RAILWAY FREIGHT INTEGRATION AND SUPPLY CHAIN RESILIENCE OF KENYA RAILWAYS

BY

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MASTER OF BUSINESS ADMINISTRATION (PROCUREMENT AND SUPPLIES MANAGEMENT)

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A RESEARCH DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION (PROCUREMENT AND SUPPLIES MANAGEMENT) IN THE SCHOOL OF BUSINESS AT KCA UNIVERSITY

OCTOBER, 2025

DECLARATION

I declare that this dissertation is my original work and has not been previously published or submitted elsewhere for the award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and the author(s) duly acknowledged.

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I do hereby confirm that I have examined the Masters' dissertation of

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And have certified that all revisions that the dissertation panel and examiners recommended have been duly addressed.

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ABSTRACT

Railway freight integration plays a crucial role in enhancing the efficiency, connectivity, and competitiveness of the transport sector by enabling seamless movement of goods across different transport modes, reducing logistics costs, and improving supply chain reliability. Effective integration of railway freight systems strengthens national and regional trade linkages, thereby contributing to economic growth and sustainable transportation. The purpose of this study was to establish the influence of railway freight integration on the supply chain resilience of Kenya Railways. The specific railway freight integration aspects that were considered in the study comprised of intermodal connectivity, scheduling coordination, cargo handling efficiency and information systems integration. The theories supporting the study comprised of Network Theory, Just-In-Time Theory, Resource-Based View Theory, and Information Processing Theory. A descriptive-correlational research design was employed in the study. The target population comprised of 106 senior officials derived from Kenya Railways, Kenya International Freight and Warehousing Association, Kenya Transporters Association and Kenya Ports Authority. A purposive sampling technique was employed to include a sample 106 respondents from the selected senior officials. Data collection was through structured questionnaires. Both descriptive and inferential statistics were employed in analyzing the collected data. Descriptive statistics comprised of means and standard deviations while inferential statistics comprised of correlation and regression. The statistics were generated through Microsoft Excel and the Statistical Package for Social Sciences (SPSS) version 25. The results of the study were displayed in the form of tables and figures. The study established that railway freight integration aspects comprising of intermodal connectivity, cargo handling efficiency and information systems integration positively and significantly correlates with supply chain resilience of Kenya Railways. Additionally, intermodal connectivity had the influence on supply chain resilience followed by cargo handling efficiency, and finally information system integration. Scheduling coordination however have an insignificant influence on supply chain resilience. The study concluded that railway freight integration influences the supply chain resilience positively. The study provides recommendations to the management of Kenya Railways to enhance the railway integration practices to enhance the levels of resilience in the supply chain.

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ACRONYMNS AND ABBREVIATIONS

ICD	-	Inland Container Depots
IPT	-	Information Processing Theory
JIT	-	Just-In-Time
KIFWA	-	Kenya International Freight and Warehousing Association
KRC	-	Kenya Railways Corporation
KTA	-	Kenya Transporters Association
MGR	-	Meter Gauge Railway
NACOSTI	-	National Commission for Science, Technology, and Innovation
RFID	-	Radio Frequency Identification
RBV	-	Resource-Based View
SC	-	Supply Chain
SGR	-	Standard Gauge Railway
SMEs	-	Small and medium-sized enterprises
SPSS	-	Statistical Package for Social Scientists

OPERATIONAL DEFINITIONS OF TERMS

Cargo Handling Efficiency	Refers to the speed, accuracy, and safety with which goods are loaded onto and unloaded from trains (Muro et al., 2024)
Information systems integration	Entails linking railway management systems with those of other supply chain stakeholders, including freight forwarders, port authorities, customs agencies, and road transport operators (Nguyen et al., 2022)
Intermodal Connectivity	Refers to the ability of the rail system to connect effectively with other transport modes, such as road, maritime, and airfreight services (Tshoopara & Mbhele, 2024)
Railway Freight Integration	Refers to the systematic coordination and harmonization of railway transport operations with other elements of the supply chain to ensure seamless movement of goods from origin to destination (Chang & Chien, 2018).
Scheduling Coordination	Entails synchronizing train departures, arrivals, and connections with other modes of transport to optimize cargo flow (Havenga & De-Bod, 2016)
Supply Chain Resilience	Refers to the capacity of a supply chain to anticipate, prepare for, respond to, and recover from disruptions while maintaining continuity of operations and safeguarding performance (Alfarsi et al., 2019)

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The railway freight sector operates within a dynamic and competitive transport environment characterized by increasing cargo volumes, growing regional trade, and the need for efficient, reliable, and sustainable logistics solutions (Sarkis, 2022). Railways plays a critical role in facilitating domestic and cross-border trade by providing a cost-effective and high-capacity mode of cargo transportation. Railway freight integration as noted by Shan and Schönberger (2024) bears the capability of enhancing supply chain resilience through improving cargo flow efficiency, reducing transit times, lowering transportation costs, and minimizing risks of disruptions. The integration further supports the adaptability, flexibility, and recovery capacity of supply chains, thus safeguarding trade continuity and economic competitiveness in the face of logistical challenges and uncertainties.

In addition, rail freight integration provides an avenue for greener logistics by reducing reliance on carbon-intensive road transport and promoting multimodal connectivity. This aligns with global sustainability agendas, as noted by Roso (2015), who emphasized that integrating rail into logistics chains contributes significantly to reducing emissions, promoting energy efficiency, and ensuring long-term resilience of transportation systems. The strategic positioning of rail freight integration is not only about enhancing efficiency but also about strengthening resilience through sustainable and adaptive supply chain models.

Railway freight integration has become a crucial driver in achieving supply chain resilience across the world. Globally, countries are leveraging multimodal transport systems to enhance connectivity, reduce disruptions, and improve logistics efficiency. For instance, China has invested heavily in a networked logic that connects inland production zones, dry ports, seaports, and cross-border corridors. According to Zhou et al., (2024), the integration is achieved through freight-dedicated corridors, modern terminal and consolidation hubs, digital systems for scheduling and customs clearance, and active public–private coordination to match hinterland demand with port capacity. Wang and Chen (2025) highlighted that China views hub selection, intermodal terminal clustering, and digital coordination as central to improving throughput and reducing single-point failures in the chain. This implies that freight can shift routes more rapidly when disruptions occur, and consolidated flows reduce reliance on vulnerable long-haul trucking links. The resilience effect has been evidenced by improved redundancy and faster recoveries.

In Europe and North America, freight integration has also played a key role in enhancing supply chain robustness. Germany's intermodal transport policy, which combines rail, road, and inland waterways, has improved resilience by enabling seamless cargo transfers and reducing bottlenecks (Scherr & Fleischer, 2015). In the United States, the integration of Class I railroads with port facilities through inland rail ports and double-stack container services has diversified freight corridors and strengthened supply chain reliability (Rodrigue, 2015). These cases demonstrate how developed economies leverage freight integration for both efficiency and resilience.

In Africa, countries are increasingly adopting similar strategies to strengthen logistics reliability. Ethiopia's Addis Ababa–Djibouti Railway provides a direct high-capacity link to the Port of Djibouti, reducing dependence on road transport and improving export competitiveness (Mohapatra, 2016). The integration of this corridor, supported by customs modernization and logistics upgrades, has improved predictability and resilience of supply chains (Takele & Tolcha, 2021). Likewise, South Africa's integration of rail freight with mining and port operations has enhanced bulk export efficiency and reduced reliance on fragile road networks (Havenga, Simpson, & De Bod, 2015). Tanzania's central corridor linking Dar es Salaam Port to landlocked countries has similarly improved resilience by shortening delivery times and providing reliable transport alternatives (Mwaseba, 2015).

In Kenya, railway freight integration has been primarily pursued through the development and operationalization of the Standard Gauge Railway (SGR), which connects the Port of Mombasa to Nairobi and extends to inland container depots (ICDs) at key logistical nodes. The SGR was conceived as a strategic freight corridor intended to decongest road transport, replace the aging meter-gauge railway, and reduce transit times between the seaport and the hinterland (KRC, 2023). Integration has been facilitated through the establishment of ICDs, enabling transfers between maritime, rail, and road transport systems. According to Odima et al., (2023), the SGR has enhanced supply chain resilience by providing redundancy in freight transport modes, improving reliability, and increasing cargo throughput capacity. However, the full realization of these resilience benefits has been constrained by operational challenges such as last-mile connectivity, freight tariff structures, and limited interoperability with the meter-gauge network.

1.1.1 Railway Freight Integration

Railway freight integration refers to the systematic coordination and harmonization of railway transport operations with other elements of the supply chain to ensure seamless movement of goods from origin to destination (Chang & Chien, 2018). The integration involves aligning infrastructure, operations, and information flows to optimize efficiency, reduce delays, and enhance the overall reliability of freight services. In national and regional logistics, railway freight integration plays a critical role in enabling smooth connectivity between railways and other transport modes, thus ensuring cargo reaches its final destination in the most cost-effective, timely, and secure manner. The concept is central to strengthening supply chain resilience, as it reduces the risks associated with disruptions, improves operational flexibility, and supports consistent service delivery even in times of logistical strain.

Railway freight integration encompasses several dimensions, including infrastructure connectivity, policy and regulatory alignment, technological integration, operational coordination, and stakeholder collaboration (González & Mancebo, 2020). Infrastructure connectivity focuses on the development of rail-linked terminals, dry ports, and access roads that ensure physical linkages between different modes of transport. Policy and regulatory alignment seeks to harmonize operational standards, customs procedures, and safety regulations across transport corridors, thereby reducing bureaucratic bottlenecks. Technological integration involves the adoption of digital systems for monitoring, communication, and automation, while stakeholder collaboration emphasizes partnerships between railway operators, logistics firms, and government agencies to enhance service delivery.

However, while all these dimensions contribute to effective freight integration, the present study focuses on four critical operational components comprising of intermodal connectivity, scheduling coordination, cargo handling efficiency, and information systems integration. This is because the components directly influence the daily movement, coordination, and management of freight along Kenya Railways' network. The components have been identified as the most significant drivers of integration effectiveness within emerging railway systems, particularly where infrastructure and digital maturity are still developing (Tshoopara & Mbhele, 2024; Nguyen et al. 2022).

A key aspect of railway freight integration is intermodal connectivity, which refers to the ability of the rail system to connect effectively with other transport modes, such as road, maritime, and air freight services (Tshoopara & Mbhele, 2024). Intermodal connectivity enables cargo to be transferred efficiently between modes without excessive handling thus minimizing transit times and reducing the potential for cargo damage or loss. This is achieved through the development of well-planned terminals, rail-linked ports, dry ports, and logistics hubs that allow for the direct transfer of containers, bulk goods, and specialized cargo. Effective intermodal connectivity according to Kouadio et al (2019) ensures that railway transport is not an isolated system but part of an integrated logistics network that supports just-in-time delivery and wider market accessibility.

Another important component is scheduling coordination, which involves synchronizing train departures, arrivals, and connections with other modes of transport to optimize cargo flow (Havenga & De-Bod, 2016). Well-coordinated schedules minimize waiting times at transfer points, reduce congestion at terminals, and allow for predictable delivery timelines. Scheduling coordination may enhance supply chain resilience by ensuring that alternative routes can be activated quickly in the event of disruptions. In advanced railway freight systems, digital scheduling tools, and real-time monitoring are used to optimize train paths, allocate resources efficiently, and ensure that freight trains operate in harmony with passenger rail services without compromising punctuality.

Cargo handling efficiency forms another critical pillar of railway freight integration and refers to the speed, accuracy, and safety with which goods are loaded onto and unloaded from trains (Muro et al., 2024). Efficient cargo handling is achieved through the deployment of modern equipment such as automated cranes, conveyor systems, and container stacking technologies.

Streamlined handling processes reduce turnaround times, and minimize the risk of damage or loss. In addition, standardized cargo units make handling more consistent and compatible across different modes of transport, further enhancing integration. High cargo handling efficiency is essential for meeting customer expectations, particularly in time-sensitive supply chains such as perishable goods, manufacturing inputs, and e-commerce logistics (Okere, 2022).

Information systems integration plays a vital role in achieving seamless railway freight integration. This according to Nguyen et al., (2022) entails linking railway management systems with those of other supply chain stakeholders, including freight forwarders, port authorities, customs agencies, and road transport operators. Integrated information systems facilitate real-time tracking of shipments, electronic documentation, and automated customs clearance, thereby improving transparency and reducing administrative delays. Advanced systems such as Transport Management Systems and Enterprise Resource Planning, can further enhance trust, accuracy, and data security in freight transactions. Mutinda and Otieno (2020) posited that information systems integration not only boosts operational efficiency but also supports rapid decision-making in the event of disruptions, ensuring that alternative transport arrangements can be implemented without significant losses.

1.1.2 Supply Chain Resilience

Supply chain resilience, as noted by Alfarsi et al., (2019) refers to the capacity of a supply chain to anticipate, prepare for, respond to, and recover from disruptions while maintaining continuity of operations and safeguarding performance. In railway freight integration, supply chain resilience is a critical determinant of operational stability, especially in environments prone to logistical, infrastructural, or environmental challenges. The resilience embodies the ability not only to withstand shocks but also to adapt to new conditions and emerge stronger, ensuring that goods and services continue to flow efficiently from origin to destination. Resilience is therefore not just a defensive mechanism but also a strategic capability that can enhance competitiveness in global and regional markets. Organizations that invest in resilience often experience shorter recovery times and lower financial losses when disruptions occur. Furthermore, resilient supply chains contribute to national economic stability by ensuring reliable trade flows even in times of crisis.

Previous studies identify several components of supply chain resilience, including redundancy, agility, flexibility, collaboration, visibility, risk management, adaptability, and operational continuity (Christopher & Peck, 2004). Redundancy involves maintaining spare capacity, backup systems, or alternative suppliers to absorb shocks when disruptions occur. Agility and flexibility refer to the speed and ease with which a supply chain can adjust operations or reroute flows when conditions change. Collaboration emphasizes strong partnerships and information sharing among stakeholders to coordinate responses to disruptions, while visibility entails real-time monitoring of supply chain activities for early detection of risks and quick decision-making. Each of these dimensions contributes to the overall resilience of supply chains in different contexts and sectors.

However, for the railway freight sector in Kenya, this study focuses on three interrelated dimensions comprising of operational continuity, risk mitigation, and adaptability as they represent the most critical aspects influencing resilience within transport logistics networks. A central aspect of supply chain resilience is operational continuity, which relates to the ability of the supply chain to sustain its core operations without significant interruption during adverse events (Alkhatib & Momani, 2023). For railways, this means maintaining the flow of goods across the network even in the face of disruptions like track damage, labor strikes, or equipment breakdowns. Ensuring operational continuity involves having robust contingency plans, redundant capabilities, and effective communication mechanisms that allow for quick problem identification and resolution to minimize downtime. This continuity also depends on regular maintenance and investment in modern railway infrastructure to prevent frequent breakdowns.

Risk mitigation is another essential aspect of supply chain resilience that involves identifying, assessing, and reducing vulnerabilities within the supply chain (Shekarabi et al., 2025). The proactive approach enables organizations to anticipate potential risks and implement strategies to lessen their impact. Risk mitigation can take the form of diversifying routes, investing in security technology, or establishing strong partnerships with other logistics providers to create buffer capacity. It also includes developing early warning systems and predictive analytics to identify disruptions before they escalate. Railway systems can spread risks and avoid total breakdowns in the event of localized failures by building redundancy into the network. Effective risk mitigation ultimately translates into reduced delays, lower costs, and enhanced customer satisfaction across the supply chain.

Adaptability on the other hand is the capacity of the supply chain to adjust its structure, processes, and strategies in response to evolving internal or external conditions (Pietrzyńska & Motowidlak, 2023). In a dynamic environment, adaptability ensures that the supply chain can realign itself in response to changing market demands and requirements. Adaptability allows supply chains to innovate processes, and deploy new technologies rapidly to meet changing customer demands and overcome disruptions. In railway freight, adaptability is demonstrated through the integration of digital tracking systems, flexible scheduling to accommodate fluctuating freight volumes, or collaboration with other transport modes. The presence of adaptability ensures that railway freight services remain competitive in an increasingly interconnected logistics landscape. It also enhances customer trust, as clients perceive railway operators as responsive and capable of meeting diverse needs. Ultimately, adaptability transforms resilience from a short-term survival mechanism into a long-term strategic advantage.

1.1.3 Kenya Railways

Kenya Railways operates within the transport and logistics sector, a key enabler of Kenya's economic growth and regional trade competitiveness. Established in 1978 under the Kenya Railways Corporation Act (Cap 397), KRC is a state-owned enterprise fully owned by the Government of Kenya under the Ministry of Roads and Transport. Its core mandate is to manage, operate, and develop railway infrastructure and services for both freight and passenger transport, thereby facilitating efficient logistics across the country and the broader East African region.

As of 2024, KR oversees both the Standard Gauge Railway and the Meter Gauge Railway networks, which collectively span more than 2,000 kilometers. The SGR, launched in 2017, provides high-capacity freight and passenger services along the Mombasa–Nairobi–Naivasha corridor, while the MGR connects secondary towns and regional routes extending to Uganda. The SGR has enhanced the speed, reliability, and volume of cargo transport, handling approximately 6 million tonnes of freight annually by 2023 (Kenya Railways, 2023). This accounts for about 25–30% of containerized cargo leaving the Port of Mombasa, significantly easing pressure on the road network (Kenya National Bureau of Statistics, 2023). MV Uhuru I and MV Uhuru II are marine vehicles owned by Kenya Railways that operate on Lake Victoria, connecting the Kenyan port of Kisumu with Tanzania and Uganda. The vessels transport cargo received via the Nakuru-Kisumu railway line from Mombasa and return with goods from ports across the lake. (Makone, 2023)

In terms of financial and asset profile, KRC's asset base was valued at approximately KES 460 billion in 2022, primarily consisting of rolling stock, railway lines, stations, and real estate holdings (National Treasury, 2023). However, the corporation continues to shoulder a substantial debt burden related to SGR construction, estimated at over KES 480 billion, largely financed through Chinese loans. The debt servicing obligations have strained KRC’s operational finances, prompting the government to explore restructuring options and public–private partnership models to enhance sustainability (Githaiga, 2021).

Kenya Railways employs approximately 3,200 staff members across technical, administrative, and operational divisions (Kenya Railways, 2023). To improve efficiency and local capacity, the corporation has implemented institutional restructuring focused on separating regulatory, infrastructure management, and service operations. In addition, efforts are ongoing to transfer operational control of the SGR from the China Road and Bridge Corporation to Kenyan personnel through targeted training and technology transfer programs.

From a performance perspective, the freight segment remains the backbone of KRC’s revenue generation, contributing nearly 70% of total income in recent years. Passenger services, including the Nairobi Commuter Rail, have shown steady recovery post-COVID-19, with over 2.5 million passengers transported in 2023, up from 1.8 million in 2021 (Kenya National Bureau of Statistics, 2023). Despite this progress, challenges such as high maintenance costs, interoperability limitations between the SGR and MGR, and underutilization of regional linkages continue to constrain growth. Furthermore, governance and policy alignment remain key concerns, with ongoing discussions about transforming KRC into a holding structure that can attract private capital while maintaining state oversight.

1.2 Statement of the Problem

Kenya Railways plays a critical role in facilitating the movement of goods within Kenya and across the East African region thus supporting national and regional economic growth. However, Githaiga (2021) highlighted that the organization has continued to face significant challenges that undermine its supply chain resilience. The challenges include inadequate connectivity, delays in cargo handling, and capacity constraints that limit the efficiency and reliability of freight services. Furthermore, disruptions arising from mechanical breakdowns, limited integration with road and port transport systems, and vulnerability to external shocks have further weakened the resilience of Kenya Railways' supply chain (Kamwere & Murigi, 2023).

For Kenya Railways, the absence of seamless coordination between rail freight services and other transport modes has contributed to inefficiencies, including prolonged cargo dwell times, inconsistent service delivery, and reduced competitiveness compared to road transport alternatives (Ndung'u, 2025). Additionally, limited digital integration in freight tracking and cargo management has hampered real-time visibility, making it difficult to respond promptly to disruptions. These weaknesses have had a ripple effect on key economic sectors such as the manufacturing, agriculture, and trade that are dependent on timely and secure delivery of goods.

Railway freight integration presents a strategic solution to these challenges. Through enhanced connectivity, integrated freight services can reduce cargo-handling delays, improve reliability, and increase operational efficiency (Chang & Chien, 2018). Additionally, by leveraging technology, railway freight integration can strengthen supply chain visibility, responsiveness, and adaptability. In this way, the integration has the potential to transform Kenya Railways into a more resilient and competitive freight transport provider, capable of withstanding disruptions and meeting the evolving demands of domestic and regional trade. However, the association between railway freight integration and supply chain resilience in Kenya Railways remains underexplored. The main focus of the study thus to establish how railway freight integration influences supply chain resilience of Kenya Railways.

Despite the growing recognition of integration as a resilience enabler, empirical evidence on how railway freight integration influences supply chain resilience remains limited, particularly within the context of Kenya Railways. Existing studies have examined supply chain resilience from broader logistics or manufacturing perspectives (Shen et al., 2023; Song et al., 2022; Gitonga, 2021), leaving a contextual and conceptual gap on the role of railway freight integration in building resilience in national transport systems. This study therefore sought to bridge this gap by examining the influence of railway freight integration on the supply chain resilience of Kenya Railways.

1.3 Objectives of the Study

The study was guided by the following general and specific objectives:

1.3.1 General Objective

The general objective of the study was to establish the influence of railway freight integration on supply chain resilience focusing on Kenya Railways.

1.3.2 Specific Objectives

i To assess the influence of intermodal connectivity on supply chain resilience of Kenya Railways.

ii To find out how scheduling coordination influences on supply chain resilience of Kenya Railways.

iii To examine the influence of cargo handling efficiency on supply chain resilience of Kenya Railways.

iv To establish how information systems integration influences on supply chain resilience of Kenya Railways.

1.4 Research Questions

i How does intermodal connectivity influence supply chain resilience of Kenya Railways?

ii To what extent does scheduling coordination influences supply chain resilience of Kenya Railways?

iii How does cargo handling efficiency influence supply chain resilience of Kenya Railways?

iv What is the influence of information systems integration on supply chain resilience of Kenya Railways?

1.5 Significance of the Study

The study was of significance to the following:

1.5.1 Management of Kenya Railways

The findings of this study is of significance to the management of Kenya Railways, as it provides insights into the role of railway freight integration in enhancing supply chain resilience. The management is better positioned to adopt best practices, and allocate resources effectively to improve service reliability, operational efficiency, and competitiveness in the national and regional transport sector.

1.5.2 Logistics Providers

For logistics service providers, the study generates valuable information on the operational and strategic benefits, associated with integrating railway freight into their supply chains. This enables them to align their logistical operations with the capabilities and efficiencies offered by rail transport, optimize cargo-handling processes, and mitigate overreliance on less efficient transport modes. Additionally, logistics providers may be better equipped to develop proactive risk management strategies, leveraging railway freight as a resilient and sustainable mode of cargo transportation.

1.5.3 Researchers

The study contributes to the existing body of literature on transport integration and supply chain resilience. The study offers an understanding of the interplay between railway freight systems and resilience-building mechanisms in supply chains, thereby filling an empirical and theoretical gap. Furthermore, the findings provide a foundation for subsequent research in the domains of railway freight integration and resilience strategies. The study also serves as a reference point for comparative analysis in different geographical and sectoral contexts, thereby enriching scholarly works.

1.6 Scope of the Study

The study focuses on establishing the influence of railway freight integration on supply chain resilience focusing on Kenya Railways. The specific aspects of railway freight integration that were considered in the study comprised of intermodal connectivity, scheduling coordination, cargo handling efficiency and systems integration. The study employed a descriptive correlation research design and targeted 106 senior officials from Kenya International Freight and Warehousing Association (KIFWA), Kenya Transporters Association (KTA), Kenya Ports Authority and Kenya Railways. A purposive sampling approach was employed. The study utilized questionnaires in collecting data for the study. The locale of the study was Nairobi City County and the research was projected to take 5 months.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter contains the literature review of the study. Theories anchoring the variables of the study are discussed in the chapter as well as the empirical literature review. The chapter further outlines the conceptual framework that shows a diagrammatic link between the independent and dependent variable. The operationalization of the variables of the study is also presented followed by an outline of the research gaps.

2.2 Theoretical Review

Adom et al., (2018) state that a theoretical review serves as the research's plan. An existing theory in a field of study serves as the foundation for the framework, which is related to and/or reflects the study's objectives. The researcher frequently "borrows" this foundation to construct his or her own research question. It provides the framework around which a study is built. The study was anchored on the following theories: Network Theory, Just-In-Time (JIT) Theory, Resource-Based View Theory, and Information Processing Theory

2.2.1 Network Theory

Network Theory was initially advanced by Jacob Moreno in the 1930 and provides a framework for understanding the structure and dynamics of interconnected systems. The theory posits that entities, referred to as nodes, are linked through various types of relationships or connections known as edges (Borgatti & Halgin, 2011). In transport and supply chain systems, the nodes can represent logistical facilities such as ports, rail terminals, depots, and customer destinations, while edges signify the transport routes and information flows connecting them.

Network Theory emphasizes that the efficiency, robustness, and adaptability of a system are determined not only by the individual capabilities of its components but also by the quality, density, and redundancy of the connections between them. This makes the theory particularly relevant for analyzing large-scale transportation systems, where interdependence is a defining feature. It also highlights the importance of mapping and quantifying relationships to better predict system performance (Newman, 2010). Furthermore, the theory provides decision-makers with a lens to identify critical nodes whose failure could disproportionately affect the entire supply chain (Barabási, 2016).

The theory asserts that highly connected and well-structured networks tend to be more resilient, as they can adapt to disruptions by rerouting flows through alternative paths and leveraging multiple interconnections (Onday, 2015). In transport logistics, the principle of intermodal connectivity, where goods move seamlessly between different modes of transportation such as rail, road, and sea, aligns with this theoretical perspective. Network Theory suggests that when transport nodes are integrated into a cohesive intermodal network, the overall system gains flexibility, reduces transit bottlenecks, and enhances its capacity to maintain operations even when certain routes or nodes face disruptions. This adaptability ensures continuity of service, which is crucial for industries relying on just-in-time delivery systems (Sheffi, 2007). It also strengthens competitiveness by lowering transaction costs and improving reliability (Rodrigue & Notteboom, 2020). In the context of Kenya Railways, applying Network Theory can help policymakers and practitioners design integration strategies that enhance supply chain resilience in both domestic and regional markets (Munyua, 2021).

Although Network Theory provides valuable insights into the interconnections within logistics and transport systems, it has been critiqued for its overemphasis on structural relationships while often neglecting the role of power asymmetries, governance mechanisms, and institutional contexts that shape network outcomes (Kilduff & Brass, 2010). In supply chain resilience, the theory assumes that increased connectivity automatically leads to adaptability, yet excessive interconnectedness may also increase vulnerability by creating cascading disruptions (Kim, Chen, & Linderman, 2015).

The Network Theory provides a strong conceptual basis in relation to the objective of assessing the influence of intermodal connectivity on the supply chain resilience of Kenya Railways. Kenya Railways operates within a broader logistics ecosystem where rail freight interacts with road transport, inland container depots, and port facilities. According to the theory, the resilience of this supply chain depends on how effectively these transport nodes are linked and how efficiently cargo can transition between them (Hearnshaw & Wilson, 2013). A well-connected intermodal network ensures multiple routing options, minimizes delays from localized disruptions, and supports timely delivery of goods, which is critical for supply chain continuity.

2.2.2 Just-In-Time (JIT) Theory

Taiichi Ohno conceptualized the Just-In-Time (JIT) theory in 1970 within Toyota Motor Corporation in Japan. The theory is a production and inventory management philosophy designed to enhance efficiency, minimize waste, and ensure the availability of materials, components, and products precisely when required. The fundamental premise of the theory is that production and supply processes should be tightly synchronized with actual demand patterns, thereby eliminating inefficiencies associated with excess inventory, prolonged storage, and overproduction (Folinas et al., 2017). Through this approach, organizations are able to achieve greater operational responsiveness, improved quality control, and reduced operational costs.

Central to the JIT philosophy is the principle of accurate scheduling and coordination across all stages of the supply chain. The theory posits that the effectiveness of JIT systems is contingent upon precise alignment between supply deliveries, production schedules, and customer requirements (Yang et al., 2021). This necessitates meticulous planning, dependable supplier relationships, integrated transportation systems, and real-time information exchange. Any disruption or misalignment in scheduling may compromise the efficiency of operations, and consequently, organizational performance.

Despite its success in reducing waste and enhancing efficiency, the Just-In-Time approach has been criticized for making supply chains more vulnerable to disruptions due to its minimal buffer stocks and reliance on highly synchronized scheduling (Christopher & Peck, 2004). The theory assumes stable and predictable operating environments, yet in contexts characterized by infrastructure challenges and frequent disruptions, such as in railway freight operations, JIT systems may worsen risks rather than enhance resilience (Papadopoulos et al., 2017). Therefore, while JIT can improve efficiency, it requires complementary risk mitigation strategies, such as redundancy and contingency planning, to ensure supply chain robustness.

In railway freight operations, scheduling coordination entails the harmonization of train departure and arrival times with cargo handling, loading and unloading activities, and subsequent transport linkages. The adoption of JIT principles within the railway can facilitate optimized freight scheduling, thereby reducing operational bottlenecks, enhancing turnaround times, and improving the predictability of cargo flows. Such improvements according to Ozalp et al., (2010) contribute significantly to supply chain resilience by enabling timely adaptation to disruptions, sustaining service reliability, and meeting fluctuating customer demands.

2.2.3 Resource-Based View Theory

The Resource-Based View (RBV) is a strategic management theory popularized by Jay Barney in 1991. The theory posits that an organization's ability to achieve and sustain competitive advantage is primarily determined by the unique resources and capabilities it controls, rather than solely by external market conditions (Barney, 1991). According to RBV, resources that are valuable, rare, inimitable, and non-substitutable form the foundation for long-term superior performance because they enable the firm to perform activities more effectively or efficiently than competitors. This implies that organizations must not only acquire resources but also manage and deploy them strategically to maximize their potential. RBV further emphasizes that temporary advantages can be eroded if resources are easily copied or substituted by competitors. Therefore, the sustainability of competitive advantage depends on how well resources are protected, nurtured, and integrated into organizational strategies.

The theory according to Sabourin (2020) classifies resources into three broad categories: physical resources (such as infrastructure, machinery, and technology), human resources (skills, expertise, and experience of employees), and organizational resources (processes, systems, and culture). These categories highlight the multidimensional nature of resources that firms must leverage for long-term competitiveness. Firms can create synergies that enhance efficiency, innovation, and resilience against market volatility by investing in resource development. The theory argues that competitive advantage arises when a firm effectively combines these resources in ways that competitors cannot easily replicate. This means that organizations with strong coordination mechanisms and dynamic capabilities are better positioned to respond to changing environments. In addition, RBV provides a framework for understanding why some firms consistently outperform others despite facing similar external conditions. This perspective shifts the focus from adapting to environmental changes alone to developing and protecting unique internal strengths that can withstand external pressures.

The Resource-Based View (RBV) theory has been influential in explaining firm performance; however, it has been critiqued for its inward-looking focus, often neglecting the dynamic external environment in which firms operate (Priem & Butler, 2001). The theory assumes that resources that are valuable, rare, inimitable, and non-substitutable guarantee sustained competitive advantage, yet in volatile contexts such as transport and logistics, external shocks may quickly erode the value of such resources (Arend & Lévesque, 2010). Moreover, RBV theory has been challenged for its lack of operational guidance on how firms can develop, combine, and protect resources in practice.

Cargo handling efficiency can be seen as a critical operational capability embedded within Kenya Railways' resource base. It encompasses specialized equipment, well-trained personnel, robust operational procedures, and advanced technological systems that ensure the swift, accurate, and safe loading, unloading, and transfer of freight (Olavarrieta & Ellinger, 2017). These elements, when optimized, not only reduce turnaround times and minimize cargo damage but also enhance the predictability and reliability of supply chain operations.

2.2.4 Information Processing Theory

The Information Processing Theory was proposed by Jay Galbraith in 1973. The theory is grounded in the idea that organizations are essentially information-processing systems that must collect, interpret, and respond to information from their internal and external environments to operate effectively (Shahid, 2022). The theory argues that the primary challenge for organizations is dealing with uncertainty, which arises when there is a gap between the information available and the information required to make optimal decisions. The theory posits that the greater the uncertainty in the operating environment, the greater the need for effective information processing capabilities. In essence, the ability of an organization to thrive is strongly tied to how well it aligns its information-handling processes with the demands of its environment. This makes the concept highly relevant in situations where rapid decision-making and responsiveness to change are crucial. Furthermore, the theory provides a strong foundation for understanding organizational adaptability in the face of turbulence and complexity.

According to IPT, organizations can address uncertainty by reducing the need for information processing through mechanisms such as creating slack resources. Additionally, the uncertainty can be addressed through establishing standardized procedures or by increasing their capacity to process information (Gurbin, 2015). Increasing capacity often involves integrating advanced information systems, enhancing communication channels, and fostering real-time data sharing across departments and with external stakeholders. Such measures not only help organizations absorb shocks but also allows them to seize opportunities as they emerge. Firms can minimize duplication of effort and misinterpretation of critical data by developing strong information channels. Over time, this creates a culture of proactive decision-making where risks are managed more effectively and coordination is improved across operational levels.

Information Processing Theory highlights the importance of information systems in managing uncertainty, yet it has been critiqued for its assumption that uncertainty can always be effectively reduced through greater information processing capacity (Daft & Weick, 1984). In practice, the overload of information can itself become a challenge, leading to decision delays or misinterpretation of critical signals (Galbraith, 1974). Furthermore, IPT often overlooks the role of organizational culture, power dynamics, and human judgment in shaping how information is interpreted and acted upon (Premkumar, Ramamurthy & Saunders, 2005).

The Information Processing Theory supports the examination of how information systems integration influences supply chain resilience in Kenya Railways. The railway freight environment is characterized by numerous uncertainties, including fluctuating demand, infrastructure constraints, operational disruptions, and coordination challenges with multiple supply chain partners. Kenya Railways can increase its capacity to gather, process, and disseminate critical operational and market data in real time through integrating information systems (Yang et al., 2025). This enables faster decision-making, improves coordination between freight scheduling, tracking, and delivery operations, and enhances the visibility of cargo movement across the supply chain.

2.3 Empirical Literature Review

An empirical literature review according to Webster and Watson (2002) is a focused, critical synthesis of existing empirical studies relevant to an area of study. Rather than simply summarizing what other authors have written, an empirical review organizes, compares, and evaluates the methods, measures, contexts, and findings reported across primary studies to produce an integrated account of what is known and what remains uncertain (Booth, Sutton, & Papaioannou, 2016). This section provides an outline of the empirical literature review in respect to intermodal connectivity, scheduling coordination, cargo handling efficiency and systems integration.

2.3.1 Intermodal Connectivity and Supply Chain Resilience

Tshoopara and Mbhele (2024) examined intermodal connectivity in Namibia and its impact on the functionality of regional logistics hubs. The study revealed that Namibia's transport system is highly dependent on road networks and suffers from a fragmented railway system, limiting intermodal integration. While the study provides valuable insights into the benefits of enhanced intermodal connections, it does not consider the effects of governance inefficiencies, funding constraints, or regulatory bottlenecks that are often prevalent in developing countries like Kenya. Unlike Namibia, Kenya's railway system, particularly the Standard Gauge Railway, faces institutional challenges such as bureaucratic delays, inadequate inter-agency coordination, and limited last-mile connectivity, which may constrain the potential benefits of intermodal integration. Therefore, while the study supports the argument that intermodal transport can enhance supply chain resilience, its conclusions need contextual adaptation to Kenya's infrastructural and institutional realities.

Kouadio et al. (2019) explored intermodality in West Africa, focusing on corridors connecting landlocked countries to coastal ports. Their findings demonstrated that cost-effective handling, reasonable rail tariffs, and efficient terminal operations enhance the competitiveness of intermodal routes and strengthen resilience against disruptions. However, the study primarily considers economic factors and operational efficiencies while downplaying the role of systemic risks such as political instability, regulatory inconsistencies, and infrastructure maintenance issues. In the Kenyan context, factors like irregular power supply, limited multimodal terminals, and high bureaucratic costs in cargo processing could significantly affect the feasibility and resilience of intermodal routes. This underscores that while intermodality improves resilience in theory, practical implementation in Kenya may face unique logistical and institutional constraints not observed in West African corridors.

Ochieng et al. (2024) investigated the effect of integrated transportation on the supply chain performance of large manufacturing firms in Kenya. Their results indicated that both intermodal and multimodal transport positively influence supply chain performance, predicting over 53% of the variation in operational efficiency. While the study provides direct evidence relevant to Kenya, it does not discuss potential constraints such as railway network limitations, inefficiencies in terminal operations, or the financial burden of multimodal adoption on SMEs. Additionally, the study does not explore contradictions, such as instances where intermodal transport may increase complexity or costs, particularly for smaller firms with limited logistics capacity. Recognizing these limitations is crucial for understanding the nuanced impact of intermodal connectivity on supply chain resilience in the Kenyan context.

Ratemo et al. (2015) surveyed manufacturing, distribution, and logistics firms in Kenya to determine intermodal transport usage and its effects. While the study highlights that rail usage is limited by network coverage and inadequate intermodal links, it also points out that cost advantages can drive adoption. This nuanced finding emphasizes that resilience benefits from intermodal integration are conditional and heavily dependent on infrastructure efficiency, coordination, and cost-effectiveness. However, the study does not compare the experiences of firms in Kenya with those in other countries, which could provide insights into how institutional differences shape the effectiveness of intermodal connectivity.

2.3.2 Scheduling Coordination and Supply Chain Resilience

Garcia and Lee (2018) analyzed operational responsiveness in European rail networks under extreme weather conditions. They found that proactive re-sequencing of train schedules and inter-operator coordination reduced recovery times by 30%. While the findings highlight the importance of scheduling coordination, European rail networks typically have advanced infrastructure, robust governance structures, and real-time operational monitoring systems. Kenya Railways, by contrast, faces infrastructural limitations, outdated signaling systems, and fragmented scheduling mechanisms, which may reduce the practical applicability of these results.

Thus, while scheduling coordination can enhance resilience, the effectiveness is constrained by Kenya's infrastructural and technological gaps.

Ghazy et al. (2022) studied technological interventions in the Klang Valley transportation network in Malaysia, emphasizing intelligent transport systems and big-data-based scheduling tools. The study demonstrates that such technologies improve timetable alignment, reduce connection failures, and minimize idle time, thereby enhancing resilience. However, the adoption of these technologies requires significant capital investment, technical expertise, and reliable data infrastructure—conditions not yet fully met in Kenya. Moreover, the study does not consider organizational and regulatory barriers that may slow adoption, which are particularly relevant in Kenyan freight operations where multiple stakeholders—government, private operators, and port authorities—must coordinate.

Havenga and De-Bod (2016) examined corridor performance in South Africa and found that poor scheduling coordination and limited visibility across actors impaired efficiency and resilience. They recommended routine scheduling indicators and improved information-sharing mechanisms. In Kenya, similar challenges exist, including a lack of centralized scheduling systems, inadequate stakeholder collaboration, and weak monitoring frameworks. However, the study does not address the interaction between policy enforcement, investment limitations, and infrastructure gaps, which could be critical factors in enhancing resilience within Kenya's railway corridors.

2.3.3 Cargo Handling Efficiency and Supply Chain Resilience

Okere (2022) investigated Nigerian ports and established a significant relationship between cargo handling equipment and port performance. While the study underscores the importance of equipment in operational efficiency, it does not consider contextual differences in regulatory compliance, labor productivity, and supply chain governance. In Kenya, cargo handling efficiency at the Port of Mombasa and ICD Embakasi is similarly affected by equipment availability but is further constrained by bureaucratic procedures, security checks, and limited storage facilities.

Muro et al. (2024) assessed Dar es Salaam Port and concluded that specialised equipment, port management systems, and staff training enhance cargo handling efficiency and customer satisfaction. Nonetheless, the study does not critically evaluate the challenges of technology adoption, maintenance costs, or inter-organizational coordination. In Kenya, implementing similar interventions may be hindered by high operational costs, limited skilled labor, and inconsistent technology adoption across port and rail operators, affecting resilience outcomes.

Ndung'u and Ndegwa (2025) evaluated the technical and revenue efficiency of the Standard Gauge Railway in Kenya. The study highlighted high operational proficiency but noted a gap between technical efficiency (94%) and financial performance (87.3%), with inflation negatively affecting efficiency. This suggests that even with operational improvements, external economic factors can erode the resilience benefits of freight operations. However, the study does not explore other constraints such as intermodal linkages, coordination failures, or regulatory bottlenecks, which could further influence supply chain resilience.

Nyaribo (2019) analyzed ICD Embakasi container port efficiency, emphasizing handling efficiency, transportation, and staff training. The study confirms that these factors significantly impact operational performance. However, it overlooks challenges such as infrastructure bottlenecks, customs delays, and policy inconsistencies, which are crucial for assessing resilience in the Kenyan logistics environment.

2.3.4 Information Systems Integration and Supply Chain Resilience

Nguyen et al. (2022) investigated information systems integration in Southeast Asian logistics firms and found that integrated systems enhance operational agility and supply chain resilience. While the study demonstrates clear benefits, Southeast Asian contexts often feature more advanced digital infrastructure and regulatory frameworks than Kenya. Kenyan freight operators may face challenges such as poor network connectivity, limited system interoperability, and resistance to digital adoption, which can constrain resilience improvements.

Chen and Li (2021) examined China Railway's nationwide freight information platform and concluded that seamless data sharing reduces disruption recovery times. While these findings highlight the importance of system integration, Kenya's fragmented institutional framework, limited real-time data infrastructure, and multi-agency coordination issues may hinder full realization of these benefits. Additionally, the study does not consider the high costs of system deployment or the technical training required, which are important in the Kenyan setting.

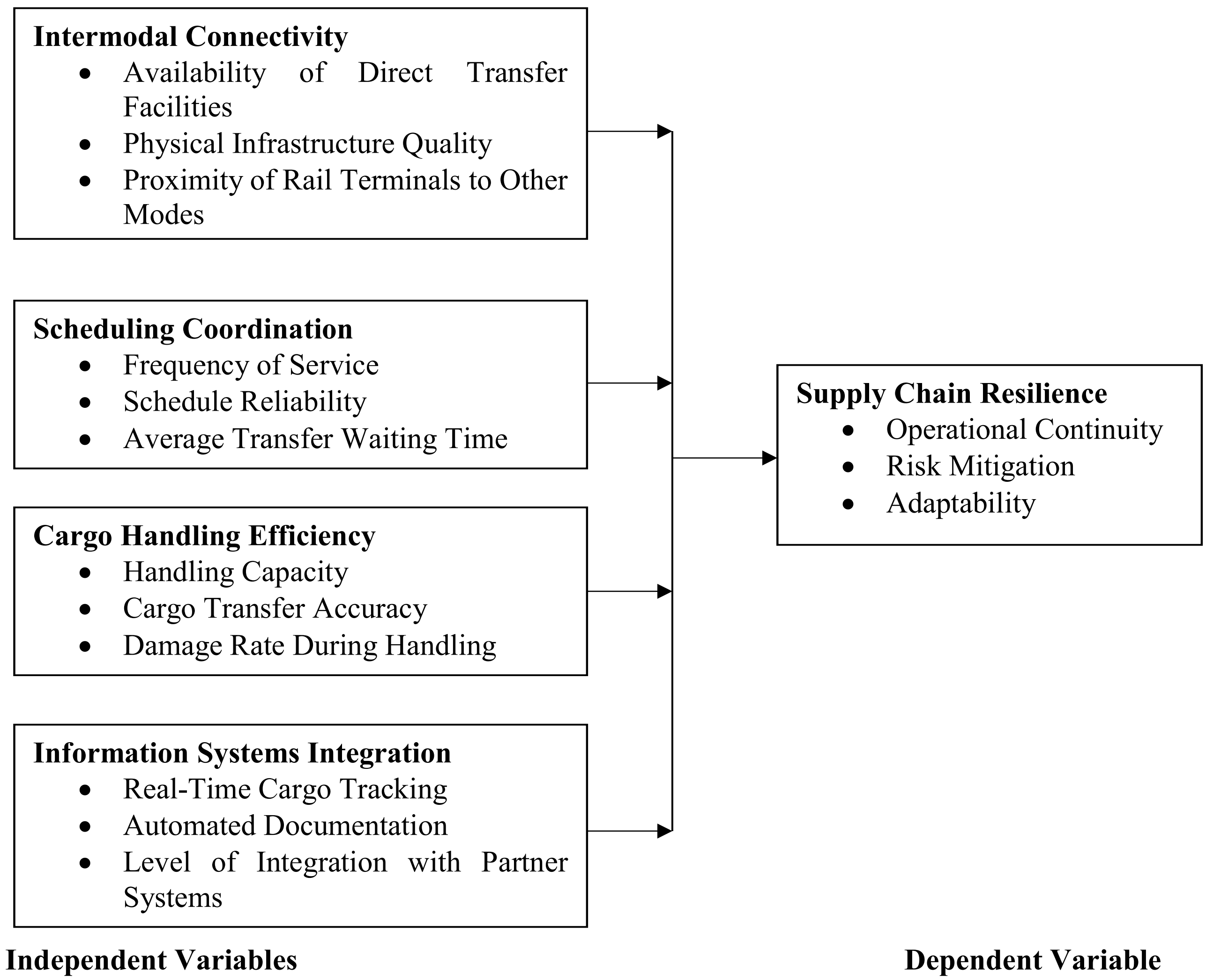
Rashid et al. (2024) found that digital supply chains and information processing significantly enhance supply chain resilience through risk management. Although the findings support the integration-resilience link, they do not address challenges like infrastructure constraints, stakeholder coordination, or regulatory bottlenecks, which are especially pertinent in Kenya.

Mutinda and Otieno (2020) assessed information system adoption at the Kenya Ports Authority and its effect on cargo handling efficiency. The study demonstrated improvements in supply chain visibility, dwell time reduction, and coordination between port and railway services. However, it does not examine limitations such as inconsistent data quality, inadequate inter-agency communication, or the high operational costs of system maintenance. These factors are critical when evaluating the practical impact of information systems integration on supply chain resilience in Kenya.

2.4 Conceptual Framework

A conceptual framework, according to Adom et al., (2018), is made up of variables that the researcher operationalizes in order to accomplish predetermined objectives. A conceptual framework establishes a connection between the independent and dependent variables. The relationship between Kenya Railways' supply chain resilience and railway freight integration is depicted in the following framework. Supply chain resilience is the dependent variable, whereas intermodal connection, scheduling coordination, cargo handling effectiveness, and information systems integration are the independent variables. The conceptual framework used in this research is shown in Figure 1.

FIGURE 1 Conceptual Framework



2.5 Operationalization of the Study Variables

Table 1 outlines the operationalization of the variables of the studies comprising of the variable, indicators and respective measures.

TABLE 1 Operationalization of the Study Variables

Variable Type	Variable	Indicators	Measurement Scale
Independent Variable	Intermodal Connectivity	• Availability of Direct Transfer Facilities • Physical Infrastructure Quality • Proximity of Rail Terminals to Other Modes	Likert Scale
Independent Variable	Scheduling Coordination	• Frequency of Service • Schedule Reliability • Average Transfer Waiting Time	Likert Scale
Independent Variable	Cargo Handling Efficiency	• Handling Capacity • Cargo Transfer Accuracy • Damage Rate During Handling	Likert Scale
Independent Variable	Information Systems Integration	• Real-Time Cargo Tracking • Automated Documentation • Level of Integration with Partner Systems	Likert Scale
Dependent Variable	Supply Chain Resilience	• Operational Continuity • Risk Mitigation • Adaptability	Likert Scale

2.6 Research Gaps

From the reviewed empirical studies on railway freight integration and supply chain resilience, several research gaps emerge. While numerous studies such as Tshoopara & Mbhele (2024); Kouadio et al., (2019); Ochieng et al., (2024) and Ratemo et al., (2015) have explored the role of intermodal connectivity in enhancing logistics efficiency and performance, there is limited empirical evidence on how such connectivity specifically contributes to supply chain resilience within the context of Kenya Railways. Most of these studies focus on cost, time efficiency, and operational performance, yet resilience remains underexplored. In addition, the reviewed literature on scheduling coordination such as Garcia & Lee, (2018); Ghazy et al., (2022); Havenga & De Bod (2016) largely addresses developed and emerging economy contexts, with minimal focus on sub-Saharan Africa's unique infrastructural, policy, and capacity constraints. This creates a contextual gap regarding how scheduling coordination mechanisms can be optimized in resource-constrained railway freight systems to improve resilience.

Similarly, while research on cargo handling efficiency such as Okere (2022); Muro et al., (2024); Ndung'u and Ndegwa, (2025); Nyaribo (2019) has demonstrated strong links between handling equipment, operational processes, and port performance, there is limited examination of how these factors interact with inland railway freight operations to sustain supply chains during disruptions. The emphasis has largely been on seaport contexts, with little attention to the performance of inland intermodal facilities such as Inland Container Depots in resilience-building. Furthermore, the studies on information systems integration such as Nguyen et al., (2022); Chen and Li (2021); Rashid et al., (2024); Mutinda and Otieno (2020) highlight the positive effects of digital systems on operational agility and coordination. However, there remains a methodological gap, as most research has relied on either single-case studies or broad sector-level analyses without integrating longitudinal data that could capture resilience outcomes over time. Moreover, little is known about the combined effect of intermodal connectivity, scheduling coordination, cargo handling efficiency, and information systems integration when implemented simultaneously in a railway freight environment in the Kenyan context.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research approach that was applied. The target population, sample techniques, and research design are presented in this chapter. It also specifies the methods for gathering data as well as the tools that were used in the study. It ends with a description of the data analysis process and the anticipated results.

3.2 Research Design

A research design is the overall plan that outlines how a study was conducted to answer the research questions (Ogoi, 2022). This study adopted a descriptive correlational research design. According to Ansari *et al.,* (2022), the design enables the collection of both descriptive and relational data, allowing the researcher to capture the current status of railway freight integration practices and measure their influence on supply chain resilience without manipulating any variables. A descriptive approach is suitable for providing a detailed account of the existing state of the railway freight integration process. The correlational component enabled the study to statistically assess the strength and direction of the relationship between integration indicators and resilience dimensions.

3.3 Target Population

The target population refers to the entire set of objects of interest from which the researcher seeks to gather pertinent data for the study (Willie, 2022). Similarly, Creswell and Creswell (2018) describe a target population as the complete group of individuals, organizations, events, or elements that possess the characteristics relevant to a particular research problem, and from which conclusions are drawn. The target population provides the broader base to which the study's findings are expected to be generalized. The study targeted senior officials from Kenya International Freight and Warehousing Association (KIFWA), Kenya Transporters Association (KTA), Kenya Ports Authority and Kenya Railways. The individuals have a direct hand in the logistics and goods transportation planning & coordinating. They are thus deemed to be in a good position to provide precise, pertinent, and evidence-based insights for the study due to their roles, which give them extensive knowledge and practical experience of how railway freight integration affects supply chain resilience. The distribution of the population is outlined in Table 2.

TABLE 2 Target Population

Target Population	Population	Percentage
Kenya Railways	56	52.8
Kenya Ports Authority	24	22.6
KIFWA	16	15.1
KTA	10	9.4
Total	**106**	**100%**

3.4 Sample Size and Sampling Technique

Bhardwaj (2019) views a sample as a smaller, manageable group of individuals, items, or observations that is selected from a larger population for the purpose of collecting data and making inferences about that population. A purposive sampling technique was employed in the study to include 106 respondents. Memon et al., (2024) views purposive sampling as a non-probability sampling technique where the researcher deliberately selects participants based on their specific characteristics, knowledge, and expertise relevant to the research objectives. The technique is justified by the fact that it enables the deliberate selection of senior officials and staff who have specialized knowledge and direct involvement in railway freight integration and supply chain operations

3.5 Research Instruments

A research instrument according to Sharma (2022) is a structured tool that a researcher uses to collect, measure, and record data relevant to a study's objectives. A structured questionnaire containing closed-ended questions was used in the study. A structured questionnaire allows the researcher to design clear, concise, and relevant questions aligned to the study objectives, ensuring that data collected is consistent, comparable, and easy to analyze statistically. Perez-Sindin (2017) adds that structured questionnaire provides a cost-effective, reliable, and scalable means of obtaining comprehensive data that directly addresses the research objectives.

3.6 Data Collection Procedure

Sharma (2023) defines data collecting procedure as the methods utilized to gather data after the research instrument has been created. A reference letter from KCA University was obtained before the researcher begins data collection. Additionally, the researcher applied for a research permit from National Commission for Science, Technology, and Innovation (NACOSTI) for authorization to gather data. The permit ensured that the study had been reviewed and approved in line with national research standards, protects the rights and welfare of respondents, and guarantees that the research is conducted responsibly and ethically. Each respondent also received an introduction letter from the researcher outlining the study's purpose, who is leading it, why it is important that they fill out the questionnaires, and that their responses were kept completely private and used only for the study's objectives. Data was gathered using a drop-and-pick method.

3.7 Pilot Study

The data gathering tool's validity and reliability was assessed through a pilot study. A pilot study serves as a test run and duplicate of the primary research, according to Anupama et al., (2023). In the pilot test, the researcher aims to ensure that all of the target respondents can understand the contents of the data collection instruments. According to Taherdoost (2016), the goal of piloting the data gathering tool is to find possible issues that might come up during the main study and create plans for skillfully addressing them. At least 10% of the sample size should be used for piloting, per Malmqvist et al. (2019). 11 questionnaires were thus used for piloting, accounting for 10% of the target population. The pilot participants were excluded in the primary research.

3.7.1 Reliability Test

Shodiya and Adekunle (2022) defines reliability of data collection instrument as the degree to which the results yielded are consistent over a given period of time. The level of consistency is evaluated by determining the relationship between results acquired from various administration of the instrument. If there is a high degree of association, the instrument is sad to yield consistent results thus considered reliable. The reliability of the data collection instrument was assessed using Cronbach’s Alpha test. Cronbach’s Alpha serves as an appropriate measure of variations ascribed to variances and subjects in relation to the interactions between items and subjects. According to Tavakol and Dennick (2011), a Cronbach’s value of 0.7 and above implies existence of good internal constancy thus considered reliable. The study therefore adopted a Cronbach’s Alpha of 0.7 and above as a threshold in testing the reliability of the data collection instruments.

3.7.2 Validity Test

Validity in research refers to how accurately a study answers the study question (Mohamad et al., 2015). In testing for validity, researchers need to ask whether the questions posed adequately address the objectives of the study. This should include whether the manner in which answers are recorded is appropriate. The study adopted a component factor analysis to test for construct validity. Factor analysis acts as a gauge of the substantive importance of a given variable to the factor. It is used to identify and remove hidden variable items that do not meet the objectives of the study, and which may not be apparent from direct analysis (Koç & Yavuz, 2022). Communalities were used to indicate the substantive importance of variable factors, where a loading value of 0.4 as a rule of thumb was used to be satisfactory. Mahatmaharti et al., (2017) argued that factor loading of 40% and above is satisfactory and hence the variable is not dropped in such a case.

3.8 Data Analysis and Presentation

The information gathered from the questionnaires was analyzed using both descriptive and inferential statistics. Means and standard deviation was the descriptive statistics that was employed, whereas Pearson correlation and multiple linear regression analysis was the inferential statistics adopted in the study (Bartley & Hashemi, 2011). Microsoft Excel and the Statistical Package for Social Sciences (SPSS) version 25 were used to generate the statistics. The following multivariate regression model was used in the study to determine how railway freight integration affects Kenya Railways' supply chain resilience. The adoption of the multiple regression model is supported by the fact that the study seeks to examine the influence of multiple independent variables (intermodal connectivity, scheduling coordination, cargo handling efficiency, and systems integration) on a single dependent variable, which is the supply chain resilience of Kenya

Railways. Multiple regression model according to Uyanık and Güler (2013) is designed to analyze the simultaneous effect of several independent variables on one dependent variable.

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon}$$

Where:

Y = Supply Chain Resilience of Kenya Railways

X_1 = Intermodal Connectivity

X_2= Scheduling Coordination

X_3 = Cargo Handling Efficiency

X_4= Systems Integration

In the model, $\beta 0$ = the constant term while the coefficient β_ii= 1….4 was used to measure the sensitivity of the dependent variable (Y) to unit change in the predictor variables while ε is the error term which captures the unexplained variations in the model.

3.9 Diagnostic Tests

Diagnostic tests in research refer to a range of statistical procedures used to examine whether the assumptions underlying data analysis and statistical modeling are satisfied (Gujarati & Porter, 2009). The tests are critical as they help researchers determine the appropriateness and robustness of the study results. Before interpreting findings from statistical techniques such as regression analysis, and correlation, it is essential to confirm that the data meets set assumptions. Failure to test these assumptions may lead to biased estimates and unreliable conclusions. The study focused on normality, linearity, multi-collinearity tests.

3.9.1 Normality Test

The normality test examines whether the residuals in a regression model follow a normal distribution, which is a key assumption for inferential statistics. Normality can be assessed using both graphical methods such as histograms, Q-Q plots, and P-P plots, as well as statistical tests including the Shapiro–Wilk and Kolmogorov–Smirnov tests. The study employed Shapiro–Wilk and Kolmogorov–Smirnov tests in assessing normality. The general rule of thumb is that when the Shapiro–Wilk test yields a p-value greater than 0.05, the residuals can be considered normally distributed, whereas a p-value below 0.05 indicates a violation of the normality assumption (Ghasemi & Zahediasl, 2012).

3.9.2 Linearity Test

Linearity evaluates whether the relationship between independent variables and the dependent variable is linear. Since regression analysis assumes a straight-line association, non-linearity can distort results and reduce predictive accuracy. In particular, a residual plot is especially useful, as a random distribution of residuals around zero without a clear pattern indicates that the assumption of linearity holds. Linearity was assessed using residual plots. If the residuals form curves or systematic shapes, the assumption may have been violated. A useful rule of thumb is that when residual plots show no discernible patterns, the linearity assumption is satisfied (Osborne & Waters, 2002).

3.9.3 Multi-collinearity

Multi-collinearity assesses the extent to which independent variables in the model are highly correlated with one another. High multi-collinearity inflates the standard errors of regression coefficients, making it difficult to determine the unique contribution of each predictor. Multi-collinearity was tested using the Variance Inflation Factor (VIF) and tolerance values. The

VIF indicates how much the variance of a coefficient is increased because of collinearity, while tolerance is the inverse of VIF. The general rule of thumb is that VIF values above 10 or tolerance values below 0.1 suggest severe multi-collinearity, which may require remedial measures such as removing or combining variables (Kutner, Nachtsheim, & Neter, 2004).

3.10 Ethical Consideration

In conducting the study, the researcher took into account several ethical considerations to ensure the integrity and credibility of the research process. The researcher sought relevant data collection letter from the Ethical and Review Committee, and a research permit from NACOSTI. The researcher further sought informed consent from all participants, ensuring that they clearly understand the purpose of the study, the type of information being collected, and how it was to be used. Participation was voluntary, and the researcher avoided any form of coercion. In addition, the researcher safeguarded the confidentiality and privacy of participants by protecting operational practices and ensuring that identities were anonymized to prevent any unintended consequences. The researcher endeavored to respect all intellectual property rights where all sources and literature used were cited and acknowledged.

CHAPTER FOUR

RESULTS AND DISCUSSION

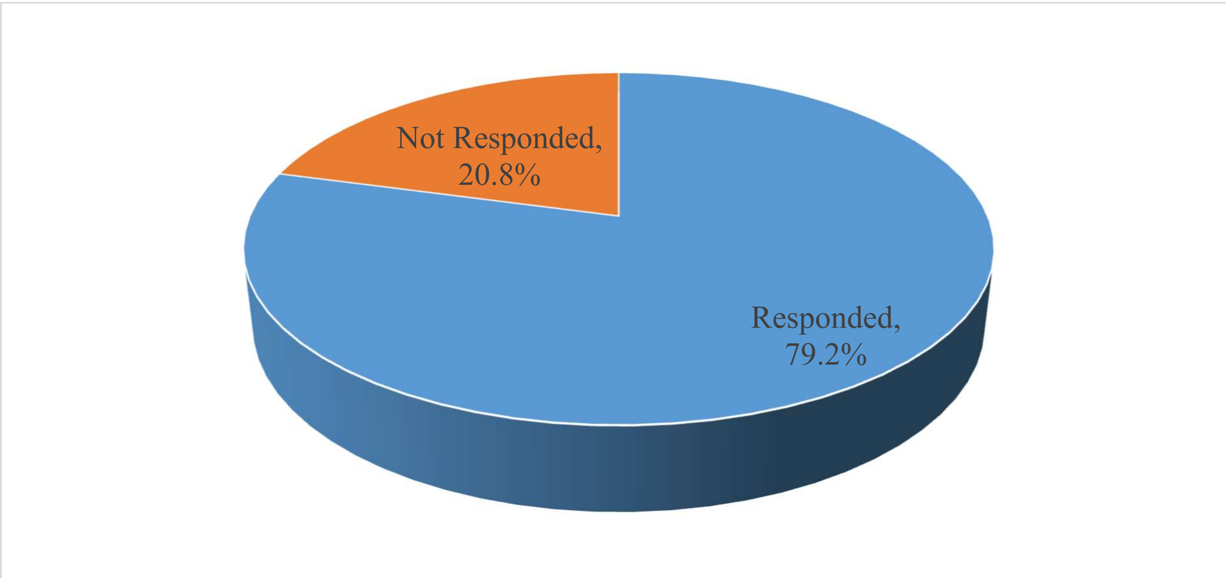
4.1 Introduction

This chapter provides a coverage of the findings of the study. It covers the response rate derived from the issued questionnaires as well as the background information of the respondents. The chapter further outlines the descriptive analysis results followed by the inferential results. The study made use of figures and tables to display the results.

4.2 Response Rate

The study targeted 106 respondents from Kenya Railways, Kenya Ports Authority, KIFWA, and KTA. From the 106 issued questionnaires, 84 of them were fully filled and returned for analysis. This accounted for a response rate of 79.2%. The response rate was justifiable for the study according to assertions by Memon et al., (2024). The high response rate acts as a representative of key stakeholders in Kenya's railway freight and logistics sector, thereby providing a solid foundation for drawing valid conclusions and making practical recommendations on enhancing supply chain resilience. Figure 2 displays the results.

FIGURE 2 Response Rate



4.3 Pilot Study Results

The study carried out a pilot study as a test run and duplicate of the primary research to assess the reliability and validity of the questionnaire (Anupama et al., 2023). In the pilot test, the researcher aimed at ensuring that all of the target respondents could understand the contents of the data collection instruments. At least 10% of the sample size should be used for piloting, per Malmqvist et al. (2019). 11 questionnaires were thus be used for piloting. The respondents involved in the pilot were excluded from the main study.

4.3.1 Reliability Test Results

The reliability of the data collection instrument was assessed using Cronbach's Alpha test. According to Tavakol and Dennick (2011), a Cronbach's value of 0.7 and above implied existence of good internal constancy thus considered reliable. The current study therefore adopted a Cronbach's Alpha of 0.7 and above as a threshold in testing the reliability of the data collection instruments. According to results outlined in Table 3, the Cronbach Alpha value for all the 7 items assessing intermodal connectivity was 0.873. This implied that all the items were consistent thus considered reliable.

TABLE 3 Reliability Results on Intermodal Connectivity

Variable	Items	Cronbach Alpha
Intermodal Connectivity	7	0.873

The results on the Cronbach Alpha as a result of deleting one item assessing intermodal connectivity as presented in Table 4 was above the threshold of 0.7 implying that all the items were relevant thus were retained in the study.

TABLE 4 Cronbach Alpha if Item is Deleted

Items	Cronbach Alpha
The existing railway freight system allows for seamless transfer of cargo between rail and other transport modes	0.859
There are adequate direct transfer facilities at major freight handling points	0.840
Coordination between rail and other modes ensures timely cargo transfers	0.841
Rail terminals have modern handling equipment to support efficient intermodal transfers	0.828
The quality of storage and loading facilities supports smooth intermodal operations	0.876
Rail terminals are located close to key ports and container depots, enhancing connectivity	0.866
Strategic location of rail terminals reduces transport costs in intermodal operations	0.871

According to results outlined in Table 5, the Cronbach Alpha value for all the 8 items assessing scheduling coordination was 0.905. This implied that all the items were consistent thus considered reliable.

TABLE 5 Reliability Results on Scheduling Coordination

Variable	Items	Cronbach Alpha
Scheduling Coordination	8	0.905

The results on the Cronbach Alpha as a result of deleting one item assessing scheduling coordination as presented in Table 6 was above the threshold of 0.7 implying that all the items were relevant thus were retained in the study.

TABLE 6 Cronbach Alpha if Item is Deleted

Items	Cronbach Alpha
Kenya Railways provides freight services at intervals that meet the needs of operations	0.880
The frequency of scheduled train services supports consistent cargo flow	0.891
Increased service frequency has improved abilities to meet customer delivery timelines	0.905
Train schedules are adhered to as published without significant delays	0.892
Freight arrival and departure times are predictable and consistent	0.891
Kenya Railways communicates schedule changes promptly to all stakeholders	0.889
The average waiting time for cargo transfers between railway and other transport modes is acceptable	0.897
Coordination between Kenya Railways and ports and warehouses minimizes transfer delays	0.898

The results outlined in Table 7, shows that the Cronbach Alpha value for all the 7 items assessing cargo handling efficiency was 0.890. This implied that all the items were consistent thus considered reliable.

TABLE 7 Reliability Results on Cargo Handling Efficiency

Variable	Items	Cronbach Alpha
Cargo Handling Efficiency	7	0.890

The results on the Cronbach Alpha as a result of deleting one item assessing cargo handling efficiency as presented in Table 8 was above the threshold of 0.7 implying that all the items were relevant thus were retained in the study.

TABLE 8 Cronbach Alpha if Item is Deleted

Items	Cronbach Alpha
Kenya Railways' freight terminals have adequate infrastructure to handle current cargo volumes efficiently	0.851
Cargo handling operations at Kenya Railways are sufficiently staffed to meet demand	0.889
The loading and unloading processes are completed within the scheduled turnaround time	0.891
Cargo is accurately recorded and documented during transfers	0.884
There are clear procedures in place to verify cargo quantities during transfer operations	0.845
Cargo handling practices at Kenya Railways minimize physical damage to goods	0.871
Equipment used in cargo handling is well-maintained to prevent damage to goods	0.880

The results outlined in Table 9 shows that the Cronbach Alpha value for all the 7 items assessing information system integration was 0.886. This implied that all the items were consistent thus considered reliable.

TABLE 9 Reliability Results on Information System Integration

Variable	Items	Cronbach Alpha
Information System Integration	7	0. 886

The results on the Cronbach Alpha as a result of deleting one item assessing information system integration as presented in Table 10 was above the threshold of 0.7 implying that all the items were relevant thus were retained in the study.

TABLE 10 Cronbach Alpha if Item is Deleted

Items	Cronbach Alpha
There is accessibility of real-time cargo movement updates through Kenya Railways' freight information system	0.861
The real-time cargo tracking system helps in reducing delays in freight delivery	0.847
Tracking information is easily accessible to all authorized stakeholders involved in freight operations	0.858
Freight documentation processes with Kenya Railways are largely automated and paperless	0.890
Kenya Railways' automated documentation system is user-friendly and reliable	0.871
Integration between Kenya Railways' system and port systems improves operational efficiency	0.870
System integration has enhanced transparency and trust among supply chain partners	0.880

The results outlined in Table 11, shows that all the 9 items assessing supply chain resilience was 0.853. This implied that all the items were consistent thus considered reliable.

TABLE 11 Reliability Results on Supply Chain Resilience

Variable	Items	Cronbach Alpha
Supply Chain Resilience	9	0.853

The results on the Cronbach Alpha as a result of deleting one item assessing supply chain resilience as presented in Table 12 was above the threshold of 0.7 implying that all the items were relevant thus were retained in the study.

TABLE 12 Cronbach Alpha if Item is Deleted

Items	Cronbach Alpha
Railway freight services ensure uninterrupted cargo movement even during peak demand periods	0.878
The integration of railway freight has reduced delays in cargo delivery across the supply chain	0.807
Railway freight services provide reliable schedules that enhance operational stability in the supply chain	0.830

Railway freight integration has reduced risks associated with cargo theft and loss	0.833
The use of railway freight has improved cargo security during transit	0.820
Railway freight integration contributes to lower operational risks during adverse conditions	0.847
Railway freight operations adjust effectively to fluctuations in cargo volumes	0.838
Railway freight systems quickly adapt to changes in port handling capacities	0.836
Railway freight integration supports flexible routing options in case of disruptions	0.837

4.3.2 Validity Test Results

The study adopted component factor analysis to test for construct validity. Communalities were used to indicate the substantive importance of variable factors where a loading value of 0.4 as a rule of thumb was used to be satisfactory. Mahatmaharti et al., (2017) argued that factor loading of 40% and above is satisfactory and hence the variable is not dropped in such a case. According to the results presented in Table 13, all items addressing each variable had a factor loading value of above 0.4 implying that they were all valid. No item was thus removed from the questionnaire.

TABLE 13 Validity Test Results

Intermodal Connectivity	Factor Loading Values
The existing railway freight system allows for seamless transfer of cargo between rail and other transport modes	0.75
There are adequate direct transfer facilities at major freight handling points	0.85
Coordination between rail and other modes ensures timely cargo transfers	0.83
Rail terminals have modern handling equipment to support efficient intermodal transfers	0.92
The quality of storage and loading facilities supports smooth intermodal operations	0.68
Rail terminals are located close to key ports and container depots, enhancing connectivity	0.69
Strategic location of rail terminals reduces transport costs in intermodal operations	0.65

Scheduling Coordination	Factor Loading Values
Kenya Railways provides freight services at intervals that meet the needs of operations	0.82
The frequency of scheduled train services supports consistent cargo flow	0.85
Increased service frequency has improved abilities to meet customer delivery timelines	0.8
Train schedules are adhered to as published without significant delays	0.81
Freight arrival and departure times are predictable and consistent	0.83
Kenya Railways communicates schedule changes promptly to all stakeholders	0.63
The average waiting time for cargo transfers between railway and other transport modes is acceptable	0.52
Coordination between Kenya Railways and ports and warehouses minimizes transfer delays	0.48
Cargo Handling Efficiency	**Factor Loading Values**
Kenya Railways' freight terminals have adequate infrastructure to handle current cargo volumes efficiently	0.74
Cargo handling operations at Kenya Railways are sufficiently staffed to meet demand	0.81
The loading and unloading processes are completed within the scheduled turnaround time	0.79
Cargo is accurately recorded and documented during transfers	0.82
There are clear procedures in place to verify cargo quantities during transfer operations	0.85
Cargo handling practices at Kenya Railways minimize physical damage to goods	0.84
Equipment used in cargo handling is well-maintained to prevent damage to goods	0.61
Information System Integration	**Factor Loading Values**
There is accessibility of real-time cargo movement updates through Kenya Railways' freight information system	0.80
The real-time cargo tracking system helps in reducing delays in freight delivery	0.73
Tracking information is easily accessible to all authorized stakeholders involved in freight operations	0.77
Freight documentation processes with Kenya Railways are largely automated and paperless	0.81
Kenya Railways' automated documentation system is user-friendly and reliable	0.79
Integration between Kenya Railways' system and port systems improves operational efficiency	0.64

System integration has enhanced transparency and trust among supply chain partners	0.76
Supply Chain Resilience	**Factor Loading Values**
Railway freight services ensure uninterrupted cargo movement even during peak demand periods	0.95
The integration of railway freight has reduced delays in cargo delivery across the supply chain	0.78
Railway freight services provide reliable schedules that enhance operational stability in the supply chain	0.8
Railway freight integration has reduced risks associated with cargo theft and loss	0.96
The use of railway freight has improved cargo security during transit	0.93
Railway freight integration contributes to lower operational risks during adverse conditions	0.97
Railway freight operations adjust effectively to fluctuations in cargo volumes	0.76
Railway freight systems quickly adapt to changes in port handling capacities	0.95
Railway freight integration supports flexible routing options in case of disruptions	0.88

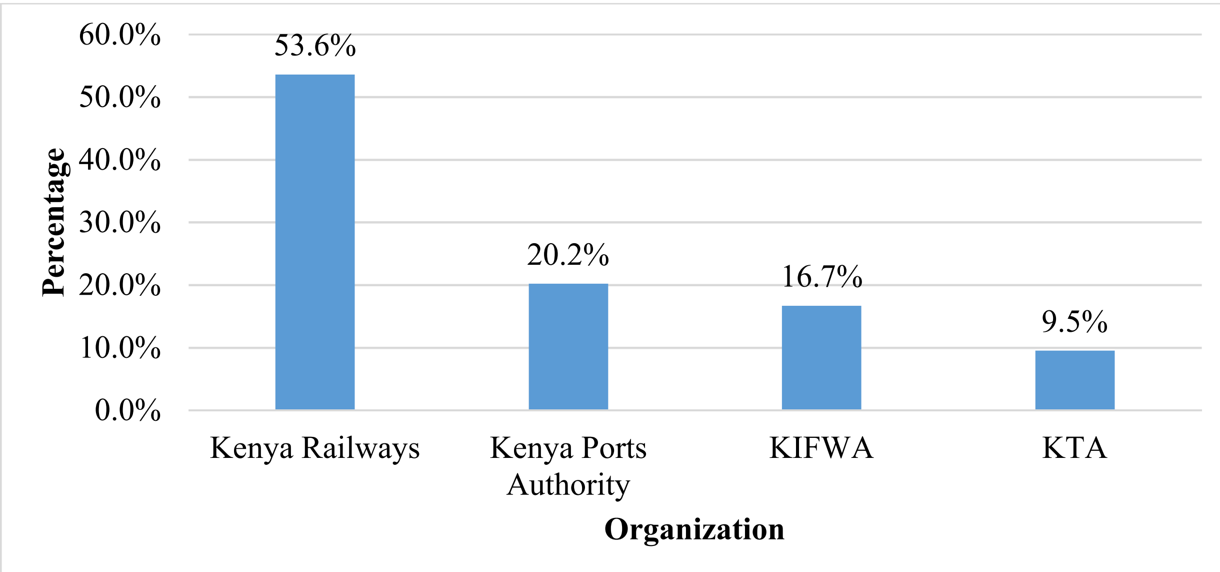
4.4 Demographic Characteristics

The study factored in the demographic characteristics of the respondents aiming at demonstrating the representativeness of the respondents, which ensured that diverse stakeholder perspectives were captured, and allowed comparison of views across groups. This was with a view of strengthening the generalizability of the results of the study. The demographic information captured in the study comprised of respondents' organization, years in the organization and the highest education level.

4.4.1 Organization of the Respondents

The study endeavored in establishing the organization of the respondents. The results outlined in Figure 3 shows that those from Kenya Railways were 53.6%, from Kenya Ports Authority were 20.2%, KIFWA accounted for 16.7% while KTA were 9.5%. According to the results, majority of the respondents were from Kenya Railways. However, there was adequate representation from other agencies involved in the study.

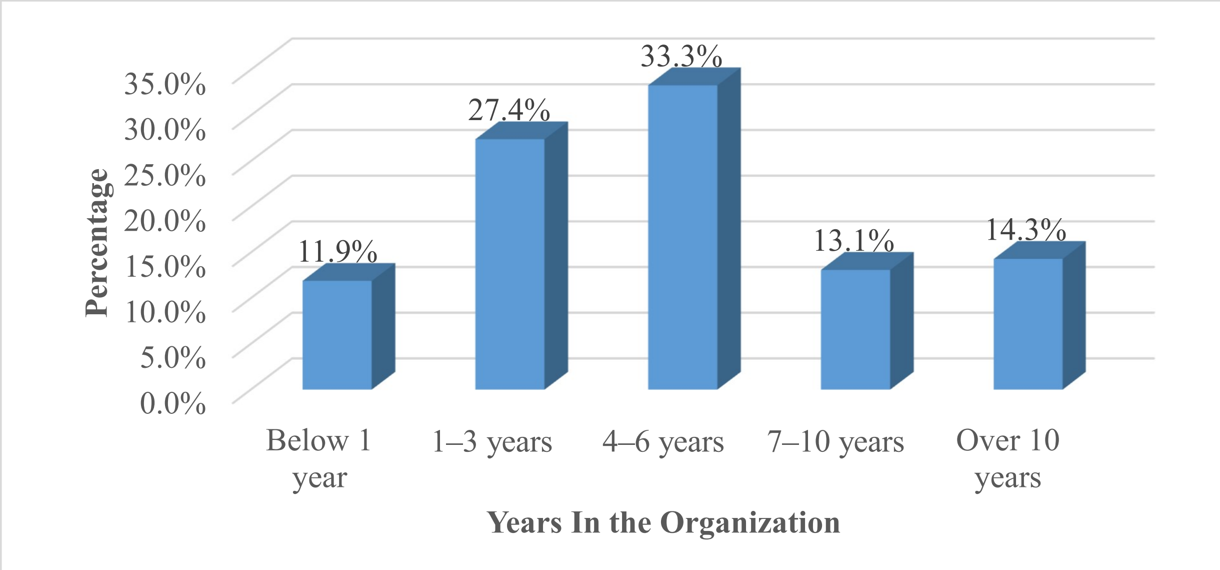
FIGURE 3 Respondents' Organization



4.4.2 Years in the Organization

The study further sought to establish the number of years respondents had been with their respective organizations. As presented in Figure 4, those who had been with their respective organization for a period of less than 1 year were 11.9%, between one and three years were 27.4%, and between four and six years were 33.3%. Additionally, respondents with between seven and ten years in the respective organizations were 13.1% while those with over ten years were 14.3%. The results shows that majority of the respondents had more than three years in their respective organizations. The results bear the implications the respondents possessed adequate knowledge of organizational operations and well positioned to provide reliable and informed responses regarding railway freight integration and supply chain resilience.

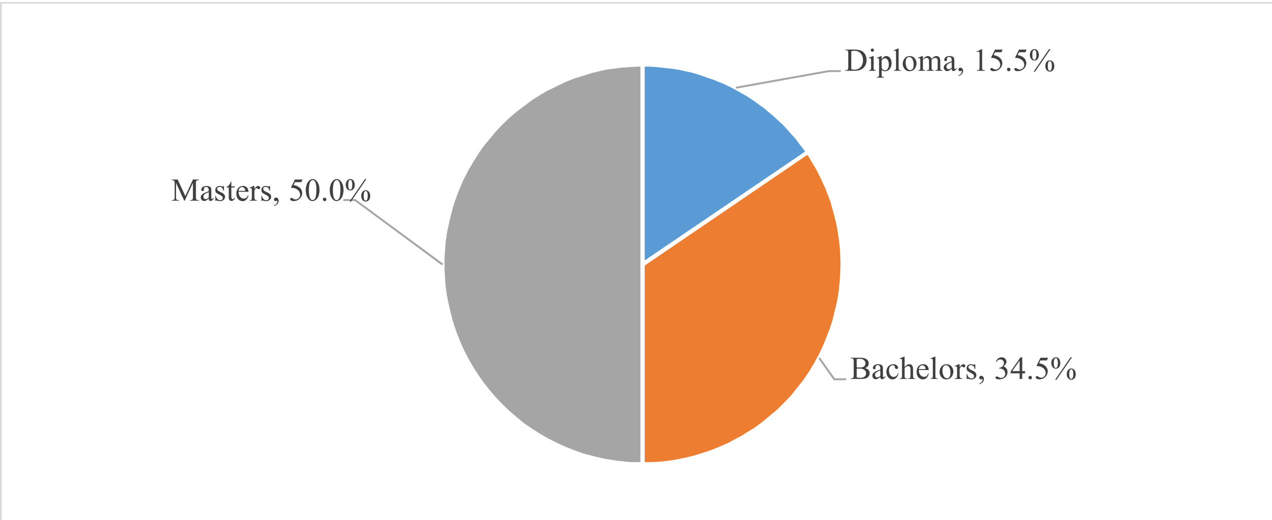
FIGURE 4 Years in the Organization



4.4.3 Highest Education Level

The highest educational attainment of the respondents was also sought in the study. According to the results displayed in Figure 5, diploma holders were 15.5%, bachelors were 34.5% while masters holders were 50%. The results shows that majority of the respondents were bachelors and masters holders. Thus, the respondents were considered educated and therefore had sufficient knowledge to provide reliable responses on railway freight integration and supply chain resilience.

FIGURE 5 Educational Level



4.5 Descriptive Statistics

The study applied descriptive statistics aiming at providing a summary and initial understanding of the data collected from the respondents. Additionally, the statistics helps in identifying patterns and distributions of responses across variables, which is crucial in establishing the general characteristics of aspects of railway freight integration and how they relate to supply chain resilience. To derive conclusions on the descriptive statistics, the researcher first calculated the means and standard deviations for each item addressing each variable in respect to the responses from the responded to the 5-point Likert scale questionnaires. An overall mean was later generated to arrive at the conclusions on the extent to which the respondents agreed or disagreed with.

4.5.1 Intermodal Connectivity

Table 14 outlines the descriptive statistics on intermodal connectivity. According to the results, respondents showed a neutral response with the statements that the existing railway freight system allowed for seamless transfer of cargo between rail and other transport modes (mean=2.676) and that there were adequate direct transfer facilities at major freight handling points (mean=2.735). Similarly, there was a neutral response on the statements that rail terminals had modern handling equipment to support efficient intermodal transfers (mean=2.618), that the quality of storage and loading facilities supported smooth intermodal operations (2.559) and that rail terminals were located close to key ports and container depots, enhancing connectivity (mean=2.500). Respondents however disagreed with the statements that coordination between rail and other modes ensured timely cargo transfers (2.382) and that strategic location of rail terminals reduced transport costs in intermodal operations (mean=2.471). The overall response on statements regarding intermodal connectivity was a mean of 2.563 and a standard deviation of 1.238 implying a neutral stance amongst the respondents. The results concurs with findings from Tshoopara and Mbhele (2024) who noted that in order to improve the functionality and effectiveness of a transport system, it is necessary to address the railway system's fragmentation, and improve intermodal connection.

TABLE 14 Descriptive Statistics on Intermodal Connectivity

Intermodal Connectivity	N	Mean	Std.Dev
The existing railway freight system allows for seamless transfer of cargo between rail and other transport modes	84	2.676	1.300
There are adequate direct transfer facilities at major freight handling points	84	2.735	1.314
Coordination between rail and other modes ensures timely cargo transfers	84	2.382	1.266
Rail terminals have modern handling equipment to support efficient intermodal transfers	84	2.618	1.293
The quality of storage and loading facilities supports smooth intermodal operations	84	2.559	1.322
Rail terminals are located close to key ports and container depots, enhancing connectivity	84	2.500	1.216
Strategic location of rail terminals reduces transport costs in intermodal operations	84	2.471	0.959
Overall	**84**	**2.563**	**1.238**

4.5.2 Scheduling Coordination

Table 15 provides an outline on the descriptive statistics on scheduling coordination. The results shows that respondents neither agreed nor disagreed with the statements that Kenya Railways provides freight services at intervals that meet the needs of operations (mean=3.324) and that the frequency of scheduled train services supports consistent cargo flow (mean=3.441). Respondents further showed a neutral response with the statements that increased service frequency had improved abilities to meet clients delivery timelines (mean=3.471) and that train schedules are adhered to as published without significant delays (mean=3.412). On the statements that freight arrival and departure times were predictable and consistent and that Kenya Railways communicates schedule changes promptly to all stakeholders, respondents did not agree or disagree as shown by means of 3.441 and 3.206 respectively. The results further revealed a general neutrality response with the statements that the average waiting time for cargo transfers between railway and other transport modes was acceptable (mean=3.324) and that coordination between Kenya Railways and ports and warehouses minimized transfer delays (3.441). Overall, respondents showed a neural response with the statements on scheduling coordination as depicted by a mean of 3.382 and standard deviation of 1.040. According to Havenga and De-Bod (2016), poor scheduling coordination, characterized by misaligned timetables, unclear slot allocations, and inadequate visibility across actors, acts as a major impediment to supply chain performance.

TABLE 15 Descriptive Statistics on Scheduling Coordination

Scheduling Coordination	N	Mean	Std.Dev
Kenya Railways provides freight services at intervals that meet the needs of operations	84	3.324	1.092
The frequency of scheduled train services supports consistent cargo flow	84	3.441	1.069
Increased service frequency has improved abilities to meet customer delivery timelines	84	3.471	1.047
Train schedules are adhered to as published without significant delays	84	3.412	1.120
Freight arrival and departure times are predictable and consistent	84	3.441	1.046
Kenya Railways communicates schedule changes promptly to all stakeholders	84	3.206	1.059
The average waiting time for cargo transfers between railway and other transport modes is acceptable	84	3.324	1.005
Coordination between Kenya Railways and ports and warehouses minimizes transfer delays	84	3.441	0.885
Overall	**84**	**3.382**	**1.040**

4.5.3 Cargo Handling Efficiency

Table 16 provides an outline on the descriptive statistics on cargo handling efficiency. According to the results, respondents had a neutral response on the statement that Kenya Railways' freight terminals had adequate infrastructure to handle current cargo volumes efficiently (mean=3.412) and that cargo handling operations at Kenya Railways were sufficiently staffed to meet demand (mean=2.853). Respondents further had a neutral stance on the statements that the loading and unloading processes were completed within the scheduled turnaround time (mean=3.000) and that cargo was accurately recorded and documented during transfers (mean=3.353). Remarkably, respondents indicated a neutral response with the statements that there were clear procedures in place to verify cargo quantities during transfer operations (mean=3.353) and that equipment used in cargo handling was well-maintained to prevent damage to goods (mean=3.382). On the statement that cargo handling practices at Kenya Railways minimized physical damage to goods, respondents disagreed with the statements (mean=2.471). All respondents overall neither agreed nor disagreed with the statements on cargo handling efficiency as shown by a mean of 3.118 and a standard deviation of 1.308. According to Muro et al. (2024) findings, long wait times, antiquated infrastructure, inadequate coordination, security concerns, bureaucratic hold-ups, and communication breakdowns are some of the cargo handling issues in ports that reduce customer satisfaction.

TABLE 16 Descriptive Statistics on Cargo Handling Efficiency

Cargo Handling Efficiency	N	Mean	Std.Dev
Kenya Railways' freight terminals have adequate infrastructure to handle current cargo volumes efficiently	84	3.412	1.151
Cargo handling operations at Kenya Railways are sufficiently staffed to meet demand	84	2.853	1.331
The loading and unloading processes are completed within the scheduled turnaround time	84	3.000	1.334
Cargo is accurately recorded and documented during transfers	84	3.353	1.599
There are clear procedures in place to verify cargo quantities during transfer operations	84	3.353	1.333
Cargo handling practices at Kenya Railways minimize physical damage to goods	84	2.471	1.342
Equipment used in cargo handling is well-maintained to prevent damage to goods	84	3.382	1.064
Overall	**84**	**3.118**	**1.308**

4.5.4 Information System Integration

Table 17 provides an outline on the descriptive statistics on information system integration. According to the results, respondents had an agree stance on the statements that there was accessibility of real-time cargo movement updates through Kenya Railways' freight information system (mean=3.500) and that integration between Kenya Railways' system and port systems improves operational efficiency (mean=3.588). Respondents were further in agreement with the statements that Kenya Railways' automated documentation system is user-friendly and reliable (mean=3.765) and that system integration had enhanced transparency and trust among supply chain partners (mean=3.559). Respondents however had a neutral stand on the statements that the real-time cargo tracking system helped in reducing delays in freight delivery (mean=3.441), that tracking information is easily accessible to all authorized stakeholders involved in freight operation (mean=3.294) and that freight documentation processes with Kenya Railways were largely automated and paperless (mean=3.412). The overall response was a mean of 3.508 and standard deviation of 1.127 implying that all respondents were in agreement with the statements on information system integration. The results tallies with Nguyen et al., (2022) who established that integrated information systems significantly improves organization's ability to collect, process, and disseminate real-time operational data thus enabling faster decision-making and enhanced responsiveness to disruptions.

TABLE 17 Descriptive Statistics on Information System Integration

Information System Integration	N	Mean	Std.Dev
There is accessibility of real-time cargo movement updates through Kenya Railways' freight information system	84	3.500	1.000
The real-time cargo tracking system helps in reducing delays in freight delivery	84	3.441	1.134
Tracking information is easily accessible to all authorized stakeholders involved in freight operations	84	3.294	1.088
Freight documentation processes with Kenya Railways are largely automated and paperless	84	3.412	1.303
Kenya Railways' automated documentation system is user-friendly and reliable	84	3.765	1.195
Integration between Kenya Railways' system and port systems improves operational efficiency	84	3.588	1.175
System integration has enhanced transparency and trust among supply chain partners	84	3.559	0.996
Overall	**84**	**3.508**	**1.127**

4.5.5 Supply Chain Resilience

Table 18 provides an outline on the descriptive statistics on supply chain resilience. From the results, respondents agreed with the statements that railway freight services ensures uninterrupted cargo movement even during peak demand periods (mean=4.588) and that the integration of railway freight had reduced delays in cargo delivery across the supply chain (mean=4.324). The results further revealed a general agreement stance with the statements that railway freight services provided reliable schedules that enhance operational stability in the supply chain (mean=4.412), that railway freight integration had reduced risks associated with cargo theft and loss (mean=4.176) and that the use of railway freight had improved cargo security during transit (mean=4.500).

Additionally, respondents were in an agreement with the statements that railway freight integration contributed to lower operational risks during adverse conditions (mean=4.235), and that railway freight operations adjust effectively to fluctuations in cargo volumes (mean=4.647). This was is addition to an agree stance with the statements that railway freight systems quickly adapt to changes in port handling capacities (mean=4.353) and that railway freight integration supports flexible routing options in case of disruptions (mean=4.471). According to Alfarsi et al., (2019), in railway freight integration, supply chain resilience embodies the ability not only to withstand shocks but also to adapt to new conditions and emerge stronger which ensures that goods continue to flow efficiently from origin to destination.

TABLE 18 Descriptive Statistics on Supply Chain Resilience

Supply Chain Resilience	N	Mean	Std.Dev
Railway freight services ensure uninterrupted cargo movement even during peak demand periods	84	4.588	1.023
The integration of railway freight has reduced delays in cargo delivery across the supply chain	84	4.324	1.083
Railway freight services provide reliable schedules that enhance operational stability in the supply chain	84	4.412	1.138
Railway freight integration has reduced risks associated with cargo theft and loss	84	4.176	1.099
The use of railway freight has improved cargo security during transit	84	4.500	1.055
Railway freight integration contributes to lower operational risks during adverse conditions	84	4.235	0.988
Railway freight operations adjust effectively to fluctuations in cargo volumes	84	4.647	0.898

Railway freight systems quickly adapt to changes in port handling capacities	84	4.353	1.010
Railway freight integration supports flexible routing options in case of disruptions	84	4.471	0.782
Overall	**84**	**4.412**	**1.009**

4.6 Inferential Statistics

Inferential statistics refers to a branch of statistics that goes beyond the mere description of data to making conclusions, predictions, and generalizations about a larger population based on information gathered from a sample (Field, 2018). The statistics allow the researcher to determine relationships, test hypotheses, and establish the probability that observed patterns in a sample also exist in the wider population (Gravetter & Wallnau, 2017). The inferential statistics employed in the study comprised of correlation and regression analysis.

4.6.1 Correlation Analysis

The study employed a correlation analysis to measure and quantify the strength and direction of the relationship between the independent and dependent variables. The results on the correlation analysis are outlined in Table 19. According to the results, intermodal connectivity positively correlates with supply chain resilience of Kenya Railways to significant levels. This is depicted by a correlation coefficient value of 0.717 and a subsequent significant value of 0.000. This has the implications that when intermodal connectivity is enhanced, it results to enhancing the levels of supply chain resilience of Kenya Railways. The results are consistent with Ratemo et al., (2015) who established that when effective transportation infrastructure is available, intermodal use may lower costs and lead times, however the resilience benefits were limited by shortcomings in terminal operations and last-mile connectivity.

The results further established existence of a negative insignificant correlation between scheduling coordination and supply chain resilience of Kenya Railways. This is depicted by a correlation coefficient value of -0.015 and a subsequent significant value of 0.895. The results bears the implications that scheduling coordination does appear to have a significant impact on supply chain resilience at Kenya Railways. According to Sakimpa, Muturi, and Otieno (2016), inefficiencies in the railway network negatively impacts business operations, suggesting that improvements in scheduling coordination could enhance supply chain resilience.

The results also established existence of a positive and significant correlation between cargo handling efficiency and supply chain resilience of Kenya Railways. This is depicted by a correlation coefficient value of 0.359 and a subsequent significant value of 0.001. This has the implications that when cargo handling efficiency is enhanced, it results to enhancing the levels of supply chain resilience of Kenya Railways. This is in tandem with Oyigi (2021) who noted that efficient cargo handling, including timely loading and unloading processes, directly contributes to reducing transit times and minimizing delays, thereby enhancing the resilience of the supply chain.

The results further established existence of a positive and significant correlation between information system integration and supply chain resilience of Kenya Railways. This is depicted by a correlation coefficient value of 0.408 and a subsequent significant value of 0.000. This has the implications that when information system integration is enhanced, it results to enhancing the levels of supply chain resilience of Kenya Railways. The results tallies with Nguyen et al., (2022) who highlighted that integrated information systems significantly improves organization’s ability to collect, process, and disseminate real-time operational data thus enabling faster decision-making and enhanced responsiveness to disruptions.

TABLE 19 Correlation Results

		Intermodal Connectivity	Scheduling Coordination	Cargo Handling Efficiency	Information System Integration	Supply Chain Resilience
Intermodal Connectivity	Pearson Correlation	1				
	Sig. (2-tailed)					
Scheduling Coordination	Pearson Correlation	.054	1			
	Sig. (2-tailed)	.626				
Cargo Handling Efficiency	Pearson Correlation	-.045	.151	1		
	Sig. (2-tailed)	.687	.171			
Information System Integration	Pearson Correlation	.194	-.436	-.041	1	
	Sig. (2-tailed)	.077	.000	.712		
Supply Chain Resilience	Pearson Correlation	.717	-.015	.359	.408	1
	Sig. (2-tailed)	.000	.895	.001	.000	
	N	84	84	84	84	84

4.6.2 Regression Analysis

The regression analysis aimed at establishing the existence of relationships between independent variables (intermodal connectivity, scheduling coordination, cargo handling efficiency and information system integration) and the dependent variable (supply chain resilience) of the study. From the model summary outlined in Table 20, the study established that the R-value was 0.866. This had the implications that there exists a high relationship between the independent variables and the dependent variable. The value of R-Square was 0.750 implying that 75% of supply chain resilience of Kenya Railways can be accounted by intermodal connectivity, scheduling coordination, cargo handling efficiency and information system integration. The other 25% is accounted by other indicators not included in this study.

TABLE 20 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.866[a]	.750	.737	0.339

A. Predictors: (Constant), Intermodal Connectivity, Scheduling Coordination, Cargo Handling Efficiency and Information System Integration

The results from Analysis of Variance (ANOVA) presented in Table 21 revealed that the significant value was 0.000 which was less than 0.05 significant level adopted in the study. The results implies that the model utilized in assessing the relationship between the dependent and independent variables was statistically significant. The model was therefore considered fit for the study.

TABLE 21 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	27.168	4	6.792	59.156	.000[b]
	Residual	9.070	79	.115		
	Total	36.238	83			

a. Supply Chain Resilience
b. Predictors: (Constant), (Constant), Intermodal Connectivity, Scheduling Coordination, Cargo Handling Efficiency and Information System Integration

The results from the model coefficient outlined in Table 22 revealed that intermodal connectivity bears a positive and significant influence on supply chain resilience of Kenya Railways. This is shown by a beta value of 0.669 and a respective significant value of 0.000<0.05. This implies that when aspects of intermodal connectivity are increased with one unit, supply chain resilience increases with 0.669 units. According to Kouadio et al (2019), effective intermodal connectivity ensures that railway transport is not an isolated system but part of an integrated logistics network that supports just-in-time delivery and wider market accessibility.

The results also revealed that scheduling coordination bears a positive but insignificant influence on supply chain resilience of Kenya Railways. This is shown by a beta value of 0.024 and a respective insignificant value of 0.748>0.05. This implies that when scheduling coordination is increased with one unit, supply chain resilience increases with 0.024 units. The results align with Havenga and De-Bod (2016) who noted that poor scheduling coordination, characterized by misaligned timetables, unclear slot allocations, and inadequate visibility across actors, acts as a major impediment to supply chain performance.

Additionally, the results established that cargo handling efficiency bears a positive and significant influence on supply chain resilience of Kenya Railways. This is shown by a beta value of 0.362 and a respective significant value of 0.000<0.05. This implies that increasing cargo handling efficiency with one unit results to 0.362 units increase in the levels of supply chain resilience in Kenya Railways. This is in tandem with Oyigi (2021) who noted that efficient cargo handling, including timely loading and unloading processes, directly contributes to reducing transit times and minimizing delays, thereby enhancing the resilience of the supply chain.

The study further established that information system integration bears a positive and significant influence on supply chain resilience of Kenya Railways. This is shown by a beta value of 0.300 and a respective significant value of 0.000<0.05. This implies that increasing aspects of information system integration with one unit increases levels of supply chain resilience in Kenya Railways with 0.300 units. The results tallies with Nguyen et al., (2022) who established that integrated information systems significantly improves organization’s ability to collect, process, and disseminate real-time operational data thus enabling faster decision-making and enhanced responsiveness to disruptions.

TABLE 22 Model Coefficient

	Unstandardized Coefficients		Standardized Coefficients		
Predictors	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	0.419	0.412		1.017	0.312
Intermodal Connectivity	0.669	0.058	0.675	11.592	0.000
Scheduling Coordination	0.024	0.073	0.021	0.323	0.748
Cargo Handling Efficiency	0.362	0.052	0.399	6.986	0.000
Information System Integration	0.300	0.064	0.302	4.684	0.000

a. Dependent Variable: Supply Chain Resilience

The model of the study after substituting the values translates into:

Supply Chain Resilience = 0.419 + 0.669(Intermodal Connectivity) + 0.362 (Cargo Handling Efficiency) + 0.300(Information System Integration) + 0.024(Scheduling Coordination)

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter provides a summary of the findings of the study. Conclusions as well as recommendations are further outlined in the chapter. The chapter additionally provides a section suggested areas of further studies.

5.2 Summary

The central focus of the study was to establish the influence of railway freight integration on supply chain resilience focusing on Kenya Railways. The specific railway freight integration aspects considered in the study comprised of intermodal connectivity, scheduling coordination, cargo-handling efficiency and how information systems integration and how they influence supply chain resilience. The population of the study was made up of senior officials from KIFWA, KTA, KPA, and Kenya Railways. The study employed a structured questionnaire to collect data for the study. Data acquired was analyzed quantitatively through both descriptive and inferential statistics. The followings sections provides a summary of the results per research variable.

5.2.1 Intermodal Connectivity and Supply Chain Resilience

The study findings indicate that the current railway freight system in Kenya demonstrates a moderate level of intermodal connectivity. Respondents expressed a generally neutral view regarding the seamless transfer of cargo between rail and other transport modes, the adequacy of direct transfer facilities at key freight points, the availability of modern handling equipment, the quality of storage and loading facilities, and the strategic location of rail terminals near ports and container depots. However, there were indications of weaknesses in coordination between rail and other transport modes, and in leveraging terminal locations to reduce transport costs. This suggests that while the infrastructure for intermodal operations exists, its effectiveness is limited by operational and coordination challenges. Correlation and regression analyses further demonstrate that intermodal connectivity plays a positive and significant role in enhancing the supply chain resilience of Kenya Railways. This implies that improvements in the integration of rail with other transport modes can strengthen the railway's ability to withstand disruptions and maintain continuity in freight operations. The results align with previous research emphasizing that improving intermodal connections and addressing system fragmentation are critical for enhancing the efficiency and resilience of transport networks (Tshoopara & Mbhele, 2024).

5.2.2 Scheduling Coordination and Supply Chain Resilience

The study examined the influence of scheduling coordination on the supply chain resilience of Kenya Railways. Findings indicate that respondents generally held neutral views regarding the effectiveness of scheduling coordination. They neither agreed nor disagreed that the frequency and timing of freight services adequately support operational needs, facilitate consistent cargo flow, or ensure predictable and timely deliveries. Similarly, respondents expressed neutrality regarding the efficiency of coordination between Kenya Railways and other transport modes, including ports and warehouses, in minimizing transfer delays. Correlation analysis revealed a negligible and statistically insignificant relationship between scheduling coordination and supply chain resilience. This suggests that, within the observed context, variations in scheduling coordination did not have a notable impact on the overall resilience of Kenya Railways' supply chain. Regression analysis similarly indicated a positive but statistically insignificant influence of scheduling coordination on supply chain resilience, implying that improvements in scheduling coordination could slightly enhance resilience, though the effect was minimal. As noted by

Havenga and De-Bod (2016), poor scheduling coordination marked by misaligned timetables, unclear slot allocations, and limited visibility across actors can act as a major impediment to supply chain performance.

5.2.3 Cargo Handling Efficiency and Supply Chain Resilience

The study examined the influence of cargo handling efficiency on the supply chain resilience of Kenya Railways. Respondents generally expressed a neutral perspective regarding the adequacy of infrastructure, staffing levels, timeliness of loading and unloading processes, accuracy of documentation, verification procedures, and maintenance of equipment used in cargo handling. However, they disagreed that cargo handling practices effectively minimized physical damage to goods. Overall, the perceptions indicated that cargo handling efficiency at Kenya Railways was moderate, with no strong consensus toward either positive or negative evaluation. The analysis further revealed that cargo handling efficiency is positively related to supply chain resilience. Improvements in handling practices, including timely loading and unloading, accurate documentation, and proper equipment maintenance, are associated with enhanced resilience, reducing delays and transit times in the supply chain. This finding aligns with previous studies highlighting the importance of efficient cargo handling in strengthening the overall performance and adaptability of transport and logistics operations (Oyigi, 2021).

5.2.4 Information System Integration and Supply Chain Resilience

The study found that information system integration plays a crucial role in enhancing the supply chain resilience of Kenya Railways. Respondents generally agreed that the railway's freight information systems provide timely updates on cargo movement, improve operational efficiency through integration with port systems, and offer user-friendly, reliable automated documentation. Additionally, system integration was perceived to enhance transparency and trust among supply chain partners. However, respondents were neutral on the effectiveness of real-time tracking in reducing freight delivery delays, the accessibility of tracking information to all authorized stakeholders, and the extent to which documentation processes were fully automated and paperless. Further analysis confirmed a positive relationship between information system integration and supply chain resilience, indicating that improvements in integration contribute to strengthening the organization's ability to respond to disruptions. Regression analysis supported these findings by showing that increased information system integration directly enhances the resilience of the supply chain. The results align with previous research highlighting that integrated information systems significantly improve an organization's capacity to collect, process, and disseminate real-time operational data, thereby enabling faster decision-making and greater responsiveness to disruptions (Nguyen et al., 2022).

5.3 Conclusion

5.3.1 Intermodal Connectivity and Supply Chain Resilience

The study concludes that Kenya Railways exhibits a moderate level of intermodal connectivity, with infrastructure in place to support the transfer of cargo between rail and other transport modes. However, operational and coordination challenges limit the effectiveness of these intermodal operations. Despite these limitations, intermodal connectivity has a positive and significant impact on supply chain resilience, indicating that better integration of rail with other transport modes can enhance the railway's capacity to manage disruptions and maintain continuity in freight operations.

5.3.2 Scheduling Coordination and Supply Chain Resilience

The study concludes that scheduling coordination at Kenya Railways has a minimal impact on the resilience of its supply chain. The neutral perceptions of respondents and the statistically insignificant relationship suggest that the current frequency, timing, and coordination of freight services neither significantly enhance nor undermine supply chain performance. While minor improvements in scheduling coordination may slightly benefit resilience, the overall effect remains limited, indicating that other factors are likely more critical in strengthening supply chain robustness.

5.3.3 Cargo Handling Efficiency and Supply Chain Resilience

The study concludes that cargo handling efficiency at Kenya Railways is moderate, with certain aspects such as infrastructure, staffing, and documentation performing adequately, while practices aimed at minimizing physical damage to goods are less effective. Despite the neutral overall perception, cargo handling efficiency has a positive influence on supply chain resilience, indicating that improvements in handling processes can enhance the reliability, responsiveness, and adaptability of the railway supply chain, ultimately reducing delays and transit disruptions.

5.3.4 Information System Integration and Supply Chain Resilience

The study concludes that information system integration is a critical factor in strengthening the supply chain resilience of Kenya Railways. Effective integration of freight information systems with port operations and other supply chain partners enhances operational efficiency, transparency, and trust, enabling the organization to respond more effectively to disruptions. While certain aspects such as real-time tracking accessibility and fully automated documentation require further improvement, overall, the integration of information systems contributes positively to the railway's capacity to manage cargo movement and maintain continuity in the supply chain.

5.4 Recommendations

The study recommended that Kenya Railways strengthens coordination mechanisms between rail and other transport modes to ensure smoother cargo transfers. Investment in modern handling equipment, improved storage, and loading facilities, and strategic utilization of terminal locations can further enhance operational efficiency. Additionally, initiatives aimed at reducing system fragmentation and fostering seamless intermodal operations supports the railway's ability to withstand disruptions and improve overall supply chain resilience.

The study additionally recommended that Kenya Railways invests in improving the alignment and predictability of its freight schedules to better support operational needs and ensure timely cargo deliveries. Enhancing coordination with other transport modes, including ports and warehouses, could help reduce transfer delays and improve the flow of goods. Implementing systems that increase visibility and communication among all actors in the supply chain may also contribute to more efficient scheduling and, over time, strengthen the overall resilience of the supply chain.

The study further recommended that Kenya Railways invests in improving cargo handling practices by enhancing staff training, upgrading equipment, and streamlining loading and unloading procedures. Strengthening verification processes and focusing on minimizing physical damage to goods further improves operational efficiency. By prioritizing these improvements, the organization can bolster supply chain resilience, ensuring smoother operations, timely deliveries, and a more reliable service for stakeholders.

Kenya Railways is also urged to prioritize the enhancement of its information system integration by ensuring real-time tracking is accessible to all authorized stakeholders and by fully automating documentation processes to reduce reliance on paper. Continuous training for staff on system usage and regular system upgrades can further improve efficiency and reliability. Additionally, fostering closer collaboration with supply chain partners through integrated platforms strengthens transparency and trust, ultimately boosting the resilience and responsiveness of the railway freight operations.

5.5 Research Areas for Further Studies

Based on the findings of the study, further research can be directed towards several key areas to deepen understanding of the role of information system integration in supply chain resilience. Future studies could investigate the effectiveness of real-time tracking systems, focusing on the challenges and limitations of accessibility and accuracy, and how improvements could enhance supply chain responsiveness. Research could also explore the barriers to achieving fully paperless documentation and assess the impact of complete automation on operational efficiency and error reduction. Additionally, other aspects of railway freight integration accounting for 25% can further be explored in a different study.

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APPENDICES

Appendix 1: Introduction Letter

Dear Respondents,

<u>REF: DATA COLLECTION</u>

I am a student at KCA University pursuing a master degree in Business Administration - Procurement and Supplies Management. Am carrying out a project as part of the requirement to of the course. My study topic is ***"RAILWAY FREIGHT INTEGRATION AND SUPPLY CHAIN RESILIENCE OF KENYA RAILWAYS".*** Towards realizing the objectives formulated in the study, I have formulated a questionnaire as attached herein. Kindly respond to the various aspects of statements regarding the objectives. The information you provide will be treated with utmost confidentiality and used for academic purpose only. A copy of the research findings were availed to you upon request.

Thank you in advance for your cooperation.

Yours Sincerely,

Koketch Brian Kolongo

Student

Appendix 2: Questionnaire

<u>Section A: Basic Information</u>

1. Kindly indicate your organization

i. Kenya Railways [ ]

ii. Kenya Ports Authority [ ]

iii. KIFWA [ ]

iv. KTA [ ]

2. Years in the organization:

i Below 1 year [ ]
ii 1–3 years [ ]
iii 4–6 years [ ]
iv 7–10 years [ ]
v Over 10 years [ ]

3. Highest education level

i. Diploma [ ]

ii. Bachelors [ ]

iii. Masters [ ]

Section B: Intermodal Connectivity

Kindly indicate your level of agreement on the statements relating to intermodal connectivity. Use a scale of 1-5, where 1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree.

Intermodal Connectivity	**1**	**2**	**3**	**4**	**5**
The existing railway freight system allows for seamless transfer of cargo between rail and other transport modes					
There are adequate direct transfer facilities at major freight handling points					
Coordination between rail and other modes ensures timely cargo transfers					
Rail terminals have modern handling equipment to support efficient intermodal transfers					
The quality of storage and loading facilities supports smooth intermodal operations					
Rail terminals are located close to key ports and container depots, enhancing connectivity					
Strategic location of rail terminals reduces transport costs in intermodal operations					

Section C: Scheduling Coordination

Kindly indicate your level of agreement on the statements relating to scheduling coordination. Use a scale of 1-5, where 1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree.

Scheduling Coordination	**1**	**2**	**3**	**4**	**5**
Kenya Railways provides freight services at intervals that meet the needs of operations					

The frequency of scheduled train services supports consistent cargo flow					
Increased service frequency has improved abilities to meet customer delivery timelines					
Train schedules are adhered to as published without significant delays					
Freight arrival and departure times are predictable and consistent					
Kenya Railways communicates schedule changes promptly to all stakeholders					
The average waiting time for cargo transfers between railway and other transport modes is acceptable					
Coordination between Kenya Railways and ports and warehouses minimizes transfer delays					

Section D: Cargo Handling Efficiency

Kindly indicate your level of agreement on the statements relating to cargo handling efficiency.

Use a scale of 1-5, where 1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree.

Cargo Handling Efficiency	**1**	**2**	**3**	**4**	**5**
Kenya Railways' freight terminals have adequate infrastructure to handle current cargo volumes efficiently					
Cargo handling operations at Kenya Railways are sufficiently staffed to meet demand					
The loading and unloading processes are completed within the scheduled turnaround time					
Cargo is accurately recorded and documented during transfers					
There are clear procedures in place to verify cargo quantities during transfer operations					
Cargo handling practices at Kenya Railways minimize physical damage to goods					
Equipment used in cargo handling is well-maintained to prevent damage to goods					

Section E: Information System Integration

Kindly indicate your level of agreement on the statements relating to information system integration. Use a scale of 1-5, where 1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree.

Information System Integration	1	2	3	4	5
There is accessibility of real-time cargo movement updates through Kenya Railways' freight information system					
The real-time cargo tracking system helps in reducing delays in freight delivery					
Tracking information is easily accessible to all authorized stakeholders involved in freight operations					
Freight documentation processes with Kenya Railways are largely automated and paperless					
Kenya Railways' automated documentation system is user-friendly and reliable					
Integration between Kenya Railways' system and port systems improves operational efficiency					
System integration has enhanced transparency and trust among supply chain partners					

Section F: Supply Chain Resilience

Kindly indicate your level of agreement on the statements relating to supply chain resilience. Use a scale of 1-5, where 1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree.

Supply Chain Resilience	1	2	3	4	5
Railway freight services ensure uninterrupted cargo movement even during peak demand periods					
The integration of railway freight has reduced delays in cargo delivery across the supply chain					
Railway freight services provide reliable schedules that enhance operational stability in the supply chain					
Railway freight integration has reduced risks associated with cargo theft and loss					
The use of railway freight has improved cargo security during transit					
Railway freight integration contributes to lower operational risks during adverse conditions					
Railway freight operations adjust effectively to fluctuations in cargo volumes					
Railway freight systems quickly adapt to changes in port handling capacities					
Railway freight integration supports flexible routing options in case of disruptions					

*********************************Thank you**********************************

Appendix 3: NACOSTI Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **919942**

Date of Issue: **02/September/2025**

RESEARCH LICENSE

This is to Certify that Mr.. Brian Kolongo of KCA University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: RAILWAY FREIGHT INTEGRATION AND SUPPLY CHAIN RESILIENCE OF KENYA RAILWAYS for the period ending : 02/September/2026.

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