 4.2: Digital Technology Adoption in FMCG Supply Chains

The empirical research by Milewska and Milewski (2022) shows that a fuel cost rise of twenty per cent or greater forces organisations to redesign their transportation networks and reassess their modal preferences and, in certain instances, repatriate sourcing from remote international providers. Min (2022) goes further to identify a statistically significant transmission of the effect of energy price volatility to the costs of commodity procurement and inventory, which suggests the effect of fuel price shocks is not limited to transportation but is also relevant to logistics planning on a larger scale. The same observation is supported by Mohammad et al. (2025) in a Middle Eastern setting, as they indicate that the volatility of crude oil prices has a systematic effect on the procurement and inventory policies in logistics-intensive sectors (Munir et al., 2020).

These dynamics are especially relevant to the supply chain operations of Nestlé in Scotland. The Purina PetCare product range is typified by a large volume of product, a high rate of replenishment, and a distribution need that is geographically spread out, features that increase exposure to the effect of an increase in per-unit transportation cost. Nestlé's (2023) corporate reporting recognises that logistics and distribution cost pressures have been a major operational challenge, which has led to strategic considerations of transportation arrangements and logistics partnerships. This exposure is further complicated by the energy intensity of cold-chain and non-

cold-chain logistics in FMCG distribution since warehousing and last-mile delivery operations have heavy energy overheads (Ivanov, 2020; Guan et al., 2020).

This evidence underpins the conceptual hypothesis that fuel and energy price volatility is not only a temporary operational cost driver, but is a structural force which can elicit strategic restructuring of the supply chain.

4.1.2 Labour Market Constraints and Third-Party Logistics Dependencies

The second driver that was identified via the thematic analysis is the compounding effect of tightening the labour market and increased dependence on third-party logistics providers. The labour shortages in the UK logistics sector (including HGV drivers, warehouse workers, logistics planners) at the end of the pandemic also minimised operational flexibility, but at the same time, increased the cost of services. Analyses of the industry report that the shortages of drivers in the UK were at critical levels between 2021 and 2023, with shortages of a minimum of over 100,000 positions at its peak (Notteboom et al., 2021; Belhadi et al., 2021). This put upward pressure on wages and rates of third-party services, which would directly raise the cost base of FMCG operators reliant on contracted logistics facilities (Dohale et al., 2022).

Similar to the activities of other multinationals in the FMCG industry, Nestlé's operations in Scotland depend heavily on the services of 3PLs in their warehousing and distribution services. This reliance adds a cost pass-through effect in which the rise in labour costs in the 3PL industry is passed on to client organisations in the form of contract renegotiation, surcharge arrangements, and a lack of service flexibility (Hohenstein, 2022; Kim and Kim, 2024). It has been suggested in the literature that high 3PL dependency FMCG supply chains are especially susceptible to such dynamics, since such organisations do not have proprietary logistics assets that can be used to absorb or offset cost increases by reoptimising internally (Song et al., 2022).

Notably, the reviewed data sources indicate that the issue of labour constraint is not only a temporary COVID-related issue but a more structural trend in the UK labour market, such as demographic changes, working pattern shifts, and the impact of post-Brexit labour environment changes (Ivanov and Dolgui, 2021; Chowdhury et al., 2021). In the case of organisations with operations in Scotland, such structural factors are compounded by the relative geographic

isolation and the shallower depth of the labour market of the region compared to the major English conurbations (Ali et al., 2021).

4.1.3 Geographic and Infrastructure Limitations in Scotland

A third unique source of logistics cost increase is the geographic and infrastructural attributes of Scotland. A study by Akgün et al. (2020) confirms that the dispersed nature of the market in Scotland, coupled with a large percentage of reliance on road freight and the lack of alternative modal choices, makes logistics systems running in the region susceptible to cost volatility compared to similar operations in less centrally located regions of the UK. The long distances between English distribution hubs, the lack of availability of intermodal freight services, and the lack of infrastructure capacity on major arterial routes further add to the per-unit logistics expenses of FMCG operators (Lohmer et al., 2020).

The Nestlé Purina PetCare case is of strategic interest in this geographic context in two ways. To start with, the spatial attributes of Scotland imply that any consolidation of routes and load optimisation, as a typical means of alleviating cost pressure in operations with a high intensity of logistics, is subject to diminishing returns above a particular threshold due to the dispersal of retail destinations. Second, the supply chain is vulnerable to port congestion and maritime freight cost volatility due to port-related freight dependencies, especially of imported raw materials and components that pass through Scottish or northern English port infrastructure (Notteboom et al., 2021).

The fact that geographically peripheral areas and those reliant on infrastructure are always more sensitive to logistics costs and less adaptive in the case of cost increases is supported in the broader literature on regional freight logistics (Craighead et al., 2020; Dolgui et al., 2020). These geographic constraints in structure thus combine with the pressures of energy and labour costs to create an exaggerated logistics cost exposure to product-division operations in Scotland (Hosseini and Ivanov, 2022).

4.1.4 Post-Pandemic and Geopolitical Disruptions

The fourth driver revealed in the process of data synthesis is the group of macroeconomic and geopolitical shocks that have structurally increased the logistics costs since 2020. The COVID-19

pandemic has caused global supply chains to be impacted by demand shocks, port congestion, container imbalances, as well as logistics capacity constraints that, together, resulted in a rise in freight rates to unprecedented levels (Guan et al., 2020; Ivanov, 2020; Sarkis, 2021). The resulting geopolitical turmoil, especially the war in Ukraine that initiated energy supply shocks and inflation strains in the logistics systems in Europe, prolonged the interval of high cost conditions beyond the immediate period of disruption by the pandemic (Niu et al., 2025) (Kumar et al., 2020; Govindan et al., 2020).

In the case of Nestlé, a multinational FMCG organisation with integrated procurement across the globe, the overall impact of these disruptions was tremendous. In its 2023 sustainability report, Nestlé recognises the major disruptions in operations and cost pressures that occurred during this period and the rapid increase in supply chain transformation initiatives in direct reaction to the altered cost environment (Nestlé, 2023). Diaz et al. (2024) report the econometric results of a supply chain disruption shock and commodity price inflation that interacted during this period to generate a long-lasting inflationary effect on the cost of logistics that surpassed the short-term forecasts of previous models (Chowdhury et al., 2021; Nikolopoulos et al., 2021).

It is confirmed in the secondary data that, together, these four drivers established a long-term and structurally high-cost logistics environment which fundamentally changed the foundations upon which decisions relating to supply chains were made. The main drivers and how they work are summarised in Table 4.1.

Cost Driver	Operational Mechanism	Key Literature
Fuel and Energy Volatility	Increases transportation costs; disrupts procurement and inventory planning	Milewska and Milewski (2022); Min (2022); Mohammad et al. (2025)
Labour Constraints and 3PL Dependency	Driver shortages raise wage costs; 3PL surcharges reduce operational flexibility.	Hohenstein (2022); Notteboom et al. (2021); Kim and Kim (2024)

Cost Driver	Operational Mechanism	Key Literature
Scottish Geographic Constraints	Peripheral location limits route consolidation; amplifies per-unit distribution costs.	Akgün et al. (2020); Dolgui et al. (2020)
Post-COVID and Geopolitical Disruptions	Container imbalances, port congestion, and energy supply shocks sustained elevated freight rates.	Ivanov (2020); Niu et al. (2025); Diaz et al. (2024)

Table 4.1: Summary of Logistics Cost Escalation Drivers in the Case Context

4.2 Theme 2: Impact on Strategic Supply Chain Decisions

The second research question is: What are the effects of increasing the cost of logistics on strategic supply chain decisions? In the thematic analysis, it is found that sustained pressure of logistics costs has an impact on three key areas of strategic decision: sourcing and procurement strategy, distribution network and transportation planning, and inventory management and demand planning. These areas do not exist in isolation, but rather they are a system of combined strategic decisions that are interdependent and each changes in response to the same underlying cost signals.

4.2.1 Sourcing and Procurement Strategy Adjustments

Reconfiguration of sourcing and procurement strategies is one of the most regularly recorded strategic measures to address enduring logistics cost growth. The literature confirms that when transportation costs are increased by a substantial amount, organisations are confronted with a changed calculation in the trade-off between the cost benefits of global or distant sourcing and the logistics overhead of transporting goods over longer supply chains (Niu et al., 2025; Dolgui et al., 2020) (Ivanov, 2020; Queiroz et al., 2020).

This has been the most evident in the reassessment of supplier geographies in the context of FMCG operations. A wider industry trend towards nearshoring and regionalisation of supply bases and the creation of dual-sourcing relationships that lower transportation cost exposure at the

expense of single distant suppliers is documented in several secondary sources (Kano et al., 2020; Wieland, 2021; Panwar et al., 2022). The publicly announced supply chain strategy of Nestlé echoes aspects of this trend: the 2023 sustainability report mentions increased attention to the proximity of supply and a shift to local sourcing programs as part of its larger supply chain change, which is already reflected in the notion of cost resilience and partially in the notion of sustainability pledges (Nestlé, 2023; Supply Chain Digital, 2024).

The secondary data also points to the more advanced supplier evaluation systems, which include the total landed cost measures, as opposed to the unit purchase price. This methodological change, a move towards total cost of ownership accounting incorporating logistics, inventory carrying, and risk premiums, is a qualitative change in the logic of procurement decision-making directly induced by the increased visibility of logistics costs (Gereffi, 2020; Ivanov, 2021; Kamalahmadi et al., 2022). In a division such as Nestlé Purina PetCare, which is logistics-intensive, the recalibration of sourcing evaluation has real strategic implications.

Also, the literature reports a heightened strategic focus on supplier relationship management as a counter to cost volatility. Organisations are making more strategic investments in collaborative procurement, long-term contracts with fuel escalation terms, and joint logistics optimisation with major suppliers (Kim and Kim, 2024; Queiroz et al., 2021). Such relationship-based approaches are a break with the entirely transactional logic of procurement and an indication that sustainable cost management in the face of volatility necessitates structural adjustment of supplier engagement models (Fosso Wamba et al., 2020; Karmaker et al., 2021).

4.2.2 Distribution Network and Transportation Planning

The second area of strategic influence is the design of the distribution network and the planning of transportation. The ongoing increase in logistics costs exerts strain on the spatial structure of distribution systems, the mode decisions made by organisations, and the tactical organisation of the transportation processes. The secondary sources evidence shows that FMCG organisations experiencing sustained cost pressure gradually implement formal network redesign reviews, which measure the optimal quantity, site, and role of distribution centres (Asgharizadeh et al., 2023; Neboh and Mbhele, 2021; Chowdhury and Quaddus, 2021).

One of the common conclusions in the literature is the increase in the focus on load consolidation, route optimisation, and vehicle utilisation as a tool to absorb cost increases in the current transportation schemes (Albertzeth et al., 2020; Pellegrino et al., 2021). These functional gains, although not a complete structural revolution, are significant adaptive measures that somewhat counteract cost increase in the short- to medium-term. Use of transportation management systems (TMS) and route planning software has created a vast improvement in organisational capability in this area by allowing route reoptimisation in real time in response to variations in fuel prices and demand (Carton et al., 2022).

In transport planning in Scotland, there are special problems due to geographic limitations, as observed in Theme 1. The constrained modal options and greater range of routes diminish the potential of major cost savings through traditional route optimisation, and the reviewed evidence indicates that Scottish-based FMCG activity is more and more based on network-level solutions, including collaborative logistics schemes and shared-user warehousing, to achieve reasonable cost benefits (Akgün et al., 2020; Belhadi et al., 2021). The operational reporting of Nestlé implies the involvement of third-party logistics management as one of the elements of transportation cost governance, as the industry shifts towards more highly managed logistics alliances (Nestlé, 2023).

4.2.3 Inventory Management and Demand Planning

Inventory management and demand planning are the third area of strategic impact. High logistics prices modify the economics of inventory holding by changing the relative appeal of the various inventory positioning strategies. In typical lean and just-in-time frameworks, the costs of holding inventory are minimised; when transportation costs are increasing at a high rate, however, the cost of high-frequency small replenishment movements can be more than the cost of holding larger strategic buffers, putting a strain on policies to re-optimise inventory holdings (Song et al., 2022; Essuman et al., 2020) (Chowdhury and Quaddus, 2021; Ivanov, 2022).

The secondary data records an increasing awareness among FMCG operators that inflexible just-in-time strategies do not fit well in a world of chronic logistics cost instability. The trend is shifting towards organisations implementing hybrid inventory policies that incorporate lean-style

predictable demand trends with strategically placed buffer levels of products with high demand, sensitive to logistics (Albertzeth et al., 2020; Ataburo et al., 2024). The reasoning goes that the expense of buffer inventory is compensated by the opportunity to minimise high-cost emergency shipments, as well as by the opportunity to secure better rates of freight due to increased volume and predictability of shipping schedules (Munir et al., 2020; Lohmer et al., 2020).

The publicly available communications of Nestlé's supply chains mention the implementation of modern demand sensing and demand forecasting technologies as one of the primary measures of enhancing inventory positioning and minimising useless logistic flows (Nestlé, 2023; Supply Chain Digital, 2024). These functional areas of intersection of digital transformation and inventory strategy reflect how the strategic areas of interest in this analysis are functionally connected (Khedr, 2024; Peng et al., 2022).

Table 4.2 gives a systematic overview of the strategic supply chain choices determined by the cost explosion of logistics, as discovered under the thematic analysis.

Strategic Domain	Key Decision Adjustments	Evidential Basis
Sourcing and Procurement	Nearshoring; total landed cost evaluation; dual sourcing; collaborative procurement	Niu et al. (2025); Kano et al. (2020); Wieland (2021)
Distribution and Transportation	Network redesign; route optimisation; load consolidation; managed 3PL partnerships	Asgharizadeh et al. (2023); Pellegrino et al. (2021); Carton et al. (2022)
Inventory and Demand Planning	Hybrid inventory models; strategic buffers; demand sensing; optimised replenishment	Song et al. (2022); Essuman et al. (2020); Nestlé (2023)

Table 4.2: Strategic Supply Chain Decisions Under Logistics Cost Pressure

4.3 Theme 3: Supply Chain Transformation Strategies

The third research question is as follows: What are the transformation strategies followed in response to the enduring logistics cost pressures? The analysis singles out four key transformation strategies: reconfiguring structural networks; diversification and collaborative logistics of suppliers; enhancing operational flexibility; and sustainability-consistent efficiency gains. These plans are very much consistent with the four dimensions of supply chain transformation, structural, operational, technological and strategic, described in the conceptual framework (Ivanov, 2020; Chowdhury and Quaddus, 2021).

4.3.1 Structural Network Reconfiguration

The most basic type of transformation response to the escalation of logistics costs is structural reconfiguration of the network. This includes an intentional redesign of the physical architecture of the supply chain, location, number of manufacturing and distribution facilities, choice of transportation corridors, and product flows on specific routes and modes (Asgharizadeh et al., 2023; Ivanov and Dolgui, 2020). The literature on network reconfiguration in FMCG settings points to the following repeating elements: consolidation of distribution levels; establishment of

regional hubs; and review of make-versus-buy options regarding logistics assets (Hosseini and Ivanov, 2022; Govindan et al., 2020).

In the case of Nestlé, corporate-level reporting on supply chains showcases a long-term programme of rationalisation and optimisation of networks, which has been hastened in the wake of the post-2020 cost environment. In the 2023 sustainability report, the company attributes investments in regional distribution infrastructure and seeks to simplify its supply chain by rationalising its network (Nestlé, 2023). Supply Chain Digital (2024) has an independent report on its global supply chain overhaul, describing it as a structural response to both efficiency demands and resilience demands. Although such reports relate to corporate-level efforts and not to Scotland-specific endeavours, the literature confirms that the operations of the product division, operating in a geographically limited area like Scotland, will be directly influenced by the decisions of corporate reconfiguration, especially on the positioning of regional hubs and the distribution footprint (Dolgui et al., 2020; Alikhani et al., 2021).

The academic literature on structural change in FMCG and logistics-intensive settings also notes the growing popularity of postponement strategies, delaying product differentiation or final packaging to stages nearer to the consumer, as a structural mechanism of lowering the costs of logistics. Organisations minimise the transportation distances and cost implications of demand forecast error by locating transformation activities in regional nodes, instead of remote centralised facilities (Rajesh, 2021; Belhadi et al., 2021) (Ivanov, 2023; Papadopoulos et al., 2020).

4.3.2 Supplier Base Diversification and Collaborative Logistics

The second identified transformation strategy includes diversifying the supplier base systematically and creating cooperative logistics initiatives. With the cost pressure conditions reported in Theme 1, the operationally and financially unsustainable risks of single-source supply and single-carrier logistics dependencies are experienced by logistics-intensive organisations (Kim and Kim, 2024; Wieland, 2021; Fosso Wamba et al., 2020; Queiroz et al., 2020).

In the literature, there are two approaches to this challenge. FMCG organisations are also investing in supplier development programmes on the supply side to push the viable supply base to regional and near-shore sourcing, thus lowering the logistics cost exposure of long-distance

international sourcing (Kano et al., 2020; Queiroz et al., 2021). On the logistics side, the emergence of carrier portfolio strategies, including sustaining relationships with multiple freight providers, different modes, and geographies, lessens reliance on single carriers, the cost structure or capacity limits of which can worsen in response to unfavourable market environments (Notteboom et al., 2021).

Another aspect of this strategy is the creation of shared logistics arrangements such as shared-user transportation programs, industry-wide freight consolidation plans, and co-loading agreements with other FMCG operators. Such cooperative strategies can greatly lower the unit cost of logistics by increasing the utilisation rates of vehicles and spreading the fixed costs of transportation over a larger volume base (Albertzeth et al., 2020; Gruchmann and Seuring, 2021). In the case of the supply chain operations in Scotland, where the comparatively thin freight market makes proprietary-only logistics solutions uneconomical, collaborative logistics is an especially applicable alternative strategy. The creation of urban consolidation centre initiatives in the Scottish context is specifically reported by Akgün et al. (2020) as a tool of enhancing logistics efficiency, which can be applied to the models of distributing FMCGs in general (Karmaker et al., 2021; Dohale et al., 2022).

4.3.3 Operational Flexibility and Adaptive Logistics

The third transformation strategy includes creating operational flexibility and adaptive logistics capabilities. The conceptual framework singles out operational transformation, including inventory management, demand planning, and logistics execution, as a critical aspect of supply chain transformation response. The secondary data supports the fact that, under pressure of costs, organisations invest in the abilities which enhance the responsiveness and flexibility of logistics operations instead of merely optimising within the given operational frameworks.

The flexibility of logistic operations can be implemented in various ways, which are reflected in the secondary materials: multi-modal transportation capacity that makes it possible to switch between road, rail, and sea transport dynamically, as relative costs fluctuate (Pellegrino et al., 2021); flexible warehousing that can scale capacity in response to variability in demand with a

minimum of disproportionate increase in fixed costs (Kamalahmadi et al., 2022; Chowdhury and Quaddus, 2021; Hosseini and Ivanov, 2022).

In its supply chain transformation reporting, Nestlé mentions the concept of adaptability as a key strategic value, which includes investments in operational flexibility as a result of which logistics strategies can be modified based on the changing market conditions (Nestlé, 2023; Supply Chain Digital, 2024). The scholarly literature confirms the perspective that this form of proactive flexibility investment, as an organisational posture taken in advance of further volatility, instead of in response to particular disruptions, is qualitatively distinct from traditional efficiency-optimisation (Ivanov, 2022; Van Hoek, 2020; Ivanov, 2020; Sharma et al., 2022).

4.3.4 Sustainability as a Co-Benefit of Transformation

The fourth dimension of transformation strategy revolves around the connection between transformation outcomes that are cost-driven and sustainability. As established in the conceptual framework, sustainability is not considered as a driver in this study but rather as a co-benefit that appears as a result of the efficiency gains related to cost-driven transformation (Stroumpoulis and Kopanaki, 2022; Oubrahim et al., 2023; Kumar et al., 2020; Govindan et al., 2020).

This characterisation is well supported by the evidence of the secondary data. The literature reports that the operational strategies that are most motivated by logistics cost-cutting, fuel efficiency initiatives, route optimisation, and load consolidation yield the same or even greater carbon emissions reductions per unit distributed (Sarkis, 2021; Sarkis et al., 2020). This correspondence between cost-efficiency and carbon-efficiency results in a positive feedback mechanism where the economic necessity of the cost management of logistics pursues environmental performance goals at the same time.

The dynamic of sustainability reporting is explicit in Nestlé. The 2023 Creating Shared Value Report reports a substantial decrease in carbon emissions related to logistics as a consequence of network efficiency enhancement and fleet decarbonisation efforts, stating that they were sought after on sustainability principles, as well as elements of a more comprehensive logistics cost management approach (Nestlé, 2023). This trend is supported by the literature on sustainable supply chain change, which has identified that the most successful organisations in

lowering emissions related to logistics have tended to pursue cost-based transformation on a holistic level (Stroumpoulis et al., 2024; Gruchmann and Seuring, 2021; Aday and Aday, 2020; Karmaker et al., 2021; Papadopoulos et al., 2020).

The four dimensions of transformation strategies identified during analysis are summarised in Table 4.3 below, the main mechanisms of each, and the underpinning evidence base.

Transformation Strategy	Principal Mechanisms	Supporting Evidence
Structural Network Reconfiguration	Distribution tier consolidation; regional hub development; postponement strategies	Asgharizadeh et al. (2023); Dolgui et al. (2020); Nestlé (2023)
Supplier Diversification and Collaboration	Near-shore supplier development; carrier portfolio strategies; shared logistics	Kano et al. (2020); Wieland (2021); Akgün et al. (2020)
Operational Flexibility	Multi-modal capability; flexible warehousing; agile supplier engagement	Pellegrino et al. (2021); Essuman et al. (2020); Ivanov (2022)
Sustainability Co-Benefits	Fuel efficiency; carbon reduction through route optimisation; fleet decarbonisation	Sarkis (2021); Nestlé (2023); Stroumpoulis and Kopanaki (2022)

Table 4.3: Supply Chain Transformation Strategies Identified Through Thematic Analysis

4.4 Theme 4: Digitalisation and Resilience as Enablers

The fourth research question is the following: How do resilience capabilities and digitalisation aid supply chain transformation amid cost pressure? The thematic analysis demonstrates that digital

technologies and resilience capabilities are facilitating infrastructure to the transformation strategies found in Theme 3, not as an end in themselves. It is possible to identify three sub-themes: the use of digital technology as a means to gain visibility and coordination; the implementation of predictive analytics and intelligent planning systems; and the systematic building of resilience capabilities (Dubey et al., 2022; Ivanov, 2023).

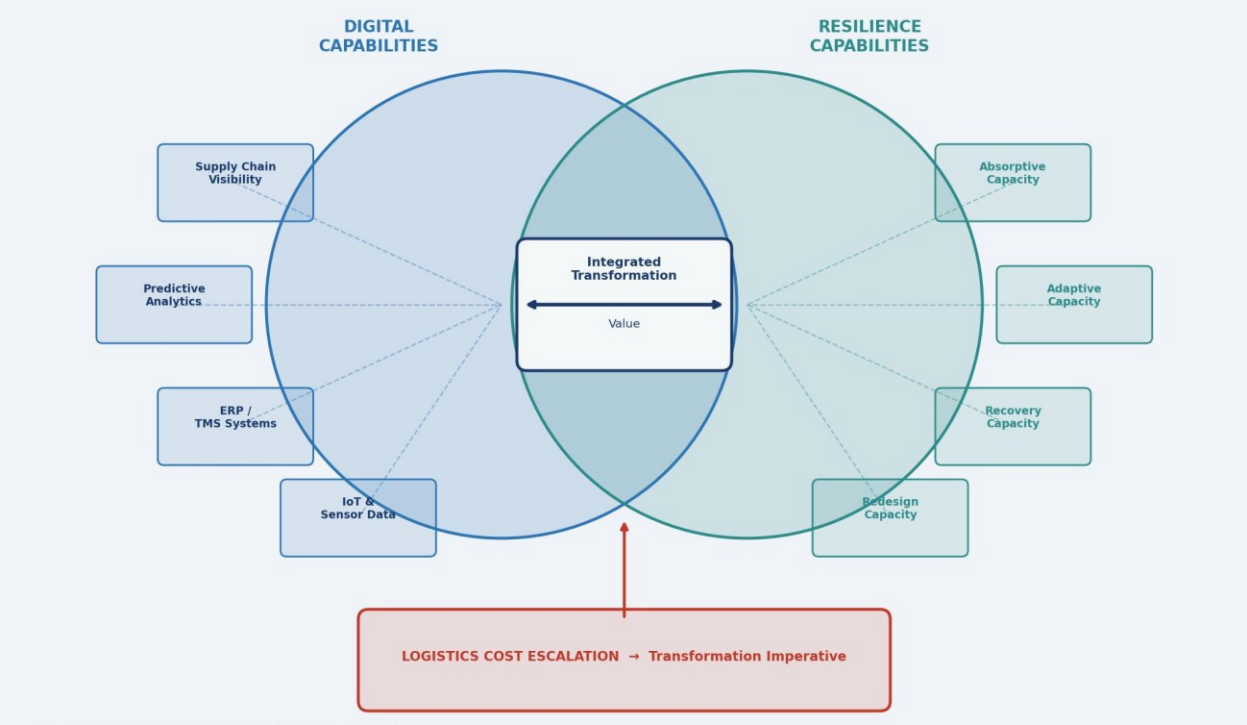

Figure 4.3: Interdependence Model for Digital Capabilities and Resilience

4.4.1 Digital Technology Adoption for Supply Chain Visibility

The identified digital capability that is present in the secondary data, as the most directly applicable to cost-driven transformation, is real-time supply chain visibility. Real-time monitoring of transportation flows, inventory levels, and costs of logistics allows organisations to dynamically react to cost indicators, recognise inefficiencies, and make decisions in response to changes without the delays of periodic reporting cycles (Carton et al., 2022; Yang et al., 2022; Fosso Wamba et al., 2020; Papadopoulos et al., 2020).

The value of visibility is greater, especially in the case of FMCG supply chains that run through complex, multi-echelon distribution channels. Studies show that organisations that have high

supply chain visibility scores consistently outperform less visible peers on logistics cost management indicators, achieving higher vehicle utilisation rates, lower emergency freight spend, and better inventory placement (Khedr, 2024; Le and Fan, 2024). The technology platform behind these features consists of IoT-enabled asset tracking, cloud-based transportation management platforms, and integrated enterprise resource planning (ERP) environments that enable a single view of data about procurement, production, and distribution (Nguyen et al., 2021; Ivanov, 2023).

Nestlé has publicly outlined investing in supply chain digitalisation as a fundamental element of its transformation agenda, such as implementing advanced planning and scheduling systems and incorporating logistics data streams into enterprise planning environments (Nestlé, 2023; Supply Chain Digital, 2024). The evidence on digital transformation in supply chains proves that companies as large and complex as Nestlé need to be end-to-end digitised to realise significant logistic cost reduction by optimising processes through visibility (Garay-Rondero et al., 2020; Preindl et al., 2020; Dubey et al., 2022; Ivanov, 2023; Queiroz and Fosso Wamba, 2021).

4.4.2 Predictive Analytics and Intelligent Planning

In addition to real-time visibility, the secondary data reflects the increasing strategic value of predictive analytics and smart planning systems as facilitators of cost-based change. Predictive analytics, using historical data, external signals, and machine learning models to predict the future state of logistics costs and demand trends, can help organisations transition to proactive, as opposed to reactive, logistics management (Islam and Ikbal, 2022; Patrick et al., 2022; Nguyen et al., 2021; Khedr, 2024; Nikolopoulos et al., 2021).

Practically, predictive analytics enables cost-based transformation in various ways. The accuracy of demand forecasting allows for more accurate positioning of inventory, minimising stock-outs that cause costly emergency replenishment and unnecessary inventory that leads to unnecessary carrying costs (Khedr, 2024). Cost forecasting systems improve modal and carrier selection decisions because they can accurately predict transportation costs, making it easier to schedule freight bookings to avoid peak-rate seasons. Dynamic routing algorithms allow adjusting delivery

routes based on real-time cost information, minimising fuel consumption and vehicle idle time (Le and Fan, 2024; Wamba et al., 2020; Ivanov, 2023; Papadopoulos et al., 2020).

The scholarly literature describes these features altogether as a part of the overall transition to data-driven supply chain management, where the quality and speed of information processing will be one of the main competitive advantages (Abideen et al., 2021; Yu et al., 2020; Bag et al., 2020). In cost-sensitive logistics-intensive FMCG operations, the capability to implement predictive intelligence in sourcing, distribution, and inventory planning can be seen as a qualitative change in the decision-making environment, and not a simple efficiency improvement to the current processes.

4.4.3 Resilience Capability Development

The third enabling dimension that is determined in the course of the thematic analysis is the systematic development of supply chain resilience capabilities. Cost-driven transformation, and not a strategic goal, is how resilience is conceptualised in this study, as established in the conceptual framework. The secondary data evidence supports and expounds this characterisation: organisations that invest in logistics cost management by employing transformation strategies gain resilience capacities as a by-product of the structural, operational, and digital transformations that they undertake (Chowdhury and Quaddus, 2021; Hosseini and Ivanov, 2022).

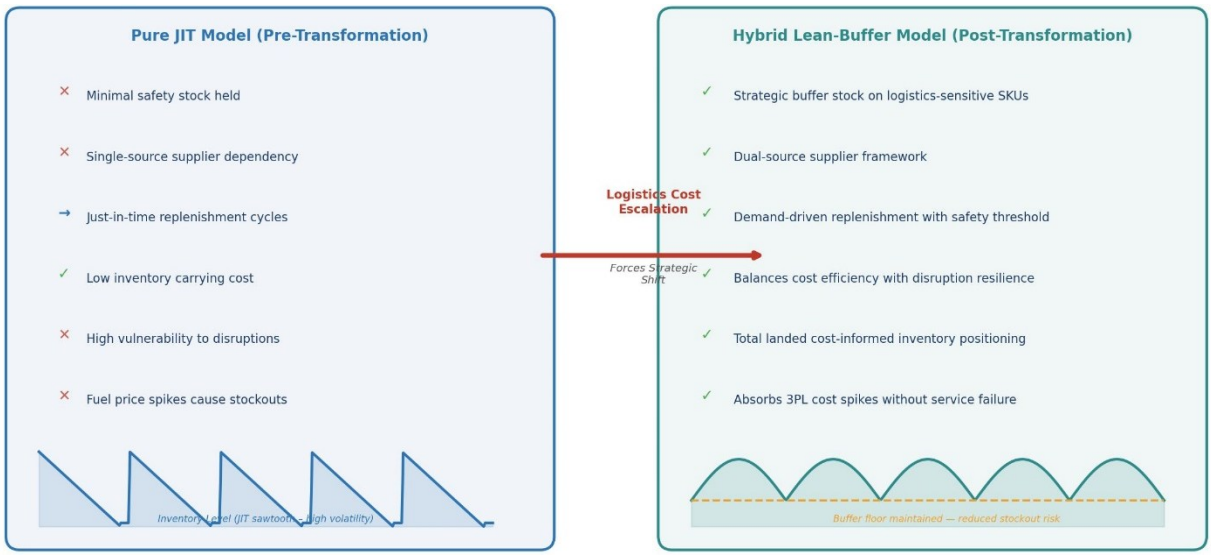

Figure 4.4: Comparison of the old pure JIT model vs the new hybrid lean-buffer strategy

The literature identifies four resilience capabilities particularly relevant to the case context: absorptive capacity, which enables supply chain continuity during short-term disruptions through inventory buffers and redundant logistics arrangements (Song et al., 2022; Essuman et al., 2020); adaptive capacity, which enables dynamic adjustment of sourcing and distribution in response to changing cost conditions (Hohenstein, 2022; Ivanov, 2022); recovery capacity, which supports rapid restoration of supply chain performance following disruption through coordinated logistics protocols and information sharing (Kim and Kim, 2024; Ataburo et al., 2024); and redesign capacity, which enables deliberate structural reconfiguration to reduce future vulnerability (Ivanov and Dolgui, 2021; Kamalahmadi et al., 2022).

The available evidence provided in the publicly accessible materials of Nestlé suggests the involvement in resilience-building in a number of these dimensions. The sustainability report of 2023 mentions supply chain resilience as one of the strategic priorities, and in particular, the diversification of the suppliers, the investments in the logistics redundancy, and the creation of contingency logistics protocols as measures of addressing the risk of the supply chain (Nestlé, 2023). The scholarly evidence of resilience in FMCG situations supports the conclusion that such

investments yield quantifiable gains in the strength of supply chains (Belhadi et al., 2021; Chowdhury et al., 2021; Nandi et al., 2021; Lohmer et al., 2020; Karmaker et al., 2021).

Enabling Capability	Functional Role in Transformation	Evidence Base
Supply Chain Visibility	Real-time monitoring of flows, costs, and inventory enables dynamic reoptimisation	Carton et al. (2022); Yang et al. (2022); Khedr (2024)
Predictive Analytics and Planning	Demand sensing; transportation cost forecasting; dynamic routing	Islam and Ikbal (2022); Nguyen et al. (2021); Wamba et al. (2020)
Absorptive Resilience	Buffer inventory; redundant logistics arrangements; short-term continuity	Song et al. (2022); Essuman et al. (2020)
Adaptive Resilience	Dynamic sourcing and distribution adjustment; scenario-based planning	Hohenstein (2022); Ivanov (2022)
Recovery and Redesign Resilience	Rapid restoration protocols; structural reconfiguration to reduce future vulnerability	Ivanov and Dolgui (2021); Kamalahmadi et al. (2022)

Table 4.4:Digitalisation and Resilience Enablers of Supply Chain Transformation

Importantly, the evidence supports the perspective, facilitated in the conceptual framework, that digital capabilities and resilience capabilities are functionally interdependent: the real-time visibility and predictive analytics in sub-themes 4.4.1 and 4.4.2 are the informational infrastructure based on which the adaptive and recovery resilience capabilities rely (Dubey et al., 2022; Ivanov and Dolgui, 2021). This interdependence implies that investments in the digital transformation and resilience-building strengthen one another, generating a compounding capability advantage to organisations that build both dimensions concurrently (Hosseini and Ivanov, 2022; Queiroz and Fosso Wamba, 2021).

4.5 Chapter Summary

This chapter has outlined the thematic findings of the research in four themes that are interrelated. The first theme found that the increasing cost of logistics in the Nestlé Purina PetCare supply chain in Scotland is caused by a complex set of structural forces, i.e., fuel and energy volatility, labour market constraints, geographic limitations, and post-pandemic disruptions, which collectively create a sustained rather than a transient cost pressure environment. The second theme revealed that this pressure has a systematic effect on all three strategic areas of sourcing, design of the distribution network, and inventory management, resulting in visible changes in decision logic and strategy formulation. The third theme recorded four strategies of transformation, structural reconfiguration, supplier diversification, operational flexibility, and sustainability-aligned efficiency, by which organisations react to continued cost escalation with multi-dimensional transformation programmes. The fourth theme determined that digital technologies and resilience capabilities are enabling the infrastructure of these transformation strategies, and digital visibility, predictive analytics, and resilience capacity development constitute a mutually reinforcing system of capability. The next chapter elaborates on these findings as they relate to the conceptual framework and draws out theoretical and practical implications.

5 Discussion and Conclusion

This chapter explains the thematic results of Chapter 4 through the theoretical framework developed in Chapter 2 and the wider scholarly discourse about supply chain transformation. It is not intended to restate the findings but to test what they entail, theoretically, empirically and practically, and to test the extent to which they corroborate, qualify or generalise the conceptual propositions formulated to inform this study. Chapter 4, on the other hand, is more abstract in its operation than Chapter 4 and takes a step further to outline what was found and evaluate the importance of this finding to knowledge and the contribution of the same.

One of the characteristics of this discussion is its integrative orientation. The four thematic findings of Chapter 4 are not presented in a vacuum but in their interconnections with each other, and with the theoretical structure of the study. Logistics cost increase does not have the effect in the conceptual framework with clear, separate changes in individual supply chain sectors, but rather coordinated multi-dimensional reactions in sourcing, distribution, inventory, digitalisation and resilience, all at the same time. The discussion chapter will thus be designed to celebrate this integration, exploring each theme and synthesising across the themes to produce the theoretical contributions and managerial implications that form the main scholarly products of the study (Dubey et al., 2022; Ivanov and Dolgui, 2021; Niu et al., 2025).

The last point to consider is that this discussion is based solely on evidence published in the academic literature of 2020 and beyond, but with corporate and industry documentation that relates specifically to the supply chain activities of Nestle Purina PetCare. This time frame indicates the methodological inclusion criterion used in Chapter 3 and assures that the interpretive conclusions made in this study are based on the current literature, but not on historical assumptions that this post-2020 logistics environment could have rendered irrelevant (Milewska and Milewski, 2022; Chowdhury and Quaddus, 2021; Hosseini and Ivanov).

This chapter explains the results of Chapter 4 in the context of the theoretical framework formulated in Chapter 2 and the literature on supply chain transformation. It examines how the results confirm, qualify, or generalise the conceptual framework constructed in this research, and

extracts the inferences of the analysis for the theory and practice of supply chain management. The chapter is structured with the four thematic findings of the research, and then the theoretical contributions and managerial implications of the study are presented.

5.1 Logistics Cost Escalation as a Structural Transformation Driver

The results in Chapter 4 serve as the empirical evidence, based on the secondary qualitative data, of the main idea of the conceptual framework: that the continuous increase in logistics costs is a structural factor of the coordinated transformation of the supply chains, instead of the short-term operational inconvenience that can be mitigated by the temporary control of costs. This is an important distinction between reactive cost management and proactive structural transformation, which has significant implications for the way organisations comprehend and react to the logistics cost challenge. The four cost escalators found in Theme 1, including fuel and energy price volatility, labour market constraints, 3PL dependency, Scottish geographic and infrastructure constraints, and post-pandemic and geopolitical disruptions, together constitute a multi-source, long-lasting cost pressure environment. The effects of interaction between these drivers are especially noteworthy: they would be individually manageable by gradual adjustment of operations, but the combination of them operating together and persistently would cause the cost displacement that would not be possible to mitigate without changing the supply chain system itself. This result is consistent with and is an extension of the cost-based adaptation literature synthesised in Chapter 2, with Milewska and Milewski (2022) and Niu et al. (2025) positing that a continuous multi-source cost pressure is qualitatively distinct from cyclical or single-source cost shock (Chowdhury and Quaddus, 2021; Ivanov and Das, 2020).

The Scottish geographic setting gives a significant spatial aspect to this argument. The results support the characterisation of the logistics environment in Scotland as structurally cost-sensitive, as Akgün et al. (2020), but go further to show how geographic constraints combine with energy and labour pressures to enhance the transformation imperative for the product-division supply chain activities in this region in particular. This local specificity, showing that the dynamics of transformation are manifested differently in geographically limited peripheral geographies than in more centrally located, modally diverse logistics landscapes, is a real contribution of this paper

to the body of literature that situates supply chains in place (Hosseini and Ivanov, 2022; Lohmer et al., 2020).

The evidence examined also confirms that the cost escalation has increased the pace of transformation initiatives, which could have otherwise been a slow process. The supply chain reporting and reviewed industry analyses by Nestlé suggest that multi-year-horizon transformation programmes have been expedited and moved to top priority due to the sense of urgency established by post-2020 cost dynamics (Nestlé, 2023; Supply Chain Digital, 2024; Ivanov and Dolgui, 2021). This dynamic of acceleration, when cost pressure is not only a direction-setter of change but also an accelerant, is under-researched in the existing literature and deserves additional theoretical consideration (Ivanov, 2023; Papadopoulos et al., 2020).

5.2 Strategic Decision Reconfiguration Under Cost Pressure

The results of Theme 2 validate and expand the theoretical hypothesis that cost escalation in logistics drives coordinated reconfiguration in the key strategic areas of supply chain decision-making. The three areas identified, sourcing strategy, design of the distribution network, and inventory management, align with the structural, operational, and strategic transformation aspects of the conceptual framework and therefore indicate that cost pressure does not impact supply chains selectively but leads to concurrent changes in a variety of decision areas (Munir et al., 2020; Chowdhury and Quaddus, 2021).

Of particular interest is the observation that reconfiguration of sourcing strategy entails a qualitative change in the logic of making decisions, a shift from unit purchase price optimisation to total landed cost assessment, rather than a quantitative change in the current sourcing parameters. This change has been theorised in the global value chain literature (Kano et al., 2020; Gereffi, 2020; Wieland, 2021) but has not yet been shown as a product-division-level reaction to the logistics cost pressure in the FMCG setting (Ivanov, 2020; Queiroz et al., 2020).

The observation that the inventory management approach is moving towards hybrid approaches that combine lean principles with strategic location of buffers for logistics-sensitive product lines has significant implications for the literature on lean supply chains. The leading paradigm of lean

also presupposes that inventory minimisation is always value-adding; the results indicate that, in the circumstances of persistent logistics cost volatility, the assumption has to be qualified in terms of context. Properly placed and managed strategic buffer inventory can potentially lower the overall supply chain cost by preventing costly emergency freight spend and negotiating a better freight rate, an argument consistent with the theoretical literature by Essuman et al. (2020) and Ataburo et al. (2024) (Lohmer et al., 2020; Karmaker et al., 2021).

5.3 Transformation Strategy as an Integrated Programme

The four transformation strategies suggested in Theme 3, structural network reconfiguration, supplier diversification and collaborative logistics, operational flexibility development, and sustainability co-benefits, are an integrated transformation programme and not a menu of independent tactical opportunities. This integration is analytically significant: the secondary data continuously indicates that organisations that have realised significant and sustained logistics cost savings have acted with many dimensions of the strategy of transformation implemented at once and not sequentially, and that the effect of interactions across dimensions generates synergies unavailable to single-dimension solutions (Fosso Wamba et al., 2020; Hosseini and Ivanov, 2022).

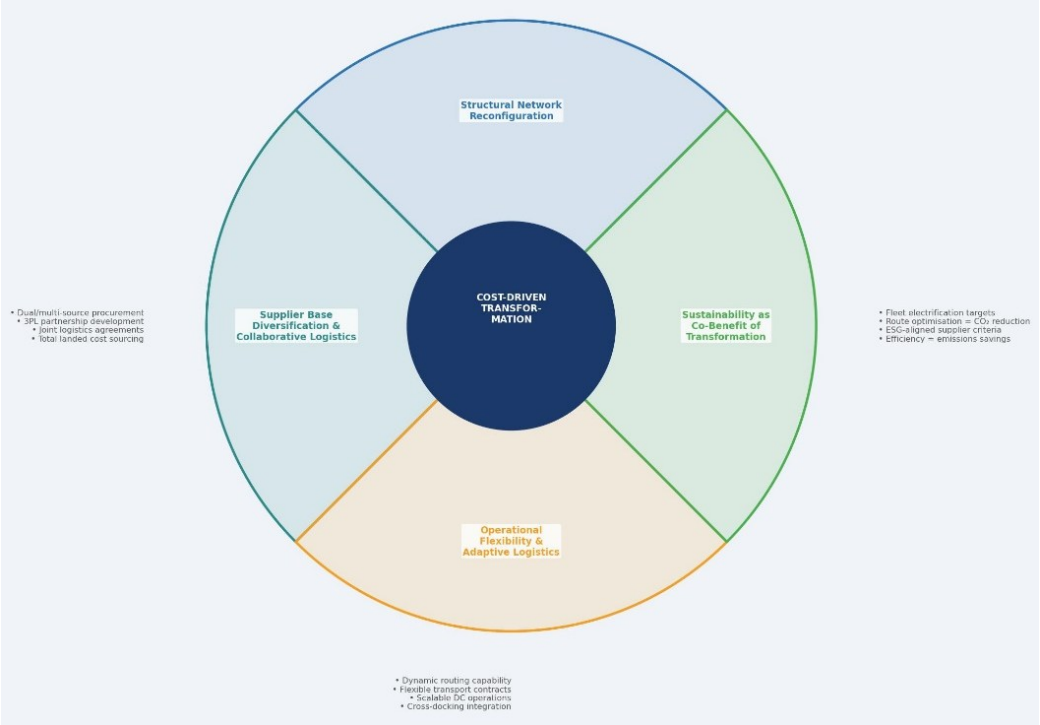

Figure 5.1: Integrated Multi-Domain Supply Chain Transformation Programme

The results of structural reconfiguration are aligned with the wider body of literature on supply chain network redesigning in the face of cost pressure (Dolgui et al., 2020; Asgharizadeh et al., 2023), but the findings of the case of Nestlé provide a product-division specificity that is relatively uncommon in the published literature, where the emphasis is on corporate-level decisions. The product-division emphasis shows that structural transformation decisions at the corporate level have both direct and substantial implications for product-line operations in geographically particular places, providing both constraints and opportunities for locally responsive strategy (Ivanov, 2023; Dohale et al., 2022).

The sustainability co-benefit result confirms and carries over the conceptual framework's description of sustainability as an accidental product of a transformation brought about by efficiency. Each of Sarkis (2021), Stroumpoulis and Kopanaki (2022), and Gruchmann and Seuring (2021) theoretically justifies the compatibility between cost efficiency and carbon efficiency in logistics processes; the results of each study reveal the compatibility in the context of Nestlé's supply chain transformation. This has wider implications on the integration of sustainability strategy and supply chain cost management: there is evidence that, when they are viewed as part of the same strategy and not competitive imperatives, the results on both fronts are better (Kumar et al., 2020; Karmaker et al., 2021).

5.4 Digital-Resilience Interdependence as a Capability Framework

The results of Theme 4 on the enabling role of digitalisation and resilience capabilities provide a clear theoretical contribution with its depiction of the functional interdependence of the two dimensions of capabilities. The conceptual framework has considered digital transformation and resilience as parallel enabling capabilities; the results indicate that they are more appropriately considered mutually constitutive, digital capabilities are the informational infrastructure on which resilience capabilities rely, and resilience requirements form the strategic imperative which stimulates the development of digital capabilities. This interdependence coincides with the theoretical argument by Dubey et al. (2022) regarding dynamic digital capabilities and supply

chain resilience, and the study by Ivanov and Dolgui (2021) of digital supply chain twins as resilience enablers (Hosseini and Ivanov, 2022; Queiroz and Fosso Wamba, 2021).

Of particular importance is the discovery that predictive analytics is a transformative and not merely an incremental capability in supply chain management that is cost-driven. It recommends that the capability differentiation in logistics cost management in the future will not be based on the availability of information in itself, which is becoming commoditised, but on the organisational potential to use predictive intelligence in real-time operational decision-making. This directly applies to investment prioritisation in programmes of supply chain digitalisation and competitive positioning of organisations in the FMCG sector (Ivanov, 2023; Nikolopoulos et al., 2021).

5.5 Theoretical Contributions

This research has three key theoretical contributions to the literature of supply chain management. First, the study offers a unified conceptual explanation of cost escalation in logistics as a unified engine of supply chain change by synthesising evidence on the domains of cost dynamics, strategic adjustment, digital transformation, and resilience into a single analytical framework. The existing literature approaches these domains separately; this research shows that they are connected and mutually reliant within a particular organisational and geographic environment, providing a comprehensive cost-driven transformation model (Milewska and Milewski, 2022; Niu et al., 2025; Preindl et al., 2020; Essuman et al., 2020; Chowdhury and Quaddus, 2021; Hosseini and Ivanov, 2022).

Second, the research adds a product-division-level perspective on supply chain transformation, which is insufficiently represented in the literature. The majority of the published literature on cost-driven transformation is based on corporate or industry-level dynamics; this study shows that product-division analysis in a geographically limited context shows clear dynamics of transformation and constraints that disappear at higher levels of aggregation (Ivanov and Dolgui, 2020; Kamalahmadi et al., 2022).

Third, the study contributes to the theoretical knowledge about the digital-resilience interdependence by illustrating how it is reflected and what it means in the context of a real-world FMCG transformation. The theoretical argument of co-development of digital-resilience has been developed in the academic literature (Dubey et al., 2022; Ivanov, 2022); this study offers the contextualised empirical evidence of the argument on the product-division level, extending the evidence base and refining the theoretical propositions concerning the mechanisms through which digital capabilities and resilience capabilities mutually reinforce each other (Fosso Wamba et al., 2020; Queiroz and Fosso Wamba, 2021).

5.6 Managerial Implications

The results of the present research can have several substantive implications for supply chain managers who work in the logistics-intensive FMCG setting.

To begin with, the research highlights the strategic urgency of considering the logistics cost increase as a driver of transformation and not a cost control issue. Companies that react to the long-term cost pressure by implementing incremental operational changes and cost-cutting in current supply chain structures will realise that the measures are inadequate in the long run. The above evidence suggests that the multi-source logistics cost pressures experienced in the post-2020 environment demand a coordinated change in sourcing, network structure, inventory policy, digital capabilities, and resiliency, all at once (Munir et al., 2020; Karmaker et al., 2021). The leaders of supply chains are advised to therefore frame logistics cost management as a cross-functional transformation agenda as opposed to a functional efficiency programme.

Second, the results provide an understanding of how the total landed cost view is strategically valuable in sourcing decision-making. Unless procurement functions are optimised based on the unit cost of purchase alone, they will underestimate the actual cost of the supply arrangements in the dynamic logistics environment. Total landed cost modelling capabilities should be invested in organisations to ensure that they integrate transportation, inventory carrying, risk premium, and resilience value dimension into supplier assessment frameworks.

Third, the interdependence of digital and resilience capabilities has direct effects on supply chain technology investment prioritisation. Digital transformation and resilience-building should not be viewed by organisations as either sequential or independent programmes; the evidence shows that they are best co-created as an integrated capability system. Supply chain visibility and predictive analytics investment must thus be specifically linked with investments in resilience capabilities, absorptive, adaptive, and recovery, to enable the full strategic value of the digital investment to materialise (Hosseini and Ivanov, 2022; Dubey et al., 2022).

Fourth, the results support the significance of place-specific logistics strategy among organisations that work in geographically peripheral areas like Scotland. The supply chain configurations which are optimised using more centrally located and modally diverse logistics setups can have poor results when implemented without modifications in peripheral locations. Leaders in supply chains who work in these environments are advised to pursue geographically-adjusted strategies such as collaborative logistics arrangements, network redesigns that take into consideration the geographic infrastructural limits, and resilience investments tailored to the geographic cost exposures of their operations environment.

5.7 Revisiting the Research Aim and Objectives

This final section ties the analytical strings that have been drawn throughout the other five chapters into a coherent final description of the purpose of the study, findings, contributions and limitations. It does not present new analysis, but synthesises what has been developed: the research problem stated in Chapter 1, the theoretical framework developed in Chapter 2, the methodology rationale in Chapter 3, the thematic results in Chapter 4 and the interpretive discussion presented above. The conclusion is thus the intellectual act of the thesis capstone, the point at which the research questions are determined, the contributions to knowledge are made clear, and limits to what has been claimed are candidly noted.

The chapter is developed in such a way that it can be used by academic and applied readers. To the academic reader, it repeats the research objectives and shows that all of them have been fulfilled, pulls out the theoretical contributions in a precise way and indicates the limitations that are specific in that they qualify the scope of the claims made. It reduces the managerial

implications to practical advice to the practitioner, and directs future research agenda where the evidence base could be further extended and deepened. All these factors comprise a full academic conclusion within the framework of the qualitative research in supply chain management (Donkor et al., 2024; Stroumpoulis et al., 2024; Mugoni et al., 2024).

There is one last point on scope that is worth mentioning. The study targets the supply chain activities in the Nestle Purina PetCare product division in Scotland, one instance in a geographically limited, logistics-intensive FMCG context. The inferences made are thus analytic, not statistical generalisations; they do not rely on the assertion about all FMCG supply chains or all multinational corporations, but theoretically informed interpretations of a deep and thoughtfully selected empirical environment (Irvine, 2024; Ivanov and Dolgui, 2021; Chowdhury and Quaddus, 2021).

This thesis aimed to investigate how continuously rising logistics costs affect the supply chain change in the Nestlé Purina PetCare operation in Scotland, and how strategic decision-making, network structure, and responsive supply chain practices influence the logistically intense environment. The four objectives were to understand the major drivers of escalating logistics costs; to understand how increasing costs change strategic supply chain decisions; to understand the responses to transformation; and to understand the contribution of digitalisation and resilience capabilities towards supporting cost-driven transformation.

The four objectives have been met by the thematic analysis of secondary qualitative information that has been provided in Chapter 4 and analysed above. The results show that every objective produced meaningful results, which together address the overall research aim. The four drivers of cost escalation have been defined and contextualised in the context of the Scottish operating environment; the strategic decision reconfiguration has been plotted across sourcing, distribution, and inventory spaces; the transformation strategies have been described and analytically categorised; and the facilitating roles of digitalisation and resilience have been characterised and theorised through the prism of digital-resilience interdependence.

5.8 Summary of Key Findings

The research gives four main results, which combine to give a coherent picture of cost-based supply chain change at the product-division level. The initial insight is that the increment of logistics costs in the Nestlé Purina PetCare supply chain in Scotland is caused by a complex of structural forces, namely fuel and energy price volatility, labour market constraints and dependency on 3PLs, geographic and infrastructure constraints, and post-pandemic and geopolitical disruptions, which interact to create a long-term cost pressure environment that cannot be resolved through incremental operational adjustment (Chowdhury and Quaddus, 2021; Hosseini and Ivanov, 2022).

The second observation is that ongoing cost pressure activates coordinated reconfiguration in three strategic areas at once: sourcing and procurement strategy changes to total landed cost assessment; distribution network design includes more consolidation and collaborative logistics; and inventory management transforms away from lean just-in-time models to hybrid strategies that include strategic buffers on logistics-sensitive product lines (Kano et al., 2020; Pellegrino et al., 2021; Essuman et al., 2020; Munir et al., 2020; Ivanov, 2020).

The third observation is that successful organisational reactions to the escalation in logistics costs are in the form of multi-domain transformation programmes as opposed to single-domain enhancement. The four dimensions of transformation strategies, reconfiguration of structural network, diversification and logistics collaboration with suppliers, development of operational flexibility, and sustainability-oriented efficiency, are synergistically interacting, which leads to results that cannot be obtained under the influence of any single strategy implemented independently (Asgharizadeh et al., 2023; Wieland, 2021; Gruchmann and Seuring, 2021; Fosso Wamba et al., 2020; Dohale et al., 2022).

The fourth observation is that digital visibility, predictive analytics, and resilience capabilities are mutually reinforcing, facilitating infrastructure to supply chain transformation. Digital capabilities offer the informational base on which resilience capabilities are structured and run; resilience needs, in turn, lead to the need to develop digital capabilities. This digital-resilience interdependence is a unique and strategically valuable attribute of cost-led supply chain

transformation in logistics-intensive FMCG settings (Dubey et al., 2022; Ivanov and Dolgui, 2021; Kamalahmadi et al., 2022; Hosseini and Ivanov, 2022; Queiroz and Fosso Wamba, 2021).

5.9 Research Limitations

This research can be characterised by a number of methodological and contextual limitations, which must be considered when discussing the results.

The main methodological drawback is the use of secondary qualitative data only. Although it is the correct method to use for the strategic-level organisational analysis conducted and aligned with the existing qualitative research practice (Irvine, 2024; Mugoni et al., 2024), it limits the extent of empirical understanding that can be achieved. Primary data gathering, interviews with supply chain managers, observation at the site, or internal operational data would give more in-depth and operationally specific evidence of the described processes of transformation. The lack of primary data implies that the results can only be rebuilt based on publicly available secondary data, which might not fully capture actual internal decision-making processes.

Although analytically suitable by its depth of focus, the single-case design restricts the generalisability of the results. The Nestlé Purina PetCare case in Scotland offers a good empirical background, but must not be presumed to be generalised in the transformation of the FMCG supply chain. The contextual factors that might not be achieved in other organisations or geographic contexts include the geographic specificity of the Scottish context, the size and resources of Nestlé as a multinational corporation, and the product-related factors of the Purina PetCare division (Stroumpoulis et al., 2024; Donkor et al., 2024).

Another shortcoming is the time horizon of the evidence base. Although the sources have been chosen since 2020 to keep the information up-to-date, the time frame is one of unprecedented and possibly non-representative volatility in logistics costs. The results can thus reflect a dynamic, specific, and non-representative moment in the history of global supply chains rather than a consistent change pathway through time.

Lastly, the researcher's interpretation is the natural constraint of the interpretivism epistemological stance taken in the study, although analytically suitable. The thematic analysis entailed the judgments of relevance, meaning, and weight of secondary data sources that could be different to another researcher. The report of these interpretive decisions is clear in the methods chapter and findings to facilitate the confirmability of the analysis (Bhangu et al., 2023; Phillips et al., 2024).

5.10 Future Research Directions

The results and constraints of this investigation pinpoint a few fruitful avenues of research for the future. The most urgent one is to continue the line of analysis of this study with the help of primary data gathering. The secondary data analysis used in this study, together with primary interviews or surveys of supply chain managers, could be considerably enriched with further empirical insights into the dynamics of transformation that have been found. Specifically, primary research might shed light on the internal decision-making process and organisational issues surrounding the introduction of integrated transformation programmes under the pressure of logistics costs, dimensions that cannot be comprehensively described by secondary data (Ivanov, 2020; Wieland, 2021; Hosseini and Ivanov, 2022; Dohale et al., 2022).

A comparison research with several cases would allow assessing the degree to which the dynamics of transformation noticed in the Nestlé Purina PetCare case can be generalised to FMCG organisations, geographic settings, and product lines. More generalisable theoretical propositions would be produced by comparative analysis of organisations of different levels of transformation maturity, different geographic footprints, and different scale profiles with regard to the cost-driven transformation relationship.

The analysis of the interdependence of digital resilience that was found in Theme 4 could also be expanded with the help of a quantitative study in the future. A more effective empirical foundation of the theoretical propositions put forward in this study would be structural equation modelling or longitudinal panel analysis of the relationship between the investment in digital capability, the development of the resilience capacity, and the supply chain cost performance

(Dubey et al., 2022; Kamalahmadi et al., 2022; Queiroz and Fosso Wamba, 2021; Chowdhury and Quaddus, 2021).

Lastly, the geographic aspect of the research opens up additional research on the topic of place-specific supply chain change in other marginalised or limited logistics settings. Studies that employ similar analytical models to supply chain change in similarly peripheral European markets, such as the other parts of the UK, Scandinavian periphery, or Southern European island markets, would provide useful comparative data on how geographic context can influence cost-driven change processes (Akgün et al., 2020; Notteboom et al., 2021).

5.11 Conclusion

The thesis has discussed the effects of increasing logistics expenses on supply chain change in Nestlé Purina PetCare in Scotland using a qualitative, single-case study design, using secondary data and thematic analysis. The research was prompted by a research gap in current literature: although the cost of logistics, digital transformation, and supply chain resilience have been widely researched as distinct phenomena, the mechanism through which sustained escalation of the cost of logistics impacts the coordinated, multi-dimensional transformation of the supply chain has been poorly theorised and empirically investigated, specifically at the product-division level in geographically specific conditions (Chowdhury and Quaddus, 2021; Hosseini and Ivanov, 2022; Ivanov, 2023).

The results affirm that the logistics cost increment in the case scenario is a product of four structural drivers that interact and that it is a non-cyclical, enduring structural force as opposed to being a temporary or cyclical challenge. Shifting the same, strategic supply chain decisions on sourcing, distribution, and inventory management were reconfigured, and four transformation strategies were adopted: structural network reconfiguration, supply diversification and collaborative logistics, development of operational flexibility, and sustainability-related efficiency improvement. The development of digital visibility, predictive analytics, and resilience capability serves as enabling infrastructure to these strategies, and digital and resilience capabilities show a functional interdependence that enhances the strategic value of each (Fosso Wamba et al., 2020; Munir et al., 2020; Lohmer et al., 2020).

The research contributes to the literature in three aspects: a cohesive explanation of the transformation based on cost, a product-division-level analytical approach, and an empirically contextualised elaboration of the interdependence of digital resilience. Alongside these theoretical contributions, it also offers practical recommendations on how supply chain leaders can address similar cost-based environments. Although the generalisability of the results will be constrained by the use of the secondary data and the one-case design, the depth of the analysis has contributed substantially to the literature on the transformation of supply chains.

The logistics cost problem that has been faced by organisations which operate in geographically restricted environments is structural in nature and is not likely to reduce. The question of how organisations can respond to that challenge, in terms of coherent multi-dimensional transformation, as opposed to the ad hoc cost-cutting, is thus a question of long-term strategic relevance. The results of this research offer a theoretically-based and empirically supported foundation to the answer to that question.

References

Abideen, A. Z., Mohamad, F. B., and Fernando, Y. (2021). Lean simulations in production and operations management: A systematic literature review and bibliometric analysis. *Journal of Modelling in Management*, *16*(2), 623–650. https://doi.org/10.1108/JM2-05-2019-0103

Abideen, A. Z., Sundram, V. P. K., and Sorooshian, S. (2023). Scope for sustainable development of small holder farmers in the palm oil supply chain: A systematic literature review and thematic scientific mapping. *Logistics*, *7*(1), 6. https://doi.org/10.3390/logistics7010006

Abideen, A. Z., Sundram, V. P. K., Pyeman, J., Othman, A. K., and Sorooshian, S. (2021). Food supply chain transformation through technology and future research directions: A systematic review. *Logistics*, *5*(4), 83. https://doi.org/10.3390/logistics5040083

Aday, S., and Aday, M. S. (2020). Impact of COVID-19 on the food supply chain. *Food Quality and Safety*, *4*(4), 167–180. https://doi.org/10.1093/fqsafe/fyaa024

Adewole, A. (2021). Application of qualitative case study methodology to supply chain management research: A reflective narrative. *International Journal of Current Research*, *13*(7), 18195–18202. Retrieved from https://research-portal.uws.ac.uk/en/publications/application-of-qualitative-case-study-methodology-to-supply-chain/

Akgün, E. Z., Monios, J., and Fonzone, A. (2020). Supporting urban consolidation centres with urban freight transport policies: A comparative study of Scotland and Sweden. *International Journal of Logistics Research and Applications*, *23*(3), 291–310. https://doi.org/10.1080/13675567.2019.1604434

Albertzeth, G., Pujawan, I. N., Hilletofth, P., and Tjahjono, B. (2020). Mitigating transportation disruptions in a supply chain: A cost-effective strategy. *International Journal of Logistics*

Research and Applications, *23*(2), 139–158. https://doi.org/10.1080/13675567.2019.1642695

Ali, I., Arslan, A., Khan, Z., and Tarba, S. Y. (2021). The role of HRM practices in developing organisational resilience in multinational corporations. *International Studies of Management and Organisation*, *51*(2), 148–162. https://doi.org/10.1080/00208825.2021.1908761

Alikhani, R., Torabi, S. A., and Altay, N. (2021). Retail supply chain network design with concurrent resilience capabilities. *Transportation Research Part E: Logistics and Transportation Review*, *150*, 102338. https://doi.org/10.1016/j.tre.2021.102338

Ambulkar, S., Blackhurst, J., and Grawe, S. (2015). Firm's resilience to supply chain disruptions: Scale development and empirical examination. *Journal of Operations Management*, 33–34(1), 111–122. https://doi.org/10.1016/j.jom.2015.01.002

Asgharizadeh, E., Daneshvar, A., Homayounfar, M., Salahi, F., and Amini Khouzani, M. (2023). Modeling the supply chain network in the fast-moving consumer goods industry during the COVID-19 pandemic. *Operational Research*, *23*(1), 14. https://doi.org/10.1007/s12351-023-00757-x

Ataburo, H., Ampong, G. E., and Essuman, D. (2024). Developing operational resilience to navigate transportation disruptions: The role and boundaries of efficiency priority. *Annals of Operations Research*, *340*(2), 723–755. https://doi.org/10.1007/s10479-024-06092-4

Bag, S., Wood, L. C., Xu, L., Dhamija, P., and Kayikci, Y. (2020). Big data analytics as an operational excellence approach to enhance sustainable supply chain performance. *Resources, Conservation and Recycling*, *153*, 104559. https://doi.org/10.1016/j.resconrec.2019.104559

Barbosa-Póvoa, A. P., da Silva, C. and Carvalho, A. (2018). Opportunities and challenges in sustainable supply chain: An operations research perspective. *European Journal of Operational Research*, *268*(2), 399–431. https://doi.org/10.1016/j.ejor.2017.10.036

Belhadi, A., Kamble, S., Jabbour, C. J. C., Gunasekaran, A., Foropon, C., and Venkatesh, M. (2021). Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries. *Technological Forecasting and Social Change*, *163*, 120447. https://doi.org/10.1016/j.techfore.2020.120447

Bhangu, S., Provost, F., and Caduff, C. (2023). Introduction to qualitative research methods: Part I. *Perspectives in Clinical Research*, *14*(1), 39–42. https://doi.org/10.4103/picr.picr_4_23

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Brusset, X., and Teller, C. (2017). Supply chain capabilities, risks, and resilience. *International Journal of Production Economics*, 184, 59–68. https://doi.org/10.1016/j.ijpe.2017.01.004

Butt, A. S. (2021). Strategies to mitigate the impact of COVID-19 on supply chain disruptions. *The International Journal of Logistics Management*, *32*(3), 1023–1039. https://doi.org/10.1108/IJLM-11-2020-0455

Carton, T. C., Ben-Zvi, T., and Ayata, B. S. (2022). Real-time visibility technologies and supply chain performance: An empirical investigation. *International Journal of Services Technology and Management*, *28*(1–2), 1–23. https://doi.org/10.1504/IJSTM.2022.123502

Cheng, J.-H., and Lu, K.-L. (2017). Enhancing effects of supply chain resilience: Insights from trajectory and resource-based perspectives. *Supply Chain Management: An International Journal*, 22(3), 329–340. https://doi.org/10.1108/IJOPM-07-2015-0411

Chiu, M. C., and Lin, C. Y. (2022). Simulation optimisation to design supply chain operations considering supply chain disruption risks. *Computers and Industrial Engineering*, *168*, 108068. https://doi.org/10.1016/j.cie.2022.108068

Choi, T. M. (2020). Innovative 'bring-service-near-your-home' operations under COVID-19: Can logistics become the new 'black'? *Transportation Research Part E: Logistics and Transportation Review*, *140*, 101961. https://doi.org/10.1016/j.tre.2020.101961

Choi, T. M. (2021). Risk analysis in logistics systems: A research agenda during and after the COVID-19 pandemic. *Transportation Research Part E: Logistics and Transportation Review*, *145*, 102190. https://doi.org/10.1016/j.tre.2020.102190

Choi, T. M., Kumar, S., Yue, X., and Chan, H. L. (2022). Disruptive technologies and operations management in the Industry 4.0 era and beyond. *Production and Operations Management*, *31*(1), 9–31. https://doi.org/10.1111/poms.13622

Chowdhury, M. M. H., and Quaddus, M. (2021). Supply chain resilience: Conceptualisation and scale development using dynamic capability theory. *International Journal of Production Economics*, *231*, 107859. https://doi.org/10.1016/j.ijpe.2020.107859

Chowdhury, P., Paul, S. K., Kaisar, S., and Moktadir, M. A. (2021). COVID-19 pandemic-related supply chain studies: A systematic review. *Transportation Research Part E: Logistics and Transportation Review*, *148*, 102271. https://doi.org/10.1016/j.tre.2021.102271

Christopher, M., and Peck, H. (2004). Building the resilient supply chain. *The International Journal of Logistics Management*, 15(2), 1–14. https://doi.org/10.1108/09574090410700275

Craighead, C. W., Ketchen, D. J., Jr., and Darby, J. L. (2020). Pandemics and supply chain management research: Toward a theoretical toolbox. *Decision Sciences*, *51*(4), 838–866. https://doi.org/10.1111/deci.12468

de Sousa Jabbour, A. B. L., Jabbour, C. J. C., Hingley, M., Vilalta-Perdomo, E. L., Ramsden, G., and Twigg, D. (2020). Sustainability of supply chains in the wake of the coronavirus (COVID-19/SARS-CoV-2) pandemic: Lessons and trends. *Modern Supply Chain Research and Applications*, 2(3), 117–122. https://doi.org/10.1016/j.jclepro.2020.122796

Diaz, E. M., Cunado, J. and de Gracia, F. P. (2024). Global drivers of inflation: The role of supply chain disruptions and commodity price shocks. *Economic Modelling*, *140*, 106860. https://doi.org/10.1016/j.econmod.2024.106860

Dohale, V., Ambilkar, P., Gunasekaran, A., and Verma, P. (2022). Supply chain risk mitigation strategies during COVID-19: Exploratory cases of make-to-order handloom saree apparel industries. *International Journal of Physical Distribution and Logistics Management*, *52*(2), 109–129. https://doi.org/10.1108/IJPDLM-07-2020-0238

Dolgui, A., Ivanov, D., and Sokolov, B. (2020). Reconfigurable supply chain: The X-network. *International Journal of Production Research*, *58*(13), 4138–4163. https://doi.org/10.1080/00207543.2020.1774679

Donkor, F., Papadopoulos, T., and Spiegler, V. (2024). Supply chain integration and supply chain sustainability relationship: A qualitative analysis of the UK and Ghana pharmaceutical industry. *Production Planning and Control*, *35*(6), 535–558. https://doi.org/10.1080/09537287.2022.2105762

Dubey, R., Bryde, D. J., Dwivedi, Y. K., Graham, G., Foropon, C., and Papadopoulos, T. (2022). Dynamic digital capabilities and supply chain resilience: The role of alliance management. *Journal of Business Research*, *148*, 527–538. https://doi.org/10.1016/j.jbusres.2022.04.076

Dwidienawati, D., Indrajaya, B. L., and Zanten, E. V. (2025). Factors affecting the implementation of green supply chain in companies in Indonesia: A qualitative study. *Sustainability*, *17*(12), 5349. https://doi.org/10.3390/su17125349

Essuman, D., Boso, N., and Annan, J. (2020). Operational resilience, disruption, and efficiency: Conceptual and empirical analyses. *International Journal of Production Economics*, *229*, 107762. https://doi.org/10.1016/j.ijpe.2020.107762

Flynn, B. B., Huo, B., and Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management*, 28(1), 58–71. https://doi.org/10.1016/j.jom.2009.06.001

Fosso Wamba, S., and Queiroz, M. M. (2022). Industry 4.0 and the supply chain digitalisation: A blockchain diffusion perspective. *Production Planning and Control*, *33*(2–3), 193–210. https://doi.org/10.1080/09537287.2020.1810756

Fosso Wamba, S., Queiroz, M. M., and Trinchera, L. (2020). Dynamics between blockchain adoption determinants and supply chain performance: An empirical investigation. *International Journal of Production Economics*, *229*, 107791. https://doi.org/10.1016/j.ijpe.2020.107791

Gammelgaard, B., and Flint, D. (2012). Qualitative research in logistics and supply chain management: Beyond the justification for using qualitative methods. *International Journal of Physical Distribution and Logistics Management*, *42*(8–9), 726–737. https://doi.org/10.1108/09600031211264272

Garay-Rondero, C. L., Martinez-Flores, J. L., Smith, N. R., Caballero Morales, S. O., and Aldrette-Malacara, A. (2020). Digital supply chain model in Industry 4.0. *Journal of Manufacturing Technology Management*, *31*(5), 887–933. https://doi.org/10.1108/JMTM-08-2018-0280

Gereffi, G. (2020). What does the COVID-19 pandemic teach us about global value chains? The case of medical supplies. *Journal of International Business Policy*, *3*(3), 287–301. https://doi.org/10.1057/s42214-020-00062-w

Ghadge, A., Kara, M. E., Moradlou, H., and Goswami, M. (2020). The impact of Industry 4.0 implementation on supply chains. *Journal of Manufacturing Technology Management*, *31*(4), 669–686. https://doi.org/10.1108/JMTM-10-2019-0368

Govindan, K., Mina, H., and Alavi, B. (2020). A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19). *Transportation Research Part E: Logistics and Transportation Review*, *138*, 101967. https://doi.org/10.1016/j.tre.2020.101967

Gereffi, G. (2020). What does the COVID-19 pandemic teach us about global value chains? The case of medical supplies. *Journal of International Business Policy*, 3(3), 287–301. https://doi.org/10.1057/s42214-020-00062-w

Grover, P., Kar, A. K., and Janssen, M. (2019). Diffusion of blockchain technology: Insights from academic literature and social media analytics. *Journal of Enterprise Information Management*, *32*(5), 735–757. https://doi.org/10.1108/JEIM-06-2018-0132

Gruchmann, T., and Seuring, S. (2021). Explaining logistics social responsibility from a dynamic capabilities perspective. *The International Journal of Logistics Management*, *32*(3), 972–993. https://doi.org/10.1108/IJLM-03-2020-0113

Guan, D., Wang, D., Hallegatte, S., Davis, S. J., Huo, J., Li, S., Bai, Y., Lei, T., Xue, Q., Coffman, D., Cheng, D., Chen, P., Liang, X., Xu, B., Lu, X., Wang, S., Hubacek, K., and Gong, P. (2020). Global supply-chain effects of COVID-19 control measures. *Nature Human Behaviour*, *4*(6), 577–587. https://doi.org/10.1038/s41562-020-0896-8

Gunasekaran, A., Subramanian, N., and Rahman, S. (2015). Green supply chain collaboration and incentives: Current trends and future directions. *Transportation Research Part E: Logistics and Transportation Review*, 74, 1–10. https://doi.org/10.1016/j.tre.2015.01.004

Guðláugsson, B., Kristjánsdóttir, K., and Sigurðardóttir, R. (2022). Digital transformation and supply chain management: A systematic literature review. *Supply Chain Management: An International Journal*, 27(2), 243–260. https://doi.org/10.1108/SCM-09-2021-0415

Hendricks, K. B., and Singhal, V. R. (2005). An empirical analysis of the effect of supply chain disruptions on long-run stock price performance and equity risk of the firm. *Production and Operations Management*, 14(1), 35–52. https://doi.org/10.1111/j.1937-5956.2005.tb00008.x

Hendricks, K. B., Jacobs, B. W., and Singhal, V. R. (2020). Stock market reaction to supply chain disruptions from the 2011 Tōhoku earthquake. *Manufacturing and Service Operations Management*, *22*(4), 683–699. https://doi.org/10.1287/msom.2019.0791

Hobbs, J. E. (2020). Food supply chain resilience and the COVID-19 pandemic: What have we learned? *Canadian Journal of Agricultural Economics*, *68*(2), 171–176. https://doi.org/10.1111/cjag.12227

Hohenstein, N. O. (2022). Supply chain risk management in the COVID-19 pandemic: Strategies and empirical lessons for improving global logistics service providers' performance. *The International Journal of Logistics Management*, *33*(4), 1336–1365. https://doi.org/10.1108/IJLM-02-2021-0109

Hosseini, S., and Ivanov, D. (2022). A new resilience measure for supply networks with the ripple effect considerations: A Bayesian network approach. *Annals of Operations Research*, *319*(1), 581–607. https://doi.org/10.1007/s10479-020-03794-9

Hosseini, S., Ivanov, D., and Dolgui, A. (2020). Review of quantitative methods for supply chain resilience analysis. *Transportation Research Part E: Logistics and Transportation Review*, *125*, 285–307. https://doi.org/10.1016/j.tre.2019.03.001

Hussain, M., Khan, M., and Saber, H. (2023). Thematic analysis of circular economy practices across closed-loop supply chains: An institutional theory perspective. *Sustainable Production and Consumption*, *40*, 122–134. https://doi.org/10.1016/j.spc.2023.01.013

Iddagoda, S. L., Jayakodi, C., Jayakodi, I., Umanga, I., Karunarathna, N., and Dayapathirana, N. (2025). Exploring female participation and challenges in the Sri Lankan logistics sector: A qualitative inquiry. *Social Sciences and Humanities Open*, *12*, 102321. https://doi.org/10.1016/j.ssaho.2025.102321

Irvine, A. (2024). First steps in qualitative secondary analysis: Experiences of engaging with the primary research team. *International Journal of Social Research Methodology*, *27*(6), 721–733. https://doi.org/10.1080/13645579.2023.2267836

Islam, M. R., and Ikbal, M. Z. (2022). Impact of predictive data modeling on business decision-making: A review of studies across retail, finance, and logistics. *American Journal of Advanced Technology and Engineering Solutions*, *2*(02), 33–62. Retrieved from https://ajates-scholarly.com/index.php/ajates/article/download/50/46

Ivanov, D. (2020a). Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus disease 2019 (COVID-19). *Transportation Research Part E: Logistics and Transportation Review*, *136*, 101922. https://doi.org/10.1016/j.tre.2020.101922

Ivanov, D. (2020b). Viable supply chain model: Integrating agility, resilience and sustainability perspectives. *TQM Journal*, *32*(6), 489–505. https://doi.org/10.1108/TQM-04-2019-0090

Ivanov, D. (2021a). Digitalisation of supply chains in the era of COVID-19: Advancing digital twin applications. *International Journal of Production Research*, *60*(2), 669–672. https://doi.org/10.1080/00207543.2021.1992431

Ivanov, D. (2021b). Supply chain viability and the COVID-19 pandemic: A conceptual and formal generalisation of four major adaptation strategies. *International Journal of Production Research*, *59*(12), 3535–3552. https://doi.org/10.1080/00207543.2021.1890852

Ivanov, D. (2022). Lean resilience: AURA (Active Usage of Resilience Assets) framework for post-COVID-19 supply chain management. *The International Journal of Logistics Management*, *33*(4), 1382–1410. https://doi.org/10.1108/IJLM-11-2020-0448

Ivanov, D. (2023). Intelligent supply chain management via digital twins: Market developments and research opportunities. *International Journal of Production Research*, *61*(1), 3–15. https://doi.org/10.1080/00207543.2022.2126205

Ivanov, D., and Das, A. (2020). Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: A research note. *International Journal of Integrated Supply Management*, *13*(1), 90–102. https://doi.org/10.1504/IJISM.2020.107780

Ivanov, D., and Dolgui, A. (2020). Viability of intertwined supply networks: Extending the supply chain resilience angles towards survivability. *International Journal of Production Research*, *58*(8), 2366–2381. https://doi.org/10.1080/00207543.2020.1750727

Ivanov, D., and Dolgui, A. (2021). OR-methods for coping with the ripple effect in supply chains during COVID-19 pandemic: Managerial insights and research implications. *International Journal of Production Economics*, *232*, 107921. https://doi.org/10.1016/j.ijpe.2020.107921

Ivanov, D., and Dolgui, A. (2022). Stress testing supply chains and creating viable ecosystems. *Operations Management Research*, *15*(1), 475–486. https://doi.org/10.1007/s12063-021-00194-5

Kamalahmadi, M., Shekarian, M., and Mellat Parast, M. (2022). The impact of flexibility and redundancy on improving supply chain resilience to disruptions. *International Journal of*

Production Research, *60*(6), 1992–2020. https://doi.org/10.1080/00207543.2021.1883759

Kano, L., Tsang, E. W. K., and Yeung, H. W. C. (2020). Global value chains: A review of the multi-disciplinary literature. *Journal of International Business Studies*, *51*(4), 577–622. https://doi.org/10.1057/s41267-020-00304-2

Karmaker, C. L., Ahmed, T., Ahmed, S., Ali, S. M., Moktadir, M. A., and Kabir, G. (2021). Improving supply chain sustainability in the context of COVID-19 pandemic in an emerging economy: Exploring drivers using an integrated model. *Sustainable Production and Consumption*, *26*, 411–427. https://doi.org/10.1016/j.spc.2020.09.019

Khan, S. A. R., Zhang, Y., Kumar, A., Zavadskas, E., and Streimikiene, D. (2020). Measuring the impact of renewable energy, public health expenditure, logistics, and environmental performance on sustainable economic growth. *Sustainable Development*, *28*(4), 833–843. https://doi.org/10.1002/sd.2034

Khan, M., Ajmal, M. M., and Shamim, S. (2022). Supply chain digitalisation and performance: An empirical analysis. *Production Planning and Control*, 33(15), 1481–1494. https://doi.org/10.1080/09537287.2021.2012553

Khedr, A. M. (2024). Enhancing supply chain management with deep learning and machine learning techniques: A review. *Journal of Open Innovation: Technology, Market, and Complexity*, *10*(4), 100379. https://doi.org/10.1016/j.joitmc.2024.100379

Kim, S., and Kim, C. (2024). Enhancing logistics performance through increased trust and collaboration in supply chain risk management: A focus on the distribution network of manufacturing companies. *Systems*, *12*(4), 141. https://doi.org/10.3390/systems12040141

Kochan, C. G., and Nowicki, D. R. (2018). Supply chain resilience: A systematic literature review and typological framework. International Journal of Physical Distribution and Logistics Management, 48(8), 842–865. https://doi.org/10.1108/IJPDLM-11-2017-0341

Kumar, A., Luthra, S., Mangla, S. K., and Kazançoğlu, Y. (2020). COVID-19 impact on sustainable production and operations management. *Sustainable Operations and Computers*, *1*, 1–7. https://doi.org/10.1016/j.susoc.2020.06.001

Le, T. V., and Fan, R. (2024). Digital twins for logistics and supply chain systems: Literature review, conceptual framework, research potential, and practical challenges. *Computers and Industrial Engineering*, *187*, 109768. https://doi.org/10.1016/j.cie.2023.109768

Li, Y., and Zobel, C. W. (2020). Exploring supply chain network resilience in the presence of the ripple effect. *International Journal of Production Economics*, *228*, 107693. https://doi.org/10.1016/j.ijpe.2020.107693

Lim, W. M. (2025). What is qualitative research? An overview and guidelines. *Australasian Marketing Journal*, *33*(2), 199–229. https://doi.org/10.1177/14413582241264619

Lim-Camacho, L., Ariyawardana, A., and Crimp, S. (2021). Responsible business in food supply chains: Emerging evidence and practice. *Journal of Cleaner Production*, *296*, 126520. https://doi.org/10.1016/j.jclepro.2021.126520

Lohmer, J., Bugert, N., and Lasch, R. (2020). Analysis of resilience strategies and ripple effect in blockchain-coordinated supply chains: An agent-based simulation study. *International Journal of Production Economics*, *228*, 107882. https://doi.org/10.1016/j.ijpe.2020.107882

Luthra, S., and Mangla, S. K. (2018). Evaluating challenges to Industry 4.0 initiatives for supply chain sustainability in emerging economies. *Process Safety and Environmental Protection*, 117, 168–179. https://doi.org/10.1016/j.psep.2018.04.018

Mandviwalla, M., and Watson, R. (2014). Generating and sustaining participant engagement in virtual communities. *European Journal of Information Systems*, *23*(1), 23–44. https://doi.org/10.1057/ejis.2013.21

Mangla, S. K., Sharma, Y. K., Patil, P. P., Yadav, G., and Xu, J. (2019). Logistics and distribution challenges to managing operations for corporate sustainability: Study on leading Indian dairy organizations. *Journal of Cleaner Production*, *238*, 117620. https://doi.org/10.1016/j.jclepro.2019.117620

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., and Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business Logistics*, 22(2), 1–25. https://doi.org/10.1002/jbl.2300220103

Melnyk, S. A., Narasimhan, R., and DeCampos, H. A. (2014). Supply chain design: Issues, challenges, frameworks and solutions. *International Journal of Production Research*, 52(7), 1887–1896. https://doi.org/10.1080/00207543.2013.787175

Milewska, B., and Milewski, D. (2022). Implications of increasing fuel costs for supply chain strategy. *Energies*, *15*(19), 6934. https://doi.org/10.3390/en15196934

Min, H. (2022). Examining the impact of energy price volatility on commodity prices from energy supply chain perspectives. *Energies*, *15*(21), 7957. https://doi.org/10.3390/en15217957

Mirzaei, S., and Shokouhyar, S. (2023). Applying a thematic analysis in identifying the role of circular economy in sustainable supply chain practices. *Environment, Development and Sustainability*, *25*(5), 4691–4722. https://doi.org/10.1007/s10668-022-02217-6

Mohammad, S. I. S., Al-Daoud, K. I., Oraini, B. S. A., Alqahtani, M. M., Vasudevan, A., and Ali, I. (2025). Impact of crude oil price volatility on procurement and inventory strategies in the Middle East. *International Journal of Energy Economics and Policy*, *15*(2), 715–727. Retrieved from https://savearchive.zbw.eu/bitstream/11159/708559/1/1929367686_0.pdf

Moosavi, J., Fathollahi-Fard, A. M., and Dulebenets, M. A. (2022). Supply chain disruption during the COVID-19 pandemic: Recognizing potential disruption management strategies. *International Journal of Disaster Risk Reduction*, *75*, 102983. https://doi.org/10.1016/j.ijdrr.2022.102983

Mou, W., Wong, W. K., and McAleer, M. (2021). Financial credit risk and core enterprise supply chains under the COVID-19 pandemic. *Asia-Pacific Journal of Operational Research*, *38*(04), 2150015. https://doi.org/10.1142/S0217595921500159

Mugoni, E., Kanyepe, J., and Tukuta, M. (2024). Sustainable supply chain management practices (SSCMPs) and environmental performance: A systematic review. *Sustainable Technology and Entrepreneurship*, *3*(1), 100050. https://doi.org/10.1016/j.stae.2023.100050

Munir, M., Jajja, M. S. S., Chatha, K. A., and Farooq, S. (2020). Supply chain risk management and operational performance: The enabling role of supply chain integration. *International Journal of Production Economics*, *227*, 107667. https://doi.org/10.1016/j.ijpe.2020.107667

Nagurney, A. (2021). Optimization of supply chain networks with inclusion of labor: Applications to COVID-19 pandemic disruptions. *International Journal of Production Economics*, *235*, 108080. https://doi.org/10.1016/j.ijpe.2021.108080

Nandi, S., Sarkis, J., Hervani, A. A., and Helms, M. M. (2021). Do blockchain and circular economy practices improve post COVID-19 supply chains? A resource-based and resource dependence perspective. *Industrial Management and Data Systems*, *121*(2), 333–363. https://doi.org/10.1108/IMDS-09-2020-0560

Neboh, N. D., and Mbhele, T. P. (2021). Supply chain design dimensions for supply chain resilience in the South African fast-moving consumer goods retail industry. *Africa Journal of Management*, *7*(sup1), 58–81. https://doi.org/10.1080/23322373.2021.1937481

Nestlé. (2023). *Creating shared value and sustainability report 2023*. Nestlé S.A. Retrieved from https://www.nestle.com/sites/default/files/2024-02/creating-shared-value-sustainability-report-2023-en.pdf

Nguyen, T., Zhou, L., Spiegler, V., Ieromonachou, P., and Lin, Y. (2021). Big data analytics in supply chain management: A state-of-the-art literature review. *Computers and Industrial Engineering*, *141*, 106309. https://doi.org/10.1016/j.cie.2020.106309

Nikolopoulos, K., Punia, S., Schäfers, A., Tsinopoulos, C., and Vasilakis, C. (2021). Forecasting and planning during a pandemic: COVID-19 growth rates, supply chain disruptions, and governmental decisions. *European Journal of Operational Research*, *290*(1), 99–115. https://doi.org/10.1016/j.ejor.2020.08.001

Niu, Y., Werle, N., Cohen, M., Cui, S., Deshpande, V., Ernst, R., … and Wu, J. (2025). Restructuring global supply chains: Navigating challenges of the COVID-19 pandemic and beyond. *Manufacturing and Service Operations Management*, *27*(4), 1025–1036. https://doi.org/10.1287/msom.2024.0879

Nooraie, S. V., and Parast, M. M. (2022). Mitigating supply chain disruptions through the assessment of trade-offs among risks, costs and investments in capabilities. *International Journal of Production Economics*, *244*, 108402. https://doi.org/10.1016/j.ijpe.2021.108402

Notteboom, T., Pallis, T., and Rodrigue, J. P. (2021). Disruptions and resilience in global container shipping and ports: The COVID-19 pandemic versus the 2008–09 financial crisis. *Maritime Economics and Logistics*, *23*(2), 179–210. https://doi.org/10.1057/s41278-020-00180-5

Oubrahim, I., Sefiani, N., and Happonen, A. (2023). The influence of digital transformation and supply chain integration on overall sustainable supply chain performance: An empirical analysis from manufacturing companies in Morocco. *Energies*, *16*(2), 1004. https://doi.org/10.3390/en16021004

Panwar, R., Pinkse, J., and De Marchi, V. (2022). The future of global supply chains in a post-COVID-19 world. *California Management Review*, *64*(2), 5–23. https://doi.org/10.1177/00081256211073355

Papadopoulos, T., Baltas, K. N., and Balta, M. E. (2020). The use of digital technologies by small and medium enterprises during COVID-19: Implications for theory and practice. *International Journal of Information Management*, *55*, 102192. https://doi.org/10.1016/j.ijinfomgt.2020.102192

Park, Y. W., and Folta, T. B. (2021). Supply chain reshoring: Learning from US firms adjusting in the face of uncertainty. *Supply Chain Management: An International Journal*, *26*(5), 662–680. https://doi.org/10.1108/SCM-06-2020-0272

Patrick, W. M., Anselemo, P. I., Ronoh, R., and Mbugua, S. (2022). Impact of predictive analytics of big data in supply chain management on decision-making. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, *8*(3), 225–238. Retrieved from https://www.academia.edu/download/112882274/CSEIT228423.pdf

Paul, S. K., and Chowdhury, P. (2021). A production recovery plan in manufacturing supply chains for a high-demand item during COVID-19. *International Journal of Physical Distribution and Logistics Management*, *51*(2), 104–125. https://doi.org/10.1108/IJPDLM-04-2020-0127

Pellegrino, R., Costantino, N., and Tauro, D. (2021). The value of flexibility in mitigating supply chain transportation risks. *International Journal of Production Research*, *59*(20), 6252–6269. https://doi.org/10.1080/00207543.2020.1811417

Peng, J., Sehgal, V., Zhang, J. Z., and Hina, S. M. (2022). Supply chain resilience in manufacturing firms during the COVID-19 pandemic: A dynamic capabilities perspective. *Supply Chain Management: An International Journal*, *27*(5), 680–698. https://doi.org/10.1108/SCM-11-2021-0492

Peng, M. Y. P., Yan, C., Tan, Y., Ye, S., Lin, T., and Lin, L. (2022). Enhancing logistics supply chain performance: The role of digital technologies. *Sustainability*, *14*(18), 11614. https://doi.org/10.3390/su141811614

Pettit, T. J., Fiksel, J., and Croxton, K. L. (2010). Ensuring supply chain resilience: Development of a conceptual framework. *Journal of Business Logistics*, 31(1), 1–21. https://doi.org/10.1002/jbl.20275

Pettit, T. J., Croxton, K. L., and Fiksel, J. (2019). The evolution of resilience in supply chain management: A retrospective on ensuring supply chain resilience. *Journal of Business Logistics*, *40*(1), 56–65. https://doi.org/10.1111/jbl.12202

Phillips, K. M., Tichavakunda, A. A., and Sedaghat, A. R. (2024). Qualitative research methodology and applications: A primer for the otolaryngologist. *The Laryngoscope*, *134*(1), 27–31. https://doi.org/10.1002/lary.30817

Ponomarov, S. Y., and Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *The International Journal of Logistics Management*, *20*(1), 124–143. https://doi.org/10.1108/09574090910954873

Preindl, R., Nikolopoulos, K., and Litsiou, K. (2020). Transformation strategies for the supply chain: The impact of Industry 4.0 and digital transformation. *Supply Chain Forum: An International Journal*, *21*(1), 26–34. https://doi.org/10.1080/16258312.2020.1716633

Queiroz, M. M., and Fosso Wamba, S. (2021). Supply chain resilience during the COVID-19 pandemic and future research opportunities. *The International Journal of Logistics Management*, *32*(4), 1318–1335. https://doi.org/10.1108/IJLM-12-2020-0494

Queiroz, M. M., Fosso Wamba, S., De Bourmont, M., and Telles, R. (2021). Blockchain adoption in operations and supply chain management: Empirical evidence from an emerging economy. *International Journal of Production Research*, *59*(20), 6087–6103. https://doi.org/10.1080/00207543.2020.1803511

Queiroz, M. M., Pereira, S. C. F., Telles, R., and Machado, M. C. (2021). Industry 4.0 and digital supply chain capabilities: A framework for understanding digitalisation challenges and opportunities. *Benchmarking: An International Journal*, *28*(5), 1761–1782. https://doi.org/10.1108/BIJ-12-2018-0435

Queiroz, M. M., Telles, R., and Bonilla, S. H. (2020). Blockchain and supply chain management integration: A systematic review of the literature. *Supply Chain Management: An International Journal*, *25*(2), 241–254. https://doi.org/10.1108/SCM-03-2018-0143

Rajesh, R. (2021). Flexible business strategies to enhance resilience in manufacturing supply chains: An empirical study. *Journal of Manufacturing Systems*, *60*, 903–914. https://doi.org/10.1016/j.jmsy.2020.10.010

Ralston, P., and Blackhurst, J. (2020). Industry 4.0 and resilience in the supply chain: A driver of capability development among manufacturing firms. *International Journal of Production Research*, 58(16), 5128–5138. https://doi.org/10.1080/00207543.2020.1736724

Reyes, P. M., Li, S., and Visich, J. K. (2016). Determinants of RFID adoption stage and perceived benefits. *European Journal of Operational Research*, *254*(3), 801–812. https://doi.org/10.1016/j.ejor.2016.03.051

Ribeiro, J. P., and Barbosa-Póvoa, A. (2018). Supply chain resilience: Definitions and quantitative modelling approaches - A literature review. *Computers and Industrial Engineering*, *115*, 109–122. https://doi.org/10.1016/j.cie.2017.11.006

Roscoe, S., Skipworth, H., Aktas, E., and Habib, F. (2020). Managing supply chain uncertainty arising from geopolitical disruptions: Evidence from the pharmaceutical and defence industries. *International Journal of Operations and Production Management*, *40*(9), 1499–1529. https://doi.org/10.1108/IJOPM-03-2020-0121

Sarkis, J. (2021). Supply chain sustainability: Learning from the COVID-19 pandemic. *International Journal of Operations and Production Management*, *41*(1), 63–73. https://doi.org/10.1108/IJOPM-08-2020-0568

Sarkis, J., Cohen, M. J., Dewick, P., and Schröder, P. (2020). A brave new world: Lessons from the COVID-19 pandemic for transitioning to sustainable supply and production. *Resources, Conservation and Recycling*, *159*, 104894. https://doi.org/10.1016/j.resconrec.2020.104894

Scholten, K., and Schilder, S. (2015). The role of collaboration in supply chain resilience. *Supply Chain Management: An International Journal*, 20(4), 471–484. https://doi.org/10.1108/SCM-11-2014-0386

Seuring, S., and Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Sharma, A., Adhikary, A., and Borah, S. B. (2020). Covid-19's impact on supply chain decisions: Strategic insights from NASDAQ 100 firms using Twitter data. *Journal of Business Research*, *117*, 443–449. https://doi.org/10.1016/j.jbusres.2020.05.045

Sharma, M., Luthra, S., Joshi, S., and Kumar, A. (2022). Accelerating retail supply chain performance against pandemic disruptions: Adopting technology and related internal measures. *Supply Chain Management: An International Journal*, *27*(2), 270–289. https://doi.org/10.1108/SCM-07-2020-0286

Sheikhattar, M. R., Nezafati, N., and Shokouhyar, S. (2022). A thematic analysis–based model for identifying the impacts of natural crises on a supply chain for service integrity: A text analysis approach. *Environmental Science and Pollution Research*, *29*(52), 79413–79433. https://doi.org/10.1007/s11356-022-21380-7

Shekarian, M., and Mellat Parast, M. (2021). An integrative approach to supply chain disruption risk and resilience management: A literature review. *International Journal of Logistics Research and Applications*, *24*(5), 427–455. https://doi.org/10.1080/13675567.2020.1763935

Simchi-Levi, D., and Simchi-Levi, E. (2020). We're all in this together. *MIT Sloan Management Review*. Retrieved from https://sloanreview.mit.edu/article/were-all-in-this-together

Sodhi, M. M. S., and Tang, C. S. (2011). Buttressing supply chains against floods in Asia for humanitarian relief and economic recovery. *Production and Operations Management*, *20*(2), 1–18. https://doi.org/10.1111/j.1937-5956.2010.01211.x

Sodhi, M. S., and Tang, C. S. (2021). Supply chain management for extreme conditions: Research opportunities. *Journal of Supply Chain Management*, *57*(1), 7–16. https://doi.org/10.1111/jscm.12255

Soni, G., Kumar, S., Mahto, R. V., Mangla, S. K., Mittal, M. L., and Lim, W. M. (2022). A decision-making framework for Industry 4.0 technology implementation: The case of FinTech and sustainable supply chain finance for SMEs. *Technological Forecasting and Social Change*, *180*, 121686. https://doi.org/10.1016/j.techfore.2022.121686

Song, M., Ma, X., Zhao, X., and Zhang, L. (2022). How to enhance supply chain resilience: A logistics approach. *The International Journal of Logistics Management*, *33*(4), 1408–1436. https://doi.org/10.1108/IJLM-04-2021-0211

Spiegler, V. L. M., Naim, M. M., and Wikner, J. (2012). A control engineering approach to the assessment of supply chain resilience. *International Journal of Production Economics*, 140(2), 688–698. https://doi.org/10.1016/j.ijpe.2012.07.023

Stroumpoulis, A., and Kopanaki, E. (2022). Theoretical perspectives on sustainable supply chain management and digital transformation: A literature review and a conceptual framework. *Sustainability*, *14*(8), 4862. https://doi.org/10.3390/su14084862

Stroumpoulis, A., Kopanaki, E., and Chountalas, P. T. (2024). Enhancing sustainable supply chain management through digital transformation: A comparative case study analysis. *Sustainability*, *16*(16), 6778. https://doi.org/10.3390/su16166778

Supply Chain Digital. (2024). Inside Nestlé's global supply chain overhaul. *Supply Chain Digital*. Retrieved from https://supplychaindigital.com/news/annual-report-inside-nestles-global-supply-chain-overhaul

Surawy-Stepney, N., Provost, F., Bhangu, S., and Caduff, C. (2023). Introduction to qualitative research methods: Part 2. *Perspectives in Clinical Research*, *14*(2), 95–99. https://doi.org/10.4103/picr.picr_246_22

Swafford, P. M., Ghosh, S., and Murthy, N. (2006). The antecedents of supply chain agility of a firm: Scale development and model testing. *Journal of Operations Management*, 24(2), 170–188. https://doi.org/10.1016/j.jom.2005.05.002

Tang, C. S. (2006). Perspectives in supply chain risk management. *International Journal of Production Economics*, 103(2), 451–488. https://doi.org/10.1016/j.ijpe.2006.03.013

Thun, J.-H., and Hoenig, D. (2011). An empirical analysis of supply chain risk management in the German automotive industry. *International Journal of Production Economics*, 131(1), 242–249. https://doi.org/10.1016/j.ijpe.2009.10.010

Tukamuhabwa, B., Stevenson, M., Busby, J., and Zorzini, M. (2015). Supply chain resilience: Definition, review and theoretical foundations for further study. *International Journal of Production Research*, 53(18), 5592–5623. https://doi.org/10.1080/00207543.2015.1037934

Tukamuhabwa, B., Stevenson, M., and Busby, J. (2017). Supply chain resilience in a developing country context: A case study on the interconnectedness of threats, strategies and outcomes. *Supply Chain Management: An International Journal*, *22*(6), 486–505. https://doi.org/10.1108/SCM-02-2017-0059

Van Hoek, R. (2020). Research opportunities for a more resilient post-COVID-19 supply chain: Closing the gap between research findings and industry practice. *International Journal of Operations and Production Management*, *40*(4), 341–355. https://doi.org/10.1108/IJOPM-03-2020-0165

van Hoek, R., and Dobrzykowski, D. (2021). Towards more balanced sourcing strategies: Are supply chain managers really reconsidering their global supply chains in the wake of COVID-19? *Supply Chain Management: An International Journal*, *26*(4), 453–463. https://doi.org/10.1108/SCM-08-2020-0395

Wanke, P., Corrêa, H., and Chen, Z. (2022). Supply chain performance and dynamic capabilities: A meta-analysis. *International Journal of Production Economics*, 248, 108480. https://doi.org/10.1016/j.ijpe.2022.108480

Wamba, S. F., Dubey, R., Gunasekaran, A., and Akter, S. (2020). The performance effects of big data analytics and supply chain ambidexterity: The moderating effect of environmental dynamism. *International Journal of Production Economics*, *222*, 107498. https://doi.org/10.1016/j.ijpe.2019.09.019

Wieland, A. (2021). Dancing the supply chain: Toward transformative supply chain management. *Journal of Supply Chain Management*, *57*(1), 58–73. https://doi.org/10.1111/jscm.12248

Wiengarten, F., Humphreys, P., Gimenez, C., and McIvor, R. (2016). Risk, risk management practices, and the success of supply chain integration. *International Journal of Production Economics*, 171, 361–370. https://doi.org/10.1016/j.ijpe.2015.06.011

Yang, L., Huo, B., and Gu, M. (2022). The impact of information sharing on supply chain adaptability and operational performance. *The International Journal of Logistics Management*, *33*(2), 590–619. https://doi.org/10.1108/IJLM-11-2020-0439

Yu, W., Chavez, R., Jacobs, M. A., and Feng, M. (2020). Data-driven supply chain capabilities and performance: A resource-based view. *Transportation Research Part E: Logistics and Transportation Review*, *114*, 371–385. https://doi.org/10.1016/j.tre.2018.03.003

Zhu, G., Paul, S. K., and Sarker, S. (2022). Impacts of internal and external factors on retail supply chain resilience during disruptions. *International Journal of Logistics Research and Applications*, *25*(6), 940–957. https://doi.org/10.1080/13675567.2021.1934993

Appendices

Appendix A

Secondary Data Source Classification Framework

Table A1.1

Classification of Secondary Data Sources by Category, Relevance, and Chapter Application

Source Category	Specific Source	Relevance to Study	Chapters Used
Peer-Reviewed Journal Articles	Ivanov (2020; 2021; 2022; 2023); Ivanov & Dolgui (2020; 2021; 2022)	Supply chain resilience theory; disruption modelling; digital twin frameworks	2, 3, 4, 5
	Milewska & Milewski (2022); Min (2022); Mohammad et al. (2025)	Fuel and energy cost volatility impacts on logistics and supply chains	2, 4
	Niu et al. (2025); Guan et al. (2020); Sarkis (2021)	Post-pandemic supply chain restructuring; COVID-19 disruption effects	2, 4, 5, 6
	Notteboom et al. (2021); Belhadi et al. (2021); Chowdhury et al. (2021)	Port disruptions; logistics labour shortages; COVID-19 supply chain reviews	2, 4
	Dubey et al. (2022); Kamalahmadi et al. (2022); Hosseini & Ivanov (2022)	Digital capabilities; supply chain flexibility and resilience measurement	2, 4, 5, 6
	Kano et al. (2020); Wieland (2021); Gereffi (2020); Panwar et al. (2022)	Global value chains; supply chain transformation; nearshoring	2, 4, 5
	Song et al. (2022); Essuman et al. (2020); Ataburo et al. (2024)	Supply chain resilience logistics; operational resilience; disruption efficiency	2, 4

	Carton et al. (2022); Yang et al. (2022); Khedr (2024); Le & Fan (2024)	Supply chain visibility; digital technologies; digital twins for logistics	2, 4
	Dollgui et al. (2020); Asgharizadeh et al. (2023); Alikhani et al. (2021)	Network reconfiguration; FMCG supply chain modelling; resilience network design	2, 4
	Bag et al. (2020); Nguyen et al. (2021); Wamba et al. (2020); Yu et al. (2020)	Big data analytics; data-driven supply chain management	2, 4
Corporate Reports & Disclosures	Nestlé (2023). Creating Shared Value and Sustainability Report 2023	Primary organisational evidence on logistics costs, transformation initiatives, and sustainability performance	1, 4, 5, 6
	Supply Chain Digital (2024). Inside Nestlé's global supply chain overhaul	Independent industry documentation of Nestlé's supply chain transformation strategy	1, 4, 5
Regional & Industry Studies	Akgün et al. (2020). Scotland/Sweden urban consolidation study	Geographic context; Scottish logistics infrastructure and freight policy	2, 4
	Neboh & Mbhele (2021). FMCG supply chain resilience, South Africa	Comparable FMCG supply chain design in constrained regional markets	2, 4
Methodological Sources	Irvine (2024); Mugoni et al. (2024); Donkor et al. (2024); Bhangu et al. (2023)	Secondary qualitative analysis; qualitative research methods in supply chain management	3

	Hussain et al. (2023); Sheikhattar et al. (2022); Mirzaei & Shokouhyar (2023)	Thematic analysis methodology applied to supply chain research	3, 4
	Phillips et al. (2024); Bowen (2009); Adewole (2021)	Qualitative case study methodology; document analysis methods	3

Appendix B

Thematic Analysis Coding Framework

Table A2

Thematic Analysis Coding Framework: Themes, Sub-Themes, Codes, and Source Examples

Theme	Sub-Theme	Descriptive Codes	Representative Source Examples
Theme 1: Drivers of Logistics Cost Escalation	**1.1 Fuel & Energy Price Volatility**	Energy price transmission to freight; modal cost sensitivity; warehouse energy overhead; oil price volatility effects	Milewska & Milewski (2022); Min (2022); Mohammad et al. (2025); Ivanov (2020)
	1.2 Labour Market Constraints & 3PL Dependency	HGV driver shortages; wage inflation; 3PL cost pass-through; post-Brexit labour; service flexibility reduction	Notteboom et al. (2021); Belhadi et al. (2021); Hohenstein (2022); Chowdhury et al. (2021)
	1.3 Scottish Geographic & Infrastructure Limitations	Market dispersal; road freight dependency; route distance; port congestion; intermodal absence; peripheral location costs	Akgün et al. (2020); Craighead et al. (2020); Dolgui et al. (2020)

	1.4 Post-Pandemic & Geopolitical Disruptions	Container imbalances; port congestion; Ukraine conflict energy shock; inflation transmission; freight rate escalation	Guan et al. (2020); Niu et al. (2025); Sarkis (2021); Diaz et al. (2024)
Theme 2: Impact on Strategic Supply Chain Decisions	**2.1 Sourcing & Procurement Reconfiguration**	Nearshoring; total landed cost assessment; dual sourcing; supplier proximity; fuel escalation clauses; procurement logic shift	Kano et al. (2020); Gereffi (2020); Wieland (2021); Panwar et al. (2022); Nestlé (2023)
	2.2 Distribution Network & Transportation Planning	Network redesign; route optimisation; load consolidation; TMS deployment; vehicle utilisation; collaborative logistics	Asgharizadeh et al. (2023); Pellegrino et al. (2021); Carton et al. (2022); Akgün et al. (2020)
	2.3 Inventory Management & Demand Planning	Hybrid inventory models; strategic buffers; demand sensing; lean model limitations; replenishment optimisation	Song et al. (2022); Essuman et al. (2020); Ataburo et al. (2024); Nestlé (2023)
Theme 3: Supply Chain Transformation Strategies	**3.1 Structural Network Reconfiguration**	Distribution tier consolidation; regional hub development; postponement strategies; make-vs-	Asgharizadeh et al. (2023); Dolgui et al. (2020); Alikhani et al. (2021); Nestlé (2023)

		buy; footprint rationalisation	
	3.2 Supplier Diversification & Collaborative Logistics	Near-shore development; carrier portfolio; co-loading; shared-user transport; urban consolidation centres	Kano et al. (2020); Wieland (2021); Akgün et al. (2020); Gruchmann & Seuring (2021)
	3.3 Operational Flexibility	Multi-modal capability; flexible warehousing; agile supplier engagement; proactive adaptability; scenario planning	Pellegrino et al. (2021); Kamalahmadi et al. (2022); Ivanov (2022); Van Hoek (2020)
	3.4 Sustainability as Co-Benefit	Carbon-cost alignment; fleet decarbonisation; emissions reduction via efficiency; route optimisation co-benefits	Sarkis (2021); Sarkis et al. (2020); Stroumpoulis & Kopanaki (2022); Nestlé (2023)
Theme 4: Digitalisation & Resilience as Enablers	**4.1 Supply Chain Visibility**	IoT asset tracking; cloud TMS; ERP integration; real-time monitoring; cost signal responsiveness	Carton et al. (2022); Yang et al. (2022); Khedr (2024); Le & Fan (2024); Nestlé (2023)
	4.2 Predictive Analytics & Intelligent Planning	Demand forecasting; ML algorithms; transportation cost prediction; dynamic	Islam & Ikbal (2022); Nguyen et al. (2021); Wamba et al. (2020); Bag et al. (2020)

		routing; data-driven management	
	4.3 Resilience Capabilities (Absorptive, Adaptive, Recovery, Redesign)	Buffer inventory; redundant logistics; dynamic sourcing adjustment; contingency protocols; structural reconfiguration	Song et al. (2022); Hohenstein (2022); Kim & Kim (2024); Ivanov & Dolgui (2021); Dubey et al. (2022)