



Assessing the feasibility of an intermodal freight transport system in South Africa

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DECLARATION

I hereby declare that the mini-dissertation submitted herewith to the North-West University in partial fulfilment of the requirements for the Master of Business Administration (MBA) degree is my own original work. It has been text-edited in accordance with professional communication standards and has not been previously submitted to any other institution for evaluation purposes.

Adriaan Wynand Muller

25/11/2025

ABSTRACT

South Africa's freight system has evidenced dependable characteristics as seen along sections of the core corridors, rising cost of logistics, and a consolidated move towards road transportation, as evidenced by logic. To encourage a more balanced approach in using the rail, this study sought to assess the viability of intermodal rail-road transport within the reform strategy, focusing on which corridors sustained or inhibited service conditions on a given shift in transport. The research took on an interpretivist and a qualitative, exploratory-descriptive approach within a single, bounded national freight system case study. Experienced stakeholders from across the freight ecosystem were recruited and interviewed using a self-developed semi-structured interview guide. The reflexive thematic approach to data analysis was supplemented by iterative coding and memoing. Ethical protocols according to POPIA were observed, and trustworthiness as a criterion was documented, leading to the completion of an audit and triangulation of data with documents.

Research found that schedule reliability, predictability of slot access, and terminal order all contributed to the threshold that, once crossed, saw intermodal shipment used more and more. Cost differentiation still played a role, but only once the minimum service standard was reached and cycle-time uncertainty was lowered. Three access corridors focused on proven access pricing and allocation rule transparency, maintenance sequencing that alleviated persistent bottlenecks, and information rights that reduced terminal dwell times and forecasted terminal handovers more reliably. Contrary to the existing reform pathway, third-party access and the institutional separation of infrastructure management from operations, provided performance commitments were maintained, and node constraints were met, satisfying the above.

The research provided a feasibility frame that was evidence-led and contingent on the governance of a corridor to intermodal revitalisation and integration with the shipper's calculus on adoption. Recommendations defined minimum service standard thresholds and monitoring milestones at the corridor level, accompanied by a phased implementation design that sequenced operational recovery to the new regulatory framework. The hope was to refine the conclusions to assist in directing efforts of decision-makers to the most promising and targeted investment and contracting avenues that would enable a more reliable access to rail within intermodal chains.

Keywords: Intermodal transport; Corridor reliability; Modal shift; Third-party access; Access pricing and slots; South African logistics.

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TABLE OF ABBREVIATIONS

Abbreviation	Description
AACODS	Authority, Accuracy, Coverage, Objectivity, Date and Significance (grey literature appraisal framework)
API	Application Programming Interface
ATLAS.ti	Qualitative data analysis software (ATLAS.ti)
BNSF	Burlington Northern Santa Fe (United States Class I railroad)
CEF	Connecting Europe Facility
COREQ	Consolidated Criteria for Reporting Qualitative Research
DoT	Department of Transport (South Africa)
ERTMS	European Rail Traffic Management System
ESG	Environmental, Social and Governance
EU	European Union
GDP	Gross Domestic Product
GIS	Geographic Information Systems
ICALT	International Conference on Logistics and Transport
IEOM	International Conference on Industrial Engineering and Operations Management
MSRS	Mode Shift Revenue Support scheme
NLCC	National Logistics Crisis Committee
PIS	Participant Information Sheet
PMO	Project Management Office
POPIA	Protection of Personal Information Act
PPP	Public-Private Partnership
PPPs	Public-Private Partnerships
RFC5	Rail Freight Corridor 5 (Baltic-Adriatic)
SATC	Southern African Transport Conference
SATS	South African Transport Services
SLA	Service Level Agreement
SLAs	Service Level Agreements
TCO	Total Cost of Ownership
TFR	Transnet Freight Rail
TRIM	Transnet Rail Infrastructure Manager

CHAPTER 1: INTRODUCTION

South Africa's rail freight system was historically central to industrial logistics. In recent years, it has steadily lost share, as shippers have shifted to roads in response to a perceived erosion in efficiency, reliability, and operational flexibility (El Yaagoubi *et al.*, 2022; Mathabatha, 2015). International scholarship consistently links investment in transport infrastructure to logistics performance and broader economic growth (Chakamera & Pisa, 2021; Govender & Mbhele, 2014; Mikesell *et al.*, 2015). Whether those impacts translate in a situation characterised by corridor security issues, terminal shortages, and fragmentation of institutions is less certain. The handover between road and rail is fragile, and in South Africa, service dependability is uneven. The study seeks to determine the conditions under which intermodal offers would be possible, rather than presuming that global templates will be applicable (Havenga *et al.*, 2012; South African Department of Transport, 2022). Over the last ten years, rail has not aligned with economic growth, and there has been an increased shift to road (Republic of South Africa & Ramaphosa, 2023). The consequences are clear: increased pressure on the national and provincial road system, an increase in maintenance costs, and a higher risk of accidents (Jorgensen, 2004).

The current state of the South African freight industry is most seen in the industry's growing reliance on road transport. This is in part because technology in the rail industry is lacking, and, in addition, steady rail performance is inconsistent. Serviceable wagon availability is stagnant, and then, as per usual, service inefficiencies arise, and timetables become unequal. Therefore, the rail sector is consistently overtaken by the flexible and swiftly modifying trucking industry (Mathabatha, 2015; Van der Mescht, 2006). Transport as a whole is responsible for 14% of CO₂ emissions in South Africa, with 97% of this transport sector being rail (Department of Forestry, 2022). The ongoing shift of freight to road transport will undoubtedly result in increased CO₂ emissions, increased direct costs of logistics, and increased road congestion, safety risks, and infrastructure maintenance.

Irrespective of the subsequent policy documents, the expected direction of change is obvious. There appears to be a deliberate policy direction which advocates the more effective use of rail for the achievement of sustainability, efficiency, and economic growth (Pisa, 2021). The National Rail Policy (2022) anticipates the rebuilding of a rail system to be cost-effective, competitive, and reliable for the year 2050. It proposes three levers, namely, corridor recovery, third-party access, and controlled terminal activities (SA Dept of Transport, 2022). The 2023 Draft Freight Logistics Roadmap endorses this strategy and proposes a number of priority actions aimed at restoring lost efficiency. Independent benchmarking, notably the World

Bank's 2023 Logistics Performance Index, continues to indicate gaps in the infrastructure and the associated risks of unreliability. Implementation, however, remains a challenge, delayed by persistent structural inefficiencies, a lack of financial headroom, and an array of operational problems unique to each corridor.

1.1 BACKGROUND TO THE STUDY

Over the past decade, long-haul freight in South Africa has shifted steadily from rail to road as shippers respond to declining reliability and growing uncertainty in rail services. Interviewees, industry reports, and recent policy reviews all point to similar patterns: services arrive irregularly, interfaces between customers and the rail operator are experienced as rigid, and planners face substantial uncertainty when they try to schedule time-sensitive flows (Republic of South Africa & Ramaphosa, 2023; South African Department of Transport, 2022). These conditions are felt most acutely on the main corridors. Congestion persists on key highway links, pavements deteriorate faster than their design life would suggest, and road maintenance budgets come under increasing pressure. The external harms of this roadward shift appear in higher emissions and increased crash risk, as well as in rising indirect costs for the broader economy (South African National Roads Agency, 2024). Recent periods of reduced rail throughput and day-to-day operational instability have weakened confidence further, so many firms now default to road haulage, even when a credible rail-based option would offer a lower total system cost (Reuters, 2025a).

Against this backdrop, the basic organising principle for a more efficient freight system is conceptually straightforward. In an intermodal configuration, rail is expected to carry the long-distance trunk haul, while road focuses on the first and last mile distribution, where flexibility and fine-grained routing are most valuable. Standardised loading units, such as containers, allow freight to move across modes with limited handling at the interface, which reduces friction and loss at the join (Hrušovský *et al.*, 2021). The terminal becomes the hinge that connects these functions. Where terminals are provided with suitable operating technologies, are controlled by regulations, and are backed by reliable information, intermodal transfers can be done effectively within certain time and cost parameters, and with rail being able to keep its benefits of volume and energy usefulness, while also being able to maintain the flexibility and coverage of roads (Goodarzi *et al.*, 2024, Klapita 2024). When this is not the case, users distrust the system and opt for road-only alternatives, and perceive them as more flexible, even if they are more costly and less sustainable.

Targeted incentives, regulatory changes, and investments to support the shift from road to rail transport for efficiency, competitiveness, and environmental reasons have been used for decades by many countries internationally (Pisa, 2021). South Africa has been more uneven. The deregulation of road transport, together with underinvestment in rail infrastructure and in rolling stock, and the variable service record of state-owned entities, have all been roadblocks to a more coherent and competitive rail-road offering (Havenga *et al.*, 2011). Yet, the core structural logic of an intermodal division of labour where rail and road complement each other remains. If there is a set of clear standards for service delivery, a contract is designed to meet market demands, and the governance encourages predictability of outcomes in service delivery, coordinated systems can be costed to lower the system costs, enhance productivity, and assist in employment and economic growth. The lower costs, however, require adaptable and resilient infrastructure and operations to meet evolving demand. (Mafokosi *et al.*, 2024).

The main deviation is therefore more about the meaning behind the concept of intermodal transport and its effectiveness within the South African economy. To meet the economy's needs, there is a focus on reliable trunk services, which provide a reduction in the total cost of delivery and provide externality mitigation. However, a substantial number of would-be users of the service see the rail component as too uncertain, inflexible, or too much of a risk. This research is carefully situated in the gap between Policies and the realities of the operational environment. This research aims to understand the intermodal rail–road operational configurations and under which circumstances South African shippers would find them to be worthwhile as well as valuable. The research focuses on the insights drawn from numerous service system participants to identify the enablers and barriers that would constitute a routing and a mode selection along the principal corridors (Chakamera & Pisa, 2021; El Yaagoubi *et al.*, 2022; Potter *et al.*, 2022).

1.2 RESEARCH PROBLEM

In South Africa, long-distance freight has increasingly been relied on for road transportation. This has posed a risk within the industry due to a lack of efficient congestion management and the increased costs of logistics associated with the new road freight transport system. (Havenga *et al.*, 2012; Kurtulus, 2020). The road system transported about 63% of domestic freight (Mathabatha 2015, Mordor 2024), which increases the road wear and carbon footprint and diminishes the cost and trade competitiveness of the mining and manufacturing industry (Havenga *et al.* 2012, South African Department of Transport). South Africa has the opportunity to model the international experience of determined intermodal services, which allows for the efficiency of the rail system and cost-competitive servicing of the road system. The problems

which need to be addressed are the logistics and congestion problems of the transportation of road freight (Kramarz et al, 2022).

Historically, railroads were foundational to South Africa's economic landscape and provided spatial integration to the region by reducing the cost of transport and connecting hinterlands to markets (Bullock, 2009; Wragg, 2009). This legacy now coexists with ageing, fixed, and unevenly distributed infrastructure, a decline in transport service delivery, and the loss of rail traffic, which have all compelled companies to adopt more conservative, road-centred operational frameworks. Terminal congestion, lack of price transparency, and coordination gaps diminish rail's trunk haul benefits (George *et al.*, 2018). This leads to a divergence between the potential in theory and the performance in practice: contrary to other developed countries, where rail and road integration offers multiple opportunities to reduce total logistics costs and improve social and economic outcomes, the South African situation lacks adequate understanding in the academic and policy realm (Kramarz *et al.*, 2022).

1.2.1 PROBLEM STATEMENT

There is insufficient practitioner-grounded specification of the operational, terminal, and governance thresholds that would make intermodal rail–road services a feasible and competitive option in South Africa's principal freight corridors. In particular, corridor-level conditions are rarely described from the perspective of shippers, operators, and policy stakeholders who make or influence routing and mode decisions on the Gauteng–Durban, Gauteng–Cape Town, and Gauteng–Gqeberha corridors. This lack of clarity impedes current reforms from adequately addressing which service attributes drive modal choice and intermodal adoption in practice (George *et al.* 2018). This research has attempted to solve this by collecting views from experienced stakeholders on the operational, terminal, and governance conditions under which they would deem intermodal rail-road services along these corridors feasible and competitive. Clarifying these practitioner-defined thresholds is intended to support targeted policy and corridor investment, terminal upgrades, service standards, pricing structures, and coordination mechanisms that can shift appropriate flows from road to rail while lowering total logistics cost and externalities.

1.3 THEORY AND CORE CONCEPTS

1.3.1 INTERMODAL TRANSPORT

Intermodal transport is the carriage of goods in a single loading unit or vehicle through at least two successive modes, typically rail on the trunk section and road on the first and last mile,

with the cargo itself not handled at mode changes. The aim is to exploit each mode's comparative advantage, using standardised units, disciplined terminal processes, and shared information to deliver an integrated, cost-efficient, and lower-carbon door-to-door service (Hrušovský *et al.*, 2021; Konings *et al.*, 2008; Rodrigue, 2020).

1.3.2 MODAL SHIFT

Modal shift is the deliberate reallocation of freight from one mode to another. In South Africa, modal shift is most often from road to rail on core corridors, to cut externalities, ease congestion, and improve energy and cost efficiency. It functions both as a policy instrument and as a market response when services are credible. Enablers include access reform, adequate terminal capacity, predictable slotting, data transparency, and pricing signals that make the preferred mode competitive (Chakamera & Pisa, 2021; Pisa, 2021; South African Department of Transport, 2022).

1.3.3 OPERATIONAL EFFICIENCY

Operational efficiency refers to delivering freight reliably, on time, and at a competitive cost while making prudent use of assets. In rail, this centres on dependable scheduling, disciplined terminal operations, infrastructure maintenance standards, and the uptake of appropriate technology. Raising operational efficiency is a necessary condition for credible intermodal offers in South Africa (Mokobori *et al.*, 2022).

These core ideas are introduced here only to frame the research problem. Chapter 2 develops them in full, situates them in the international and South African literature, and links them to related themes such as asset maintenance, the differentiated roles of rail and road, and the components of transport and trade costs. For each concept, Chapter 2 provides clear definitions and the operational measures used in this study, establishing a consistent foundation for the empirical work that follows.

1.4 PURPOSE STATEMENT

This study evaluates the operational and strategic feasibility of intermodal rail–road freight services in South Africa. Its purpose is to specify the conditions, capabilities, and governance arrangements under which informed shippers would rationally adopt intermodal services on principal corridors. The design is qualitative by intent: semi-structured interviews with operators, logistics providers, regulators, and freight owners are triangulated with

documentary and performance evidence to surface feasibility thresholds rather than to produce financial calculations or econometric appraisals (Kramarz *et al.*, 2022; South African Department of Transport, 2022). Pricing is treated as a contractual and service-design variable, only insofar as it shapes perceived credibility, consistent with international treatments of intermodal systems and their enabling interfaces (Mokobori *et al.*, 2022; United Nations Economic Commission for, 2000).

The study's contribution is actionable operational guidance. It aims to distil minimum service standards and process requirements, schedule-adherence bands, terminal dwell/turnaround targets, capacity-assurance practices, information-visibility, and exception-management routines, and to indicate the coordination mechanisms needed between actors for repeatable, bankable services (Kramarz *et al.*, 2022; Mokobori *et al.*, 2022). In line with the National Rail Policy White Paper (2022) and the Freight Logistics Roadmap (2023), the study's outputs support access reform, corridor recovery, terminal capacity, and disciplined operating standards that enable credible private participation.

1.5 RESEARCH QUESTION

How feasible is intermodal rail–road adoption on South Africa's principal freight corridors, and under what minimum service, terminal, and governance conditions would informed shippers regard such offers as credible and competitive?

Boundary note: The study specifies adoption conditions on identified corridors. It does not assume universal transferability and recognises that in some flows, road remains the rational choice under current constraints.

1.6 AIM OF THE STUDY

1.6.1 AIM

This study aims to determine whether, where, and under what conditions intermodal rail and road services constitute a feasible and competitive option for South Africa's principal freight corridors. It assesses the operational, terminal, and governance thresholds that enable credible adoption. It evaluates the extent to which these conditions could improve economic efficiency, lower total delivered cost, and support more sustainable freight movement.

1.6.2 SECONDARY OBJECTIVES

In support of the aim, the study pursues the following objectives:

1. To evaluate the feasibility of intermodal rail and road services for South Africa through a targeted review of academic, industry, and policy literature.
2. To elicit and analyse stakeholder perceptions of intermodal adoption using individual semi-structured interviews.
3. To distil actionable measures that would enable implementation, including minimum service standards, terminal operating requirements, information-visibility and exception-management routines, and supportive governance arrangements.

These objectives guide the research design and analysis, and they are interpreted against current literature and practice to derive conclusions and recommendations for the sector.

1.7 SCOPE OF THE STUDY

This study in the field of operations management reviews South Africa's rail freight sector, compares rail and road on efficiency, and evaluates whether intermodal logistics can improve freight mobility. Given the rising dependence on roads and its costs, it assesses the feasibility of intermodal options in the South African context. The scope centres on general freight moved along the country's primary corridors, with attention to node-mode interfaces, terminal availability, access arrangements, and day-to-day reliability as experienced by industry stakeholders. The research concentrates on the perspectives of stakeholders, and the most recent policy frameworks, and assesses the extent to which integrated rail-road services, along specific corridors, could mitigate the total cost delivered and its externalities. Detained engineering designs and full cost-optimisation models are also excluded, and passenger services, along with captive bulk flows with specific economics, are also excluded.

The spatial focus is South Africa's major economic corridors: Gauteng–Durban, Gauteng–Cape Town, and Gauteng–Gqeberha (Port Elizabeth). These routes carry bulk commodities, containerised cargo, and manufacturing inputs, and they serve as core arteries of the country's trade and industrial system (Havenga *et al.*, 2011).

The temporal scope spans approximately 2000 to 2024, capturing two decades of policy shifts, infrastructure investment, and modal preference changes, with forward-looking implications considered to 2030 where appropriate. During the proposal stage, several provisional themes

were identified to organise data collection and analysis, subject to refinement through the empirical work:

1. **Policy ambition and delivery capacity.** Alignment between strategic intent and execution, including National Rail Policy (2022) and the Freight Logistics Roadmap (2023).
2. **Rail deterioration and road shift.** Service reliability, volume trends, and externalities have driven traffic to the road.
3. **Node-mode interface and terminal discipline.** Inland terminal capacity, appointment systems, yard rules, equipment, and information flows that reduce interface penalties.
4. **Access reform, PPPs and corridor security.** Governance arrangements that crowd in investment, allocate risk, and restore service credibility.
5. **Adoption calculus.** How shippers weigh time, reliability, and total cost of ownership across sectors, and the conditions under which intermodal becomes a rational choice.

The analysis prioritises issues raised by research participants on the three principal corridors. These pillars guide data collection and analysis and were refined as stakeholder evidence is gathered.

1.8 METHODOLOGICAL SCOPE

This study adopted a qualitative case-study design centred on South Africa's principal freight corridors. Semi-structured interviews with operators, logistics providers, regulators, and freight owners were complemented by documentary analysis of policy, industry, and academic sources to support triangulation and a robust evidentiary base. Analysis followed a reflexive thematic approach to surface feasibility thresholds and adoption conditions; the design was not intended to produce financial calculations or econometric appraisals.

1.9 JUSTIFICATION FOR THE CHOSEN SCOPE

The South African rail freight sector is economically significant. However, the continuous inefficiencies and the declining share, compared to road haulage, justify the focused scrutiny. As road logistics cost increases and infrastructure also declines, along with environmental pressures, a rigorous assessment of the rail revitalisation and intermodal options is justified (Republic of South Africa and Ramaphosa 2023). The principal corridors are the main focus of the scope as they provide the most analytical clarity, as this is where the key decision-making occurs and the reforms can be implemented and tested at scale.

The researchers employed a qualitative design comprised of semi-structured interviews with a variety of professionals to capture their expertise and lived operational realities, such as their experiences as operators, logistics providers, freight owners, and government officials. To add to the depth and credibility of the research, the team utilised documents sourced from policy and industry materials to corroborate and validate their findings. The selected thematic pillars framed constraints and enablers in an integrated way, supporting practical, evidence-informed measures to improve national and regional freight mobility.

1.10 JUSTIFICATION OF THE RESEARCH APPROACH AND DESIGN

The methodological aspects of this study are described in Chapter 3 of this dissertation. A brief overview of the main methodological elements is discussed here.

1.10.1 QUALITATIVE APPROACH AND RATIONALE

Following Creswell and Creswell (2018), qualitative research seeks to understand the meanings individuals and groups attach to social and organisational challenges, which suits a study of industry dynamics, stakeholder judgements, and system frictions. An inductive stance was adopted so that patterns and tentative explanations could emerge from the data, rather than being tested against a prior hypothesis (Saunders *et al.*, 2009). This orientation supported a grounded reading of what inhibits and enables intermodal feasibility on South Africa's principal corridors.

1.10.2 DESIGN AND DATA COLLECTION

The study used a qualitative case design centred on the Gauteng–Durban, Gauteng–Cape Town, and Gauteng–Gqeberha corridors, the main freight corridors in the South African transport system, responsible for freight movement. It collected primary data in the form of nine individual semi-structured interviews with operators, logistics providers, freight owners, and public officials. The guide for the interviews was focused on detailing the participants' perceptions and experiences pertaining to reliability, terminal discipline, information visibility, access arrangements, and corridor security, while also leaving space for participants to expand on their workarounds and other experiences. The study also performed an analysis of documents such as policy texts, industry reports, and technical reviews to augment and support the triangulation (Saunders *et al.* 2009).

1.10.3 ANALYSIS AND RIGOUR

Thematic analysis was conducted with an inductive approach to develop a theory. Close readings of transcripts involved coding processes and further developing and refining themes related to adoption thresholds, service standards, and conditions of governance. Decisions made during this process were documented through an audit trail; credibility was attained via transparency of the process, and, where possible, verification of key points by the participants. The design remained iterative so that prompts, memos, and provisional themes were refined as new insights emerged (Creswell & Creswell, 2018).

1.10.4 ALIGNMENT WITH THE STUDY AIM

This methodological scope aligns with the dissertation's purpose. It is designed to surface corridor-level service parameters, terminal operating requirements, and governance levers that would make intermodal rail and road offers credible and competitive. Pricing was considered part of service design and contracting only insofar as it shaped perceived credibility. Findings were interpreted alongside current literature to generate practice-aware implications for policy and industry strategy.

Boundary note: the design specifies corridor-level service, terminal, and governance conditions for credible adoption; it does not attempt econometric appraisal or system-wide cost-benefit modelling.

1.11 DISSERTATION FRAMEWORK BY CHAPTER SYNOPSIS

This dissertation comprises five chapters. Together, they evaluate whether, where, and under what conditions intermodal rail and road services are feasible on South Africa's core corridors, and they set out practical measures to restore credible freight performance.

CHAPTER ONE: INTRODUCTION

Chapter One frames the problem and the purpose. It outlines the decline in rail performance, the shift toward road transport and its consequences, and the need to specify feasibility thresholds for intermodal adoption. The chapter states the aim, objectives, and research questions, defines the core concepts, and delimits the study's scope across the three principal corridors.

CHAPTER TWO: LITERATURE REVIEW

Chapter Two integrates international and South African literature, policy documents, and industry reports to analyse the current state of the intermodal transportation system. It outlines the historical development of rail, analyses its costs, service reliability, and externalities, and examines the intermodal transportation system, terminal operations, and governance frameworks. The chapter identifies a lack of context-specific evidence, stakeholder-focused research, and inadequate analysis of the road–rail interface, which the current study addresses.

CHAPTER THREE: RESEARCH METHODOLOGY

Chapter Three presents the qualitative case design, study setting, and the sampling and recruitment procedures of experienced stakeholders across South Africa's principal freight corridors. This chapter outlines the collection of nine semi-structured interviews and a selective documentary case study analysis. Then the chapter outlines the steps of the coding, discussing the concerns of trustworthiness, including audit trail and reflexivity, confidentiality, as well as the analytical framework of reflexive thematic. Finally, the chapter explains the ethical concerns, data management, POPIA, and recognises the relationship between the methodological choices and the study aim.

CHAPTER FOUR: FINDINGS AND ANALYSIS

Chapter Four elaborates on the findings of the thematic analysis. After recapping the methodology of both data collection and analysis, reflexive thematic analysis is described, covering the phases of coding and thematic construction, and the measures that were taken throughout to ensure the credibility and trustworthiness of the findings. Irregular stakeholder testimonies are catalogued on the deterioration of rail and the subsequent substitution by roads. Furthermore, the inland terminals and operational discipline, the access, financing and corridor security, and the adoption of the trade-off of time, reliability, and total price. Illustrations of corridor-specific perceptions are provided by means of anonymised quotes, tables, and a conceptual map that identifies the key drivers and obstacles to the provision of intermodal rail–road services.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

Chapter Five brings the findings together in the form of decision-ready guidance. It identifies intermodal offerings with a combination of minimum service requirements, terminal operating

and governance frameworks, information visibility, exception handling, and operational interdependency as plausible. The chapter identifies corridor-specific outcome expectations for prioritisation and resource deployment, discusses the study's limitations, and suggests future research opportunities.

1.12 CHAPTER 1 CONCLUSION

Chapter 1 located the study within the context of South Africa's freight paradox, the coexistence of a road-dominated system and extensive rail network, a well-defined policy framework, and increasing external costs. It has shown how declining rail performance, corridor bottlenecks, and fragile node-mode interfaces have encouraged defensive road-centred operating models, with adverse implications for logistics costs, infrastructure wear, and sustainability. Against this backdrop, the chapter has outlined the conceptual case for intermodal rail–road transport; clarified the core concepts of intermodal transport, modal shift, and operational efficiency; and located the central research gap in the lack of practitioner-grounded specification of the operational, terminal, and governance thresholds that would make intermodal offers feasible and competitive on South Africa's principal corridors. The research problem, purpose, question, aim, and secondary objectives were stated in this context, with the study framed explicitly around corridor-level feasibility conditions on the Gauteng–Durban, Gauteng–Cape Town, and Gauteng–Gqeberha routes.

The chapter has also delimited the study's scope and justified the chosen qualitative, corridor-centred case design. It explained why semi-structured interviews with operators, logistics providers, freight owners, and public officials, supported by documentary analysis, are appropriate for surfacing adoption thresholds and feasibility conditions rather than producing financial or econometric appraisals. In doing so, it prepared the ground for the detailed treatment of the literature and methods that follow. Chapter 2 now develops the theoretical and empirical foundations in depth, reviewing international and South African work on freight transport, intermodal systems, corridor performance, and governance. Chapter 3 then sets out the research methodology in full, specifying the case design, sampling, recruitment, data collection, analytic procedures, and ethical safeguards that shape the findings and recommendations presented in Chapters 4 and 5.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Transport infrastructure is foundational to economic development. It enables the efficient flow of commodities, lowers trade costs, and supports national and regional integration (Chakamera & Pisa, 2021; Mikesell *et al.*, 2015). In South Africa, the freight logistics system shows structural and operational weaknesses. Road freight carries more than 63% of shipments (Mordor Intelligence, 2024). The result is faster road deterioration, persistent congestion, and higher carbon emissions (Department of Forestry, 2022). Rail underpinned industrial expansion for decades. It now loses ground as assets age, investment lags, service quality varies, and institutions remain fragmented (George *et al.*, 2018; Havenga *et al.*, 2012). The literature is clear that transport investment supports growth (Mikesell *et al.*, 2015). South Africa is different. High logistics costs, reliability shortfalls, and governance misalignment appear to blunt the productivity gains that rail-centred investment should yield (Govender & Mbhele, 2014; Havenga *et al.*, 2012).

This modal imbalance has renewed interest in intermodal transport, the coordinated movement of goods across more than one mode, typically rail and road, within a single logistics chain and using a standard loading unit (Govender & Mbhele, 2014; Hrušovský *et al.*, 2021). Intermodal transport has gained ground in the literature: when it is well coordinated, a single loading unit moves across rail and road with minimal handling, and systems capture efficiency, cost, and environmental gains by playing to each mode's strengths (El Yaagoubi *et al.*, 2022; Hrušovský *et al.*, 2021; Kramarz *et al.*, 2022). South Africa has not been able to turn its potential into progress. Fragmentation reveals itself in thin terminal capacity, limited integration of information, and inconsistent application of policies (Phaladi *et al.*, 2019b; South African Department of Transport, 2022). When there is an extended history of underinvestment and lack of reliable services, it is expected that potential customers would be cautious (Havenga *et al.*, 2011).

The chapter continues with a presentation of a synopsis. First, it outlines the conceptual and theoretical foundations of intermodal systems and transport economics. Then there is a discussion of the historical development of rail and road transport and an attempt to locate the present controversies in the policy and regulatory frameworks. Following this, it draws on international practice and empirical work to evaluate the drivers of modal shift and the complexities of infrastructure constraints, regulatory frameworks, design and sustainable financing, and regulatory frameworks, and to assess the empirical work in international

practice and the literature on South Africa's rail–road services (Chakamera & Pisa, 2021; Pisa, 2021).

The following explains the construction of this chapter. First, the intermodal freight streams in Rutledge's framework of efficiency, modal shift and sustainability are discussed. Then, the definitional clarity used in this study is reviewed. Then, South Africa's Transport System is discussed. The history of South Africa is traced, and the evolution of policies on infrastructure, specifically the rail and road, is discussed. The practice of other countries is reviewed, and the principles applicable to South Africa are discussed. Then, the intermodal integration challenges are used to discuss the integration. Then, the predominant approaches to intermodality and the challenges of these approaches are discussed. The applicable gaps in the literature are reviewed, and the positioning of this study to address the gaps is discussed. The chapter ends by summarising the key findings and justifying the aims of the study.

In reflection, these sections orient the study against contemporary scholarship and practice and shine a light on an underexplored intersection in South Africa, namely, the interplay between logistics policy, the development of relevant infrastructure, and stakeholder readiness. The chapter provides the groundwork to assess whether an intermodal rail–road system has the potential to mitigate freight inefficiencies and facilitate a sustainable future in logistics, by clarifying definitions, analysing local and international evidence, and balancing contradictory evidence.

2.2 KEY CONCEPTS AND DEFINITIONS

This segment elaborates on the key concepts in the review and illustrates how they are relevant to the South African context. By embedding each concept in scholarly discourse and local realities, it provides a sound basis upon which the evidence may be interpreted to arrive at rational conclusions. It also delineates the scope of the study in such a way that subsequent analysis builds on a set of meanings that are unambiguous and shared.

2.2.1 INTERMODAL TRANSPORT

Intermodal transport is the coordinated movement of a single loading unit, typically a container, across two or more modes in one journey without handling the cargo itself at transfers (Rodrigue, 2020). The idea rests on modal complementarity. Rail carries the energy- and scale-efficient trunk haul. Road freight offers reach and flexibility on the first and last mile, where fine-grained access and routing matter most (Reis *et al.*, 2013). The functioning of

intermodal systems fundamentally relies on each individual node's functioning. Inland terminals should operate as designed; intermodal handling equipment should operate smoothly across the different transport modes; and communication should allow all relevant actors to make operationally sound decisions. Where all these factors are present, the transfer of cargo from rail to road can be accomplished without significant additional time and costs. Where these factors are absent, delays occur, frustration with the offer becomes widespread, and communication breaks down (Reis *et al.*, 2013). History from Europe and China suggests that even with these systems, operational and governance misalignments at the terminals can still result in intermodal systems sustaining inefficiencies and negative externalities (Xie, 2022).

These conditions are especially true in the Southern Africa region. The uneven access arrangements, history of under-investment in rail, rail systems, and the fragmented coordination led to the regional feasibility of intermodal systems being assessed on a corridor basis under the specific conditions of terminal availability, operating discipline, and predictable slot allocation. Where these factors are present, intermodal systems can offer the long-distance service of rail combined with the responsiveness of road, improving service punctuality and frequency, overall delivery cost, and reducing the negative external costs of freight transport (Havenga *et al.*, 2011; Reis *et al.*, 2013; Rodrigue, 2020).

2.2.2 MODAL SHIFT

Modal shift is an umbrella term that encompasses the transfer of traffic from one mode to more sustainable alternatives, usually from road to rail or inland waterways (Takman & Gonzalez-Aregall, 2024). It is primarily a policy instrument, but also a logistics choice, used to relieve congestion, reduce greenhouse gas emissions, and enhance the durability of infrastructure systems over time (European, 2020). The hardest part is coordination. Multi-modal systems have nodes that need to be highly synchronised; when there is a slip in either of the schedules or when there is a lack of information, small delays that might accumulate on a system can frustrate the whole system (Goodarzi *et al.*, 2024).

A combination of push and pull factors influences the response of shippers. Push factors include diesel price volatility, road congestion, and maintenance costs, as well as the charges that come along with the environment. Pull factors include rail service reliability, endpoint pricing, and certain rewards or subsidies that reduce the costs for switching (Pisa, 2021). In the European Union's Sustainable and Smart Mobility Strategy, these levers have and continue to be grouped together; consequently, modal shift is located within the more

comprehensive economic and environmental objectives rather than being a singular action (European, 2020).

Challenging settings are common in South Africa. While road transport is the leader in the region and the benefits of rail are understood (Govender & Mbhele, 2014). Deteriorating rail infrastructure, reduced last-mile connectivity, and perceived unreliability amplify risk and weaken the pull factors. In this context, corridor-level fixes are credible shifts to place demand on rail. These include operating terminals, guaranteed servicing, and flexible access, so the adoption calculus leans in rail's favour on timely deliveries, reliability, and total landed costs, not just tariffs (Chakamera & Pisa, 2021; Pisa, 2021).

2.2.3 RAIL FREIGHT

The transport of heavy commodities, such as minerals, containers, and crops, is the core business of rail. It operates optimally over long distances, and road transport is surpassed by rail in transport output. Globally, rail delivers around 6% of tonne-kilometres while producing only 1% of transport CO₂, a clear carbon advantage over road (International Energy, 2024).

The reason why it works is no secret. It is reliable tracks, functional locomotives, and wagons; consistent operational schedules, and well-coordinated integration with other transport modes. These are the factors that contribute to an efficient system (Havenda et al, 2012). South Africa is not performing well in this area. The legacies of a monopoly, minimal funding, and fragile operational systems result in an unequal distribution of services and underutilised capacity (George *et al.*, 2018). Rail should work in South Africa due to favourable geography, including lengthy inland corridors and large distances between ports and hinterland markets. Unfortunately, operational and institutional frictions continue to reduce rail's reliability and competitiveness (Van der Mescht, 2006).

There is a consensus during reviews concerning the policy. Analyses point out the deficiencies in management, the age of the assets, and the narrowing of customers throughout the value chain (Phaladi *et al.*, 2019a). The document from the Department of Transport of 2022 acknowledges the new national railway policy on the national investments; however, it remains on the challenges concerning the vets and sections of the infrastructure, the underutilisation of the network, and the large capital (South African Department of Transport, 2022). Unsurprisingly, shippers adjust their behaviour. When reliability is uncertain and access arrangements lack transparency, many shippers turn to road transport by default. This behaviour reinforces the roadward shift and highlights the importance of targeted reinvestment

and credible access frameworks if rail is to compete meaningfully (Boye, 2023; Havenga *et al.*, 2012).

On paper, therefore, the structural fit between South Africa's geography and rail-based intermodal solutions is strong; in practice, delivery falls short. Addressing asset condition, stabilising service performance, and improving governance emerge as preconditions for a meaningful modal shift and for intermodal services that use rail for the trunk haul and road for first- and last-mile distribution.

2.2.4 ROAD FREIGHT

Road freight is the movement of goods by trucks and other commercial vehicles. It is highly flexible and, worldwide, it dominates logistics because it offers door-to-door service, high frequency, and quick response to short-term shifts in demand (Rodrigue, 2020). In South Africa, it is the backbone of the system, carrying around 63% of domestic freight volumes (Mordor, 2024).

That flexibility carries costs. Heavy reliance on roads raises logistics expenses through fuel price volatility, maintenance, and congestion delays, and it increases exposure to crashes and carbon emissions (Havenga *et al.*, 2012). Pavement wear is particularly acute. Heavy-duty trucks impose disproportionate axle loads that accelerate deterioration on national and provincial roads, with sizeable long-run maintenance bills for the state (Jorgensen, 2004).

When viewed in terms of corridors, the general picture is one of paradox. During uncertain periods in rail services, roads provide reach and reliability. Overuse, however, externalities are intensified and diverted public spending to road maintenance instead of network diversification is a patchwork control. The policy question, therefore, is not road or rail, but how best to combine them so that road's access strengths complement rail's long-haul efficiency in a credible intermodal offer (Havenga *et al.*, 2012; Rodrigue, 2020).

2.2.5 NODE-MODE INTERFACE

The node-mode interface refers to the operational point where freight transfers between two transport modes, most commonly between rail and road within an intermodal system (Notteboom & Rodrigue, 2008). It is the physical and organisational junction where terminals, yards, loading equipment, appointment systems, and information flows converge to enable a clean modal handover. In practice, the interface determines how efficiently units are received,

processed, and released, and is therefore central to service reliability, dwell times, and total logistics cost. When node-mode interfaces are well designed and governed, with disciplined yard rules, predictable operating windows, and shared data standards, modal integration becomes feasible. Where these interfaces are weak or fragmented, handling penalties accumulate, schedules slip, and the attractiveness of intermodal options declines (Rodrigue, 2020).

2.2.6 TRANSPORT INFRASTRUCTURE

Transport infrastructure includes the physical and technological systems that enable movement, from roads and railways to ports, terminals, and intermodal hubs, together with the information platforms that coordinate them (George *et al.*, 2018). Efficient infrastructure acts both as a direct driver of freight performance and as a signal of institutional capacity and coordination (Havenga *et al.*, 2011). For intermodal services, compatibility is central and depends on standard loading units and handling equipment, reliable power and signalling, aligned track and pavement standards at terminals, and digital platforms that provide shared visibility across modes (Notteboom & Rodrigue, 2008; Rodrigue, 2020).

In South Africa, bottlenecks appear at several points in the chain. Legacy terminal designs, thin investment in inland capacity, and poorly maintained rail links slow transfer and raise end-to-end cost, while uneven access regimes and weak yard discipline lengthen dwell and undermine schedule integrity (Phaladi *et al.*, 2019a; South African Department of Transport, 2022). Corridor security and asset condition also matter. Theft and vandalism of signalling, overhead traction, and track assets disrupt services and deter private uptake, while heavy truck axle loads accelerate pavement wear and pull public funds into road maintenance rather than node-mode integration (Jorgensen, 2004; South African Department of Transport, 2022).

The literature converges on a practical remedy. Targeted renewal of track, turnouts and yards, expansion of terminal capacity, credible open-access arrangements, and interoperable information flows reduce handling penalties and restore reliability on priority corridors (George *et al.*, 2018; Havenga *et al.*, 2011; South African Department of Transport, 2022). Where these elements align, terminals become effective hinges between modes, and coordinated services can realise rail's long-haul advantage without sacrificing road's responsiveness, lowering total delivered cost and externalities in the process (Notteboom & Rodrigue, 2008; Rodrigue, 2020).

2.2.7 LOGISTICS AND TRANSPORT COSTS

Transport is a large share of the logistics bill, alongside warehousing, inventory holding, administration, and insurance. In developing economies, it can exceed 60% of total logistics cost, which drags on trade competitiveness and firm productivity (Havenga *et al.*, 2012; Havenga *et al.*, 2014; Lafourcade & Thisse, 2011). The impacts of such costs are evident and well understood in other systems. The costs of road transport, especially, are affected by the volatility of diesel prices and are therefore very significant. The costs are then introduced to the system through layers, creating inflationary pressures on the economy. The costs driving this particular issue are ageing and insufficient infrastructure, long cycle times, limited options to provide backhaul and the unutilised opportunity to use bulk-efficient systems such as rail (Mokobori *et al.* 2022).

South Africa reflects this pattern. Diesel prices, toll charges, congestion, and vehicle maintenance costs raise the marginal cost of road movements and widen the gap between what would be technically efficient and what firms select in practice. Where distance and volume permit, intermodal services offer a partial corrective. Using rail for the trunk haul and road mainly for the access legs can, in turn, lower door-to-door costs for bulk and distance-sensitive flows, and improve the overall cost performance of national logistics networks (Mokobori *et al.*, 2022).

2.2.8 SUSTAINABILITY IN FREIGHT TRANSPORT

Sustainability in freight transport concerns limiting environmental damage while supporting economic performance and social welfare (International Energy, 2024). In practical terms, it calls for lower greenhouse-gas emissions, reduced air and noise pollution, more efficient fuel use, and more careful use of land along corridors and at terminals (Banister, 2008). Intermodal design fits these aims. Put the trunk haul on energy-efficient rail, keep the road for collection and delivery, and the emissions intensity of a door-to-door move usually falls without a loss of service quality or speed, where interfaces are well managed (International Energy, 2024). Policy debates have followed this logic. Many systems now treat modal shift from road to rail as a competitiveness and efficiency lever, not only an environmental add-on (Pisa, 2021).

The South African case is starker. Paris-aligned commitments, domestic energy constraints, and a large transport carbon profile raise the opportunity cost of delay (South African Department of Transport, 2022). Heavy reliance on long-distance road haulage runs counter to these goals and externalises the costs of congestion, safety, and emissions to the broader economy. A corridor-focused intermodal programme can offer a concrete response, provided

two fundamentals are in place: services must run reliably, and terminals must be operated in a disciplined way. Where this is accomplished, the energy advantages of rail transport are not lost while the road continues to provide the flexibility of access on the first and last mile.

They are not simply descriptive signs. They determine the analytical bounds of the study and affect how feasibility is considered. Each of these concepts comes with certain assumptions and compromises that determine how the current inefficiencies are understood and what reform options might be viable. Building on established concepts enables the study of South Africa's freight transition with more focus and while keeping local choices connected to the more global body of evidence.

2.3 RAIL CORRIDOR LIBERALISATION AND THIRD-PARTY ACCESS IN SOUTH AFRICA

South Africa's reform pathway introduces open access on priority freight corridors for qualified private operators, while stewardship of the core rail infrastructure remains with the state. The National Freight Logistics Roadmap does more than signal intent. It sets out a governance design in which infrastructure management is separated from above-rail operations, train paths are allocated on transparent terms, and service delivery is monitored through a performance regime coordinated by the National Logistics Crisis Committee and Operation Vulindlela (Department of, 2023; National & The, 2025). The Economic Regulation of Transport Act 6 of 2024 provides the legal foundation for this design by establishing a single transport economic regulator with mandates for access-pricing methodology, information-disclosure rules, registration and oversight of access agreements, and dispute resolution, with enforcement powers. Together, these instruments establish predictable entry conditions, make reliability and minimum service standards contractible, and provide the regulatory certainty needed to mobilise private investment in corridor services. (Republic of South Africa, 2024). The following subsection shows how these provisions are being operationalised through TRIM's Network Statement and the first cycle of rail access tariffs.

Implementation has now taken concrete form. Transnet Rail Infrastructure Manager (TRIM) issued a Network Statement and access tariffs that specify slot purchase requirements, safety and interoperability requirements, and the application and adjudication process. Their publication and subsequent extension are recorded in the Government Gazette (Republic of South Africa, 2024, 2025; Transnet Rail Infrastructure, 2024). Progress reports place these tools within a wider execution framework aimed at corridor recovery and evidence transparency. They also take into account the practical limitations that continue to shape

outcomes, in particular the backlogs in maintenance and bottlenecked terminals that must be resolved before gains in reliability can be fully realised. Independent coverage documents the awarding of the first slots and entry of private players, evidencing that access is no longer merely theoretical, but operational. The outcomes, however, remain contingent on regulatory trust, clarity in pricing, and performance at the nodes, particularly at terminals and major intersections.

For rail revitalisation, third-party access signals a move toward performance-managed corridor services. Where access pricing is credible, and maintenance is targeted at known bottlenecks, asset utilisation can improve, on-time running tends to stabilise and cycle times can shorten. These shifts are consistent with the Roadmap's aim of rebuilding dependable corridor capacity (Department of, 2023). The core mechanisms are predictable slot adherence, transparent allocation rules, and a performance regime that ties access rights to the delivery of agreed service levels. For intermodal feasibility, the implications are immediate. As corridor reliability improves and slotting becomes more predictable, total logistics costs and the risk premium on rail-linked road legs tend to decline. This enhances the business case for time-sensitive rail–road combinations and scheduled domestic intermodal services. In short, the liberalisation instruments align with the threshold conditions for modal shift identified in this study, especially on bulk-adjacent flows where fixed schedules, terminal dwell limits, and service guarantees carry the greatest weight (Republic of South Africa, 2024; Reuters, 2025b).

2.3.1 OPERATIONAL EFFICIENCY

Operational efficiency in freight transport is the capability to deliver commodities with minimal time, cost, and resource waste, while maintaining reliability and service quality (Borgi *et al.*, 2017). From a corridor perspective, it is characterised by predictable slot discipline, high utilisation of equipment and crews, efficient turnaround and reduction in terminal dwell, high flow of accurate information and synchronised schedules. Rail systems typically achieve superior efficiency at scale for uniform bulk and scheduled services (Notteboom & Rodrigue, 2008), yet flaws in maintenance sequencing, timetable coordination and data sharing can erode these advantages (Chupin *et al.*, 2025). In fragmented networks with weak intermodal collaboration or poorly specified institutional roles, operational inefficiencies tend to dominate, producing irregular cycle times and higher cost-of-risk that undermine modal shift (Notteboom & Rodrigue, 2008).

2.4 ANALYTICAL AND CONCEPTUAL FRAMEWORK

This study does not rely on a single grand theory. In freight logistics, especially in a developing-economy setting, no solitary lens captures how infrastructure, policy, economics, and sustainability interact. The analysis, therefore, draws together five complementary perspectives: intermodal transport, modal shift, operational efficiency and transport-cost economics, institutions and public–private partnerships, and environmental sustainability. Taken together, these lenses define the key constructs, clarify their relationships, and provide a practical framework for designing, implementing, and sustaining an integrated logistics system in South Africa.

2.4.1 INTERMODAL TRANSPORT (CONCEPTUAL LENS)

Intermodal transport rests on the coordinated use of at least two modes, most often rail for the trunk and road for access, with the load remaining in a single unit at transfers (Rodrigue, 2020). In practice, the concept is realised through standardised intermodal units, such as ISO containers, purpose-built terminals, including dry and inland ports, and information systems that synchronise bookings, handovers, and status updates across actors (Rodrigue, 2020). When these elements work in step, the system exploits each mode’s comparative strength, long-haul energy efficiency on rail, and flexible distribution on road, lifting door-to-door performance and reliability (Gleser & Elbert, 2024; Slack, 2016).

In South Africa and other countries with established rail assets and increasing reliance on road transport, the intermodal perspective is useful in guiding the redesign of corridors and the combination of regulated terminals with flowing schedules and synchronised data. The outcome is an offering that competes on service delivery, cost and service reliability.

2.4.2 MODAL SHIFT (POLICY-BEHAVIOURAL PERSPECTIVE)

The concept of modal shift revolves around the intentional diversion of traffic from a predominant means of transport, usually road, to more ecologically beneficial alternatives like rail and inland waterways (Takman & Gonzalez-Aregall, 2024). This case is both practical and normative, as it aims to achieve a balance of network utilisation, diminishing externalities, and the construction of transport system resilience over the long term (Goodarzi *et al.*, 2024). Shipments are influenced by a complex set of paired factors. There are push factors, such as congestion, safety challenges, and diesel volatility. Conversely, pull factors consist of: reliable rail service, specific subsidisation, and environmental targets to reduce the risk of switching (Pisa, 2021).

Policy design reflects this logic. In Europe and Asia, along with the balancing of external costs, governments configure operational assistance for rail, along with capital investments in intermodal terminals and the regulated pricing for roads with high emissions in traffic (European Court of Auditors, 2023; Takman & Gonzalez-Aregall, 2024). Mixes of this are also applicable in poorer contexts where the system risk is better distributed, and the easing of congestion is beneficial. The hinge is behaviour. Firms have a tangible response when there are visible benefits from reliable transport, transparent pricing, and stable regulations. Once reliability is established in the daily operational performance, adoption becomes more sustainable, as opposed to having only a beneficial tariff to entice it (Vickerman, 2024).

2.4.3 OPERATIONAL EFFICIENCY AND TRANSPORT COST ECONOMICS (ECONOMIC LENS)

Operational efficiency for a transport system means moving goods in a timely, reliable, and cost-efficient manner, while also utilizing resources and personnel in an optimal manner (Borgi *et al.*, 2017). In the case of rail transport, dependable timetables for locomotives and crew personnel, disciplined terminal routines that minimise dwell, and considerable wagon utilisation (material) of the fleet. In road transport, performance depends on optimal route design, strict turnaround guidelines, and disciplined fleet utilisation (Chupin *et al.*, 2025). When these routines slip, the effects cascade along the chain. Costs increase, timetables are disrupted, and service quality drifts from what is actually needed by the customers (Vickerman, 2024).

Transport-cost economics contributes to the ledger view by breaking down the bill into its core components: fuel, tolls, maintenance, labour, compliance, and other related costs (Lafourcade & Thisse, 2011). Having a clear understanding of the cost drivers is important, especially in developing economies, where the burden is usually heavier, as corridor bottlenecks, limited modal choice, and under-investment increase costs, making them non-competitive (Chakamera & Pisa, 2021). Careful measurement then provides the test, showing whether and under what conditions intermodal configurations deliver material, financial, and operational gains.

2.4.4 INSTITUTIONS AND PPPS (GOVERNANCE FRAMEWORK)

From an institutional perspective, the complex transport systems are influenced by formal rules, regulatory frameworks, and organisational cultures (Chupin *et al.*, 2025). Within freight

transport, there are state-owned enterprises, private logistics actors, and regulators, and their relationships shape how reforms are put into practice through integration of policies, funding, and operating mandates (Phaladi et al 2019b; Takman & Gonzalez-Aregall 2024).

The domestic freight system in South Africa is still only partially integrated. Fleet and road logistics, standalone, can never meet the required scale, reliability and affordability. This is still the case with the increasing costs in relocating goods across major road-linked economic regions, the deteriorating condition of road assets, and the growing need to alleviate the environmental impact of road logistics (Havenga *et al.*, 2012). In such an environment, intermodal transport has become the main subject of policy and industry debate. The central proposition is to combine modes of transport to remove inefficiency, stabilise service, and serve an economy whose activity is large and complex. The intermodal shifts, with operationally disciplined terminals and predictable service, can remove total transport costs and improve access to remote areas (Havenga et al, 2011).

Public-private partnerships fit within this governance framework. The core PPP concept enables both public and private parties to develop, operate and maintain infrastructure, designed to attract capital, allocate risks, and enhance innovation within public sectors where the state is unwilling to act (Maluleka, 2008). Examples from other countries illustrate PPPs in freight logistics: the financing and operation of intermodal terminals, extensions of rail links to ports, and implementations of corridor control systems in India, Turkey, and Brazil (Arvis *et al.*, 2018; World Bank, 2018). For developing economies, these structures can mitigate public capacity constraints, release capital for priority schemes, and improve confidence in multi-year delivery schedules (Sebitlo *et al.*, 2022).

A similar approach is warranted in South Africa. Rail-freight renewal should be guided by a single, coherent strategy that couples public investment with credible PPPs to speed upgrades and lift day-to-day performance. Within this frame, Transnet SOC Ltd's Freight Rail Sector Improvement Programme, supported by ZAR 18.5 billion from the New Development Bank, prioritises the modernisation and restoration of core assets rather than isolated fixes (New Development Bank, 2024). The programme's actions, network renewals, locomotive overhauls, and wagon-fleet modernisation aim to rebuild capacity and counter the shift to road as demand recovers (New Development Bank, 2024).

The ambition is broader than asset health; it is to improve competitiveness and lower end-to-end logistics costs. Enabling credible modal shift should stimulate activity, strengthen trade competitiveness, and lower end-to-end logistics costs, while reducing congestion, road-

maintenance outlays, and emissions (New Development Bank, 2024). Although Transnet is wholly state-owned, the programme highlights the complementary role that PPPs, multilateral finance, and private capabilities can play in sequencing modernisation and embedding longer-term sustainability in the rail-logistics ecosystem (New Development Bank, 2024).

2.4.5 ENVIRONMENTAL SUSTAINABILITY (NORMATIVE-ANALYTICAL LENS)

The environmental lens asks how freight activity can operate within ecological limits while supporting a functioning economy. In transport, this centres on lowering greenhouse-gas emissions, minimising land take, and favouring modes that conserve natural resources (Chupin *et al.*, 2025). Road haulage is the most significant contributor to freight-related emissions; rail, measured per tonne-kilometre, is markedly less carbon-intensive, which makes it an attractive option for bulk and long-distance flows (Goodarzi *et al.*, 2024).

When looking at sustainability frameworks in logistics, there is a tendency to take a triple bottom-line approach. Instead of looking at a single metric of efficiency, options are evaluated based on environmentally, economically, and socially viable outcomes (Välilä, 2025). Consequently, intermodal systems are analysed based on their costs and service performance, but also on their ability to mitigate emissions and contribute to the improvement of urban air quality and road safety (Rodrigue, 2020). Resilience also falls in this category. Freight networks are expected to withstand long-run shocks, such as fuel price increases, climate change impacts, and trade disruptions, without suffering systemic failure (Potter *et al.* 2022). Considered in their totality, the perspectives provide not only a normative guidance but also a practical mechanism to assess the impact of freight reform on South Africa.

2.4.6 CONCLUSION: AN INTEGRATED ANALYTICAL LENS

These five perspectives provide a complete frame of reference to assess intermodal feasibility. Intermodal transport and modal shift deal with the questions of how different modes are combined and why different actors change their modes. Operational efficiency and transport cost economics answer the question of what is feasible from a practical standpoint. Institutions and PPPs provide the governance framework, and the environmental lens identifies the broader ecological and developmental goals.

This analysis considers more than just technical performance. Policies, economics, governance, and sustainability are all tied together into one evaluative framework, which provides a solid foundation for future empirical research.

2.5 HISTORICAL AND POLICY CONTEXT: RAIL VS. ROAD IN SOUTH AFRICA

To appreciate how South Africa's freight transport system developed, we need more than a superficial account; we need a detailed examination of historical patterns, institutional structures, and policy frameworks. The present imbalance between road and rail is no accident. It is the product of decades of strategic choices, deferred maintenance, policy misalignment, and broader socio-economic shifts. In what follows, the researcher traces the rail sector's deterioration and the concurrent rise of road-based logistics, before assessing the state's recent efforts to revitalise rail infrastructure. Together, these strands provide the context needed to judge the feasibility of an intermodal freight system.

2.5.1 THE LEGACY OF RAIL: INDUSTRIAL EXPANSION AND COLONIAL INFRASTRUCTURE

Railways underpinned South Africa's economic and spatial development. In the mid-nineteenth century, colonial administrators engineered a network that tied mineral-rich interiors to seaports, with extraction and export, gold, coal and diamonds foremost, set above domestic integration or regional trade (Bullock, 2009). By the early twentieth century, the country had assembled one of Africa's most extensive systems, fuelling urbanisation, industrial expansion and employment (Wragg, 2009). Road haulage now dominates many corridors; even so, rail remains a critical logistics instrument: it carries bulk flows efficiently and, where service regularity and density are present, is increasingly used for manufactured goods (Potter *et al.*, 2022; Havenga, 2012).

Throughout the apartheid era, rail infrastructure and services were firmly under state control, with the South African Transport Services (SATS) and, later, Transnet exercising monopoly authority. That model delivered coordination benefits on selected corridors and heavy-haul chains; it also entrenched bureaucratic rigidity, political interference, and weak responsiveness to market signals (Stander & Pienaar, 2002). By the democratic transition in 1994, assets were ageing, funding was constrained, and service unreliability had eroded freight-owner confidence, conditions poorly matched to a liberalising economy (South African Department of Transport, 2022; Stander & Pienaar, 2002).

From the mid-1990s, three reinforcing dynamics widened the road–rail gap. Institutional and funding constraints slowed rehabilitation and technology renewal beyond the core heavy-haul lines. Private road operators then expanded rapidly, exploiting flexibility, shorter lead times, and a proliferating depot network to win general-freight share. At the same time, many sectors

shifted to just-in-time, high-frequency replenishment, valuing predictability over pure line-haul economies, an environment in which inconsistent rail service quality struggled to compete (Stander & Pienaar, 2002). Rail did not become obsolete; rather, competitiveness became contingent on density, schedule adherence, and seamless terminal interfaces, the very levers targeted by intermodal design (Havenga *et al.*, 2012).

Recent policy acknowledges this path-dependence and seeks a governance reset. Open-access aspirations, heightened safety oversight, and clearer distinctions around infrastructure-operation separations are all articulated in the White Paper on National Rail Policy, 2022 (2022 South African Department of Transport), whereas the National Freight Logistics Roadmap 2023 (2023 South African Department of Transport) provides an action plan for corridor recovery and granting third-party access. From an intermodal perspective, these shifts create two fundamental conditions for a genuine modal shift. On one hand, the availability of rail services at competitive prices is essential, and on the other, there needs to be a robust policy on slot allocation and service provision at freight levels for real enforcement to take place. On the other hand, terminals must offer sufficient capacity and be run in ways that keep dwell times low, avoid unnecessary double-handling, and safeguard information flows between modes (Havenga *et al.*, 2012; Potter *et al.*, 2022).

The resulting imbalance between road and rail in South Africa is therefore not accidental, nor can it be attributed only to recent shocks. It stems from the cumulative effects of past design decisions, long periods of under-investment, and shipper strategies that have consistently prioritised flexibility over the cost advantages of efficient long-distance rail haulage. Understanding that history clarifies the feasibility conditions for an intermodal system: concentrate flows, guarantee schedule reliability, professionalise terminal operations, and align governance and incentives with performance. The subsequent sections evaluate those conditions empirically and assess where and under what operating and policy arrangements road–rail integration is realistically achievable in the South African context.

2.5.2 DEREGULATION AND THE RISE OF ROAD FREIGHT

The liberalisation of the South African economy in the late 1980s and early 1990s coincided with the deregulation of the freight transportation sector. This enabled private operators to compete unrestrictedly in the road freight industry, which had previously been stringently regulated by license and quota regimes. Deregulation aimed to enhance competition, lower costs, and elevate service quality; nonetheless, it additionally produced unforeseen with repercussions (Phaladi *et al.*, 2019a). Following the deregulation of South Africa's freight

transport industry, a prolonged policy and implementation vacuum, coupled with years of under-investment and uneven service performance in rail, has hindered the development of an integrated, market-credible rail–road model (Havenga *et al.*, 2014; Republic of South Africa & Ramaphosa, 2023; South African Department of Transport, 2022).

Regulatory barriers fell, and road freight moved quickly to the centre of cargo movement. Lower upfront capital, faster door-to-door delivery, and flexible routing made it attractive to shippers adjusting to a changing economy. Rail did not keep pace. Institutional inertia, slow technological uptake, and weak responsiveness to customer needs limited its competitiveness (Van der Mescht, 2006). The outcome was predictable: a marked shift from rail to road, most visible in containerised and time-sensitive flows.

The current pattern reflects that shift. Road now carries more than 63% of South Africa's freight volumes, a reversal of the mid-twentieth-century balance (Mordor Intelligence, 2024). This reweighting also permits more flexible and just-in-time logistics, which is commercially advantageous; however, the downsides are higher logistics costs, more rapid deterioration of road assets, and greater greenhouse gas emissions.

2.5.3 THE DETERIORATION OF RAIL INFRASTRUCTURE

The drop in rail freight is not only due to competition with road transport. It shows a more general and long-standing problem of underinvestment, management flaws, and institutional disarray. Over two decades, core assets have aged without timely renewal, rolling stock has become unreliable, critical equipment has been stolen or vandalised, and maintenance regimes have struggled to keep pace (George *et al.*, 2018; South African Department of Transport, 2022). Service quality follows asset condition. Instability and delay erode user confidence, and volumes migrate accordingly. In the past five years, more than a quarter of long-distance freight has shifted to road as infrastructure has deteriorated, with visible spillovers into faster road wear and recurring congestion. (Chakamera & Pisa, 2021; Republic of South Africa & Ramaphosa, 2023).

Market structure compounds these pressures. The monopoly model at Transnet Freight Rail has limited adaptation and innovation. Some reforms have been attempted, including branch-line concessions and narrowly framed private participation, yet coordination has been uneven and funding insufficient, so results remain thin (Boye *et al.*, 2023; Phaladi *et al.*, 2019b). The outcome is a network with strong corridors and weak peripheries. Significant sections are underutilised or idle, particularly beyond primary industrial routes where predictable access,

equipment availability, and terminal discipline are hardest to guarantee (Havenga *et al.*, 2012; South African Department of Transport, 2022).

On paper, the direction is clear. Rail transport is emphasised as the primary transport mode for passengers and freight, and along the strategic corridors, it enables scope increases, which lowers marginal costs and increases the economic growth of the country (South African Department of Transport, 2022; Stander & Pienaar, 2002). Where good rail networks, predictable schedules, and timetables are, rail transport is able to move large quantities of goods and sustain long-distance flows supportively and cost-effectively (Abioye *et al.* 2016, Havenga *et al.*, 2011). The current gap is there for operational reasons. Time and effort have not been commensurate with the expectations on a number of corridors where there are prospects for intermodal transport, and where frequent but unreliable services are provided.

Technology deepens these disparities. Mature operators in Europe and Asia implement predictive maintenance, automated scheduling, and real-time cargo visibility. In stark contrast, several operations in South Africa are still using legacy manual systems that hinder efficient movement, and opaque status information (Potter *et al.*, 2022). This creates a credibility gap in supply chains that demand flexibility and visibility. To bridge this gap, a foundational, strategic reinvestment in tracks, yards and rolling stock, traction and signalling assets, credible open-access frameworks, and visibility systems over nodes and modes (Havenga *et al.*, 2012; Republic of South Africa & Ramaphosa, 2023; South African Department of Transport, 2022). Where these elements align, the rail's long-haul advantage becomes usable in practice, and the system can begin to reclaim traffic from road on time, reliability, and total delivered cost.

2.5.4 POLICY RESPONSES AND NATIONAL RAIL REFORM EFFORTS

Government policy has moved more decisively on rail in recent years, acknowledging its strategic role in the logistics system. The National Rail Policy White Paper (2022) sets a long-term vision for a cost-efficient, reliable, and environmentally sustainable rail system by 2050, across both freight and passenger markets (South African Department of Transport, 2022). Core directions include widening private participation, tightening governance, prioritising investment in intermodal terminals, and aligning rail with a coherent national logistics strategy. The policy also signals open-access intentions and corridor-based planning, so that capacity, terminals, and service slots are planned as an integrated offering rather than as isolated assets (South African Department of Transport, 2022).

Implementation instruments sit alongside this vision. The 2023 Freight Logistics Roadmap targets structural limits in the system, with a focus on corridor optimisation, infrastructure security, and digital integration to stabilise operations and rebuild credibility (Republic of South Africa & Ramaphosa, 2023). The National Logistics Crisis Committee (NLCC) convenes Transnet, industry, and labour to coordinate these measures, aiming to unblock short-term constraints while crowding in investment for medium-term recovery (Phaladi *et al.*, 2019b; Republic of South Africa & Ramaphosa, 2023). In practice, priority actions emphasise yard discipline, terminal throughput, theft and vandalism prevention, and predictable access arrangements that allow rail and road services to connect cleanly at the node-mode interface (Notteboom & Rodrigue, 2008).

Policy attention to rail is also shaped by the external costs of roads. In Jorgensen's view (2004), South Africa's road network was exhibiting severe degradation trends, with rail having the potential to serve as a crucial congestion and pavement decay relief valve. That reasoning still holds. South Africa has recently adopted blended finance for tackling asset backlogs, and the New Development Bank has made a commitment of over R18 billion to the Freight Rail Sector Improvement Programme, signalling further intent and the required scale to start undoing decades of deterioration (Chakamera & Pisa, 2021; New Development Bank, 2024). The potential benefits are not abstract, but are instead practical. Secure corridors, capacitated terminals, and credible access arrangements should improve reliability, making it more rational for shippers to route distance-sensitive flows through intermodal services and, in the process, lower total delivered cost and associated externalities (Republic of South Africa & Ramaphosa, 2023; South African Department of Transport, 2022).

2.5.5 THE PERSISTENT DOMINANCE OF ROAD AND THE INTERMODAL GAP

Despite recent policy attention, road freight remains the dominant mode. This pattern reflects the long neglect of rail and the absence, in practice, of a cohesive intermodal plan that provides users with a predictable, end-to-end experience. South Africa still lacks fully integrated hubs that enable clean transfers between road and rail. Private logistics firms remain cautious about intermodal investment because operational risk feels high, access is uncertain, and incentives are thin (Havenga *et al.*, 2011; Phaladi *et al.*, 2019b; South African Department of Transport, 2022). The result is a steady-state equilibrium. It favours the short-term flexibility of the road and slows the build-out of corridor-based intermodal services.

Recent throughput trends highlight how rail has been exposed to competitive pressure and wider industrial change. Total freight volumes declined from 226 Mt in 2017/18 to 149.5 Mt in

2022/23, a contraction that aligns with the expansion of road haulage and a gradual loss of shipper confidence in the day-to-day reliability of rail services (Potter *et al.*, 2022; Republic of South Africa & Ramaphosa, 2023). The way road freight is structured competitively is therefore significant. Deregulation, low barriers to entry, and a large, privately owned asset base give road operators a speed and reach that rail struggles to match when its own services are uncertain. An intermodal strategy that aims to shift meaningful volumes cannot focus solely on price. It must also take seriously the market conditions and structural advantages that shape how road and rail compete on key corridors (Chakamera & Pisa, 2021; Potter *et al.*, 2022).

In practice, this points to investment in terminals and yards, clear and enforceable service standards, and coordination mechanisms that cut dwell and protect schedule integrity. Without these basics, modal shift is unlikely to scale, and intermodal integration will stall (Notteboom & Rodrigue, 2008; South African Department of Transport, 2022).

Intermodal transport is well established internationally; locally, progress is uneven. Standard containers helped align sea and land operations, yet regulatory and institutional misalignment, fragmented accountability, and patchy enforcement have slowed rail reform (Phaladi *et al.*, 2019b). Current measures focus on tightening the rail–road interface, and mutual gains are plausible if node performance and access arrangements stabilise (Beytell, 2012; South African Department of Transport, 2022). Taken together, these strands indicate that intermodal development in South Africa is more than a technical upgrade; it is a coordination task that relies on credible governance and consistent delivery along the main corridors. It is a socio-political project that depends on credible cross-sector coordination and consistent delivery along the main corridors (Havenga *et al.*, 2012; Republic of South Africa & Ramaphosa, 2023).

2.5.6 CONCLUSION

From the historical record and policies that have been pursued, it is clear that South Africa's current over-reliance on road freight is a product of design. It is the outcome of a sustained period of regulatory realignments, institutional silos, and patchy investments that culminated in the deterioration of rail in the freight system. The road gained operational flexibility, consolidation of capacity, and greater commercial dexterity, while rail was left to contend with old and ageing assets, governance challenges, and service delivery inconsistency. The outcome is a freight imbalance, with road predominating in the system and in key corridors where the rail could, in theory, be competitive.

Simultaneously, this context is also dynamic. The articulation of policies and the introduction of changes to operations early on suggest a renewed focus on stabilising the rail system, and on opening access and optimising performance at certain key ports and terminals. These efforts do not eliminate the legacy of past decisions, but they begin to shape the parameters within which the provision of intermodal services on primary corridors could be feasible. The historical and policy analysis, for this study, makes the constraints and the levers clear – any credible intermodal strategy is bound to this path dependence for its institutional capability, and it cannot ignore node-level reliability as a key factor towards any substantial shift from road to rail – intermodal services within a given framework.

2.6 GLOBAL PERSPECTIVES ON INTERMODAL TRANSPORT

Global trade has grown larger and more intricate, and logistics has followed suit. Intermodal freight is now a practical way to raise efficiency, build resilience, and reduce environmental harm, rather than a niche technical fix. In Europe, Asia, and North America, progress has come from long-horizon investment in terminals and rail links, backed by policies that integrate ports, inland nodes, and digital data flows. This section reviews leading international cases to show how structure (corridor planning and node design), institutions (clear accountability and pricing signals), and technology (port community systems and real-time coordination) work together in practice. The aim is straightforward: to distil the lessons most relevant to South Africa's context and convert them into actionable design cues for intermodal initiatives.

2.6.1 EUROPE: POLICY-DRIVEN MODAL SHIFT AND TERMINAL INTEGRATION

Europe's intermodal strength is the product of choices made over decades rather than a fortunate accident. The European Commission's 2011 Transport White Paper set measurable targets, shifting 30% of road freight over 300 km to rail or inland waterways by 2030, rising to 50% by 2050, and then paired those goals with money and governance (European, 2011). The Connecting Europe Facility (CEF) translates ambition into projects by co-financing cross-border links, terminal upgrades, and digital interfaces that enable modal shift (Cinea, 2025; European, 2022). Practically, that policy-and-finance spine empowers corridor managers and national authorities to eliminate bottlenecks, ensure uniformity in technical standards, and achieve interoperability without the abandonment of all step-wise approaches.

Germany shows what that looks like on the ground. Kombiverkehr's network ties a dense lattice of terminals to scheduled intermodal trains reaching more than 170 locations across Europe, with real-time slotting and operational coordination between logistics providers and

Deutsche Bahn (Buchholz, 2014). Targeted subsidy schemes lower the marginal cost gap with road, allowing rail–road services to compete on both price and reliability. Scale matters here: once volumes accumulate, timetable stability and asset utilisation reinforce one another, creating a durable ecosystem rather than isolated pilot services.

The Netherlands has pursued integration at the node-corridor interface. Tri-modal inland terminals (road–rail–barge) are planned as part of corridor operations, not as stand-alone assets, and a dedicated freight railway, the Betuweroute, links the Port of Rotterdam to Germany as a high-reliability spine for hinterland flows (Konings *et al.*, 2008). Dutch authorities emphasise two disciplines that travel well: long-horizon, freight-first planning (synchronising port expansions with inland capacity) and formal stakeholder alignment so that infrastructure owners, operators, and regulators address the same constraint simultaneously.

2.6.1.1 Implications for South Africa

Three cues recur across these cases: (i) set explicit modal-shift targets and fund the connective tissue (terminals, cross-border links, data systems); (ii) create scale through scheduled services and predictable incentives so rail can win repeatably on key corridors; and (iii) treat inland terminals and dedicated rail paths as an integrated design problem with ports, not an afterthought to roads. Together, these moves convert “intermodal” from an aspiration into a working operating model.

2.6.2 NORTH AMERICA: MARKET-DRIVEN INNOVATION AND SCALE ECONOMIES

Unlike Europe’s policy-led model, North American intermodalism, especially in the United States, has been shaped predominantly by markets and managerial autonomy. The pivotal reform was the Staggers Rail Act (1980), which loosened price controls, enabled confidential contracts, and allowed carriers to rationalise networks; the result was a sustained improvement in financial health and productivity, with real (inflation-adjusted) rates falling and service quality improving (Dennis, 2001; Federal Railroad, 2011; Office, 1990).

Growth in U.S. intermodality followed as railroads leveraged long, largely unobstructed freight corridors and introduced high-clearance routes for double-stack container trains. Doubling the stack has a significant impact on the cost curve because of increased train capacity and decreased fuel burn per unit and crew hour; these efficiencies have been documented by the Federal Railroad Administration and other studies (Federal Railroad, 2009; Lai, 2005).

By the late 2010s, rail intermodal had become a mainstay of U.S. logistics: official figures record a peak of about 14.5 million containers and trailers in 2018, moderating slightly thereafter (Association of American, 2018; Williams, 2021). Intermodal thus remains a large share of Class 1 business, underscoring the durability of the operating model (Association of American, 2018).

Scale and private investment underpin the system's resilience. Class 1 railroads, particularly BNSF and Union Pacific, have financed inland ports and automated handling equipment and digital gate systems that compress dwell and improve reliability at the truck-rail interface (Union Pacific, 2021, 2024). Illustratively, BNSF's Logistics Park Kansas City incorporates wide-span electric rail-mounted gantry cranes and an automated gate complex; Union Pacific's recent capital programmes add new intermodal ramps, autonomous wide-span cranes, and a growing network of "focus sites" to pull freight onto rail near production and consumption centres (Stroh, 2025; Union Pacific, 2021, 2024).

2.6.2.1 Implications for South Africa

Three mechanisms are transferable: managerial freedom paired with clear commercial signals (post-Staggers), network geometry that permits double-stack operations on priority corridors, and continuous private reinvestment in inland terminals and digital coordination. Where these conditions co-exist, rail wins repeatedly on long-haul lanes linking seaports and distribution regions, with trucking focused on first/last-mile agility (Association of American, 2018; Federal Railroad, 2009).

2.6.3 CHINA: STATE-LED EXPANSION AND THE BELT AND ROAD INITIATIVE

China's intermodal development has been steered from the centre and financed at scale, with logistics treated as state capacity rather than a purely commercial afterthought. Since 2013, the Belt and Road Initiative has tied inland production regions to coastal gateways and Eurasian markets through purpose-built rail links, intermodal logistics parks, and "smart" border processes (National *et al.*, 2015; State Council Information Office of the People's Republic of, 2023). State-owned rail operators work with port authorities and platform companies to deliver vertically integrated services, allowing timetables, terminal slots, and customs processes to be planned as a single system (State Council Information Office of the People's Republic of, 2023; Zhang *et al.*, 2018).

A distinctive feature is the inland “dry port” network. Large inland hubs connect cities to seaports via rail, road, and inland waterways, pulling containers off roads upstream of congested coastal nodes. Standardised ICT layers, data interchange, interoperable booking, and electronic customs compress dwell times at handover points and improve the reliability of cross-border services (Wang & Meng, 2019).

China’s governance model will not transplant wholesale into liberal market economies. Even so, it yields three transferable insights: long-horizon programme discipline (corridor and node capacity built together), a clear organising centre for intermodal decisions (so rail paths, terminal upgrades, and border processes move in step), and a digital backbone that makes multimodal coordination routine rather than heroic (Wang & Meng, 2019; Zhang *et al.*, 2018).

2.6.3.1 Implications for South Africa

Treat inland terminals and rail paths as the organising spine, not as accessories to road; align port upgrades with scheduled inland rail services; and invest in a shared data layer for bookings, slot allocation, and customs/inspection processes. These moves do not require China’s state structure, but they do require a single locus of accountability and a programme budget that binds nodes, corridors, and data into one design.

2.6.4 EASTERN EUROPE: TRANSITION ECONOMIES AND INTERMODAL REVITALISATION

Eastern Europe’s intermodal turn has been driven by hard rebuilding rather than rhetoric. After decades of central planning and deferred maintenance, Poland, Slovakia, and Hungary used EU accession and cohesion instruments to renew track and signalling, add or modernise inland terminals, and streamline cross-border operations along designated freight corridors. Programme documents and audits show that cohesion and CEF funding increasingly target terminals, rail–road interfaces and corridor pinch-points to enable modal shift (European, 2024a; European Court of Auditors, 2023).

Slovakia is instructive. Straddling Danube barge flows and the Baltic-Adriatic axis, it has invested in a lattice of intermodal terminals, planned with rail paths and customs capacity in mind, rather than bolted on afterwards. Recent assessments point to measurable performance gains linked to tighter digital integration across operators/authorities, more deliberate crowding-in of private operators, and corridor-level capacity planning (Klapita, 2024). These

moves have been reinforced by EU-cofinanced upgrades on strategic sections around Žilina and related nodes (European, 2024b).

Corridor governance has mattered too. The Baltic-Adriatic Rail Freight Corridor (RFC5), spanning Poland, Czechia, Slovakia, Austria, Slovenia, and Italy, offers harmonised international freight capacity, performance monitoring, and terminal linkage along a north-south spine (Rail Freight Corridor, 2025; Rete Ferroviaria, 2024). Its sister Orient/East-Med corridor (formerly RFC7) performs a similar role on the east-west axis across Central and South-East Europe (East-Med, 2024). Together, these frameworks make it easier for rail operators to book cross-border paths and for terminals to align their operating windows to corridor timetables, which reduces border-related dwell (East-Med, 2024; Rail Freight Corridor, 2025).

Poland and Hungary illustrate the same pattern at the project level. In Poland, national documentation highlights EU-cofinanced upgrades at key gateways such as Małaszewicze, a major rail–road interchange on the eastern frontier, to grow intermodal capacity and shift freight from road to rail (Adampol, 2025). In Hungary, recent programmes combine rail modernisation on freight-relevant routes (e.g., Szajol-Debrecen) with the rollout or expansion of intermodal hubs serving growing industrial zones around Debrecen (Association of Hungarian Logistic Service, 2023; Railway, 2022).

2.6.4.1 Implications for South Africa

Eastern Europe shows how previously fragile rail assets can be converted into a functioning intermodal platform when three conditions are met: long-horizon public investment targeted at the rail-terminal-border interface (rather than scattered projects), corridor governance that simplifies cross-border pathing and performance management, and a shared digital layer that shortens terminal and border dwell. Applied at home, this translates into synchronising port upgrades with inland terminal capacity, reserving reliable train paths for shuttle services on priority corridors, and wiring permitting/inspection processes into a single workflow so the system behaves like a network, not a patchwork (European Court of, 2023).

2.6.5 LESSONS FOR SOUTH AFRICA

For South Africa, the translation is clear. International experience shows that modal shift only sticks when five levers move together: a funded, time-bound policy spine; a single locus of coordination that trims institutional clutter; terminals planned as part of corridors and sited near

significant flows; a shared digital layer for bookings, slotting and customs that reduces dwell; and pricing or incentive signals that make rail competitive on priority lanes. The broader comparative evidence also warns against one-size-fits-all borrowing: the political economy, regulation, and endowment of infrastructure determine what will work and when. The essentials, coupled with sustained policy commitment, infrastructure integration, stakeholder alignment, and technological modernisation, inform a measurement of South Africa's readiness and the feasibility of these ideas. Given the systemic infrastructural deficits, the modal imbalance, and the environmental pressures, a reliably integrated road–rail platform has the capacity to reduce logistics costs, increase productivity, create employment, and support economic growth as long as the capacity is planned at the corridor level and is resilient and adaptable (Mafokosi *et al.*, 2024).

2.7 EMPIRICAL STUDIES ON BARRIERS AND FACILITATORS

In theory, intermodal transport should be a game changer for the current challenges with freight, but in reality, it is much more complicated to implement. Empirical evidence reveals that it doesn't come down to any single project or policy lever, but instead, the degree to which technology, finance, regulation, infrastructure, institutions, and user behaviour are harmonised. When aligned, intermodal systems can scale. When not, there is a tendency for initiatives to stall; political commitments to be superficial and for the rhetoric to be strong.

This section seeks to summarize the evidence on the above conditions. It synthesises findings on barriers and facilitators drawn from emerging markets, transitional economies, and closely related case studies, with an eye to financial viability and operational reliability. The aim is straightforward: to separate generalised claims from demonstrated mechanisms and to isolate the design choices that matter for South Africa's context.

2.7.1 INFRASTRUCTURE CONSTRAINTS AND TERMINAL GAPS

A recurrent finding in the empirical literature is that weak physical infrastructure, especially at the rail–road interface, undermines intermodal performance. Studies from Eastern Europe and Southeast Asia show that sparse high-capacity terminals, patchy rail coverage, and non-standard loading equipment interrupt handovers and erode rail's economics in the door-to-door chain (Hrušovský *et al.*, 2021; Klapita, 2024). In practice, terminal siting, yard, and network connectivity are decisive. When cranes, tracks, and gates are not configured for volume and velocity, costs climb and reliability slips.

Polish evidence is instructive. Kramarz *et al.* (2022) report that too few high-throughput terminals created structural bottlenecks, longer truck and wagon turnarounds, and under-utilised train paths, despite available mainline capacity. A parallel pattern appears in India, where the absence of integrated dry ports near industrial clusters muted the gains from new dedicated freight routes (Varese, 2020).

These lessons translate directly to South Africa. Deferred rail maintenance, limited handling equipment at key nodes, and a shortage of integrated logistics parks impose hard physical barriers to intermodal feasibility. The result is higher dwell and diluted advantages from longer-haul rail operations (Boye *et al.*, 2023; George, 2018). Closing the gap requires treating terminals as part of corridor design, co-locating capacity with major flows, standardising equipment for rapid transfer, and ensuring reliable rail paths, rather than adding small, isolated facilities.

What ultimately caps performance is not mileage but the interface. If axle loads are low, loops are short, and the loading gauge is tight, signalling rules will force shorter, slower trains (Bouraima *et al.*, 2023). Add South Africa's maintenance backlog, and you get temporary speed limits and more failures, delays that show up at the terminal gate as missed paths, and extra dwell (Mafokosi *et al.*, 2024). The latest recovery material says the same thing: renewals and day-to-day upkeep are underfunded, so the first order of business is to rebuild reliable paths for scheduled shuttles (New Development Bank, 2024). Without that geometry and condition, location alone will not deliver a stable intermodal service.

Terminal productivity and landside access determine whether the economics scale. Reviews of emerging-economy cases link higher throughput to ISO-compatible handling (RTGs/RMGs), electronic gates, and digitally scheduled slots that compress lift-to-wheels time and truck turnarounds (Pisa, 2021). South African policy recognises this interface: the White Paper on National Rail Policy calls for integrated terminal planning, dry-port development, and improved rail access to seaports to reduce dwell and unlock port-hinterland capacity (South African Department of Transport, 2022). Local case work points the same way. Decarbonisation and cost outcomes improve when terminal upgrades, corridor pathing, and operating rules move together (Havenga *et al.*, 2014). The practical message is unambiguous: design terminals as part of corridor operations, invest in the digital and mechanical kit that cuts dwell, and reserve reliable rail paths so those investments pay (Dibakoane, 2013; Mtebele, 2023; Mukwena, 2018).

2.7.2 OPERATIONAL INEFFICIENCIES AND SCHEDULING MISALIGNMENT

Operational inefficiencies remain a persistent brake on intermodal uptake. Reliability, transshipment time, and dwell time largely determine whether an intermodal chain is competitive or not (Govender & Mbhele, 2014; Notteboom & Rodrigue, 2008). When handovers are missed, trains arrive out of step with truck collection windows, or manual inspections prolong dwell, any notional cost advantage of the rail leg is quickly eroded (Govender & Mbhele, 2014; Notteboom & Rodrigue, 2008).

In emerging markets, however, these frictions can be far worse. Digital coordination is virtually nonexistent, and information is often delayed or absent altogether. There may be a lack of suitable wagons, which may be in the wrong locations, or service spacing may be inconsistent, leading to unreliable service deliveries across transport segments. When there are no predictive schedules or reservations for yard gates and cranes, the queues for blockages increase and the risk of misrouting the whole sequence also increases (Goodarzi *et al.* 2024). Data opacity magnifies these challenges further; there is no reliable or real-time visibility on the status of wagons across operators, which weakens their planning and cascades unreliability through the supply chain (Mathabatha 2015).

International practice suggests that a credible route out of this pattern is to design operations around dependable rhythm and shared data. Rail services work better when they run as regular shuttles on reserved paths, with fixed handover windows that customers and operators can plan around. Truck slots and crane rosters are scheduled against this timetable so that dwell is minimised upfront, rather than controlled reactively once queues have already formed (Havenga *et al.*, 2014; Pisa, 2021). Interoperable information platforms, such as port community systems with open APIs for wagon status, slot bookings, and release notifications, allow all parties to work from the same live data instead of relying on fragmented phone and email updates (Goedhals-Gerber *et al.*, 2018; Mtebele, 2023; South African Department of Transport, 2022).

The implication is clear. Where information systems are fragmented and logistics platforms are not integrated, intermodal services struggle to scale and to remain profitable. Where timetabled shuttles, shared data environments, and aligned contractual incentives are in place, the conditions for reliable, repeat intermodal business begin to emerge.

2.7.3 FINANCIAL BARRIERS AND CAPITAL REQUIREMENTS

Intermodal systems are capital-hungry. Track upgrades, terminal construction, and specialised handling equipment require large upfront outlays, while the returns arrive slowly and depend on coordinated operations across multiple actors. In many developing economies, the state's fiscal headroom is limited and private investors are cautious, especially where political or institutional instability raises perceived risk and stretches hurdle rates (Monios & Bergqvist, 2017). Evidence from Turkey shows that, even with a supportive regulatory stance on modal shift, constrained access to finance can inhibit logistics firms from building intermodal capability (Kurtuluş & Çetin, 2020). The South African picture is consistent: Transnet's recent operating losses and ratings pressure have curtailed capital available for network renewal and terminal modernisation, delaying recovery of dependable rail paths (Boye *et al.*, 2023).

Cost structure compounds the financing problem. Intermodal networks carry high fixed costs and long payback periods; they rely on steady volumes to amortise sunk investment. As a result, they struggle to compete on short hauls or thin flows, where roads' low entry barriers and flexible deployment dominate (Lafourcade & Thisse, 2011). Without durable subsidies or long-term financing arrangements that match asset lives, rail-centred intermodal propositions tend to lose out to road on capital cost and liquidity grounds.

South Africa should prioritise a small set of freight corridors (port-hinterland, bulk-agri) and provide multi-year funding to avoid stop-start delivery. Deploy blended finance to share upfront costs and stabilise revenues via availability-based PPPs, take-or-pay contracts with anchor customers, and transparent access-charge regimes. The solution is to provide time-sensitive incentives through equipment gifts, minimal operational assistance, shuttle service, and carbon-related rebates to eliminate uncertainties during the beginning years. In conclusion, prioritise these devices along with operational instruments, dependable train routes, specific terminal improvements, and electronic scheduling, so the viability and bankability improve, and feasible intermodal systems arise sooner.

2.7.4 REGULATORY FRAGMENTATION AND POLICY UNCERTAINTY

Disruptions to logistics intermodality are often a consequence of institutional friction and conflicting policy scopes. In Southeast Asia, cross-country studies indicate that inconsistent cross-country licensing, overlapping agency domains, and inconsistent enforcement are major barriers to the standardisation of intermodal processes and the efficient processing of transactions (Wang & Meng, 2019). South Africa shares the same issues in the absence of

transport logistics integration. Regulatory silos, missing policy frameworks, and policy gaps. (Phaladi *et al.*, 2019b). Thus, stalled are the designed initiatives to stimulate the growth of the rail and establish public–private partnerships, decaying from bureaucratic exhaustion and inter-agency competition. The broader governance literature is unequivocal: Potential modal integration is a function of institutional integration, especially in the domains of regulation, enforcement, data transfer, and control (Scott, 2014).

This is especially the case for South Africa. There are no alternatives to the intermodal strategy. To succeed, it must have a clearly defined owner and established parameters. This translates to a corridor programme office with the ability to design schedules, assign resources, make trade-off decisions, settle trade-offs, plain-English MoUs, and service-level agreements that clearly define the regulator, operator, payer, and data to be shared and the timelines for data sharing; a single compliance and safety enforcement framework so that licenses, safety, and access fees to the rail and road and terminals align. Where responsibilities are still spread, append a basic RACI to every corridor deliverable and use a minimum data standard for port community and terminal systems. None of this takes care of the political dimensions but it does reduce the discretion, slow down collaboration, and make the political trade-offs easier to see, all of which make the case for intermodal reforms.

2.7.5 INDUSTRY RESISTANCE AND MARKET LOCK-IN

Part of this resistance to intermodal uptake is due to truck road haulage competitors. There is much of this resistance due to slightly hidden factors due to incumbent road haulage players. Companies with large sunk investments in distribution networks and trucks perceive rail linked initiatives to severely threaten their operational model and asset base (Behrends, 2011). Road carriers have largely deregulated and hold influential power over logistics decisions, and have been characterised as highway lords, as their dominant power over large swathes of road networks allow for considerable lobbying power with respect to access, price & schedule, and other and protective parameters for corridor access, and thus serious intermodal trials is blocked (Behrends, 2011). Evidence from Latin America and parts of Africa adds a political-economy layer. Patronage networks and the scale of informal road activity help to keep trucking dominant. When governments or operators try to expand intermodal options, they face resistance through formal channels, such as legislative delay and procedural obstruction, and through informal tactics, including aggressive price undercutting and selective control of routes (González-Benito, 2010).

A pragmatic response is to link intermodal roll-out to transition measures that change incentives without abruptly cutting off existing livelihoods. In practice, this involves several linked measures. Corridor pilots are phased with transparent access charges and non-discriminatory slot allocation. Enforcement is tightened on key road externalities, such as overloading and safety violations, so that cost comparisons with rail reflect their full costs. Time-bound support is also offered to draw incumbents into the new system. Practical instruments include rebates for hauliers that feed rail–road shuttles, preferential gate slots for truckers serving timetabled trains, and buy-back or scrappage schemes for the most polluting vehicles, paired with retraining vouchers for drivers and dispatchers (Department for, 2023; Federal Office for & Border, 2024). Transparent service-level contracts on pilot corridors (turn-time and on-time thresholds with gain-share/penalties) can shift competition toward reliability rather than regulatory leverage. Finally, structured social dialogue with road-freight associations and unions, under a just-transition plan with clear milestones, metrics, and review points, reduces political friction and makes policy reversals less likely, while creating room for incumbents to invest in rail-compatible services instead of defending legacy positions (Behrends, 2011; González-Benito, 2010).

2.7.6 KEY ENABLERS: TECHNOLOGICAL INNOVATION AND DIGITAL LOGISTICS

Digital capability is now a primary lever for intermodal performance. Platforms that share operational data in real time, intelligent monitoring of cargo and assets, and automation at the terminal interface consistently correlate with fewer disruptions and tighter schedules. In a study of the Le Havre-Paris corridor, El Yaagoubi *et al.* (2022) show that introducing real-time simulation to support day-of-operations decisions improves coordination between trains, trucks, and terminal equipment, shortens recovery from incidents, and strengthens the competitive position of rail in the door-to-door chain (El Yaagoubi *et al.*, 2022).

Technologies already proven at scale, GPS/telematics for rolling stock and trucks, RFID/IoT tagging for units, and optimisation algorithms for routing and slotting, have reshaped planning in Germany, China, and the United States (Pisa, 2021). Their value is practical rather than abstract: they reduce uncertainty, tighten timetables, and make status information visible to all parties, which in turn supports reliable service commitments (Rodrigue, 2020). The cumulative effect is higher asset utilisation and lower dwell at the rail–road interface.

South Africa’s comparatively low digital maturity in the public logistics sphere is therefore both a constraint and a tractable opportunity. Even targeted steps, port community system integration with rail operator data, electronic gate appointments at intermodal terminals, live

wagon/consist status, and API-based release notes, can deliver outsized gains in planning accuracy and stakeholder confidence. The near-term priority is to build a common information backbone and basic predictive tools (for timetabling and slot reservation), then layer automation where volumes justify it.

2.7.7 COLLABORATIVE GOVERNANCE AND PUBLIC-PRIVATE PARTNERSHIPS

Multiple Intermodal systems scale when governance and delivery are collaborative by design. Rather than treating ports, rail, roads, and terminals as separate silos, effective programmes create shared rules, joint assets, and corridor-level coordination. Europe's experience is instructive: the Marco Polo/TEN-T policy family provides common frameworks for cross-border planning, cost-sharing, and performance management, turning individual projects into network effects (European, 2011; Konings *et al.*, 2008). Corridor governance has this approach deepened, with Rail Freight Corridors formalising the integration of timetable coordination, cross-country blockade and terminal capacity allocation, making managed cross-border rail a service, not just an aspiration (European Court of, 2023; Rail Freight Corridor, 2025).

The USA is an example which has managed to apply this governance thinking to functioning large hubs, in partnerships with railroads, ports and shippers. With mega-terminal complexes and integrated inland logistics zones designed around scheduled rail service provision and high capacity truck service gates, regional flows and service quality have been anchored and service quality stabilised (Hdr). The underlying unifying element is not one but a cooperative network, involving a clear distribution of roles, collaborative data usage, and binding contracts.

In transitional economies, partnerships between the public and private sectors provide the public balance sheet with one of the key financing components – credibility and capital. Slovakia and Hungary demonstrate that intermodal hubs thrive with transparent procurement and collaboration between actors of different of different sectors and performance-based contracts that reward standby availability and reliability, as opposed to traditional financing based on inputs (Klapita, 2024; Railway, 2022). The presence of these elements is associated with an increase in terminal availability and more public overtaking of the private sector in operational capacities, inversion to the case where projects are dislocated and throughput is underperformed.

2.7.7.1 Implications for South Africa

In this case, the lesson is simple, and it is that finance alone without tangible results is not enough. For the full intermodal benefit to be realised, there needs to be corridor-level institutional frameworks that can allocate rail paths, coordinate terminal time windows, and publish terminal access rules; contractual joint ventures or concession agreements that tie terminal profitability to service level agreements; and a federated data architecture so that partners can plan off a single picture. South Africa's existing policy direction provides the hinge, using the National Rail Policy to mandate corridor governance, standardise access and data requirements, and then deploy PPPs where they add capacity and discipline (European, 2011; South African Department of Transport, 2022).

2.7.8 PRELIMINARY BARRIERS AND FACILITATORS

A review of the literature indicates the following facilitators and barriers that shape intermodal feasibility in South Africa.

2.7.8.1 Facilitators

1. **Policy and financing instruments.** Targeted incentives, enabling legislation, and well-structured PPPs can de-risk early operations and crowd in private capital (Pisa, 2021).
2. **Economic case.** Lower end-to-end logistics costs, improved supply-chain performance, and enhanced competitiveness are achievable on prioritised corridors when rail–road integration is reliable (Havenga *et al.*, 2011).
3. **Cross-actor coordination.** Formal collaboration between government, operators, logistics firms, and trade bodies strengthens implementation and reduces policy drift (President Cyril Ramaphosa, 2024).
4. **Sustainability drivers.** National and international climate commitments and green logistics programmes create durable incentives for a road-to-rail shift (Department of Forestry, 2022).
5. **Sectoral readiness.** Manufacturing, mining, and agriculture can realise material gains where demand density supports scheduled intermodal services and firms are organisationally prepared (Colicchia *et al.*, 2017).

2.7.8.2 Barriers

1. **Infrastructure constraints.** Track condition, ageing rolling stock, and a shortage of modern intermodal terminals undermine integration and punctuality (George *et al.*, 2018).
2. **Capital limitations.** High upfront costs for fleet renewal, hubs, and corridor upgrades, combined with long payback periods, deter investment (Boye *et al.*, 2023).
3. **Regulatory friction.** Complex rules and uneven enforcement weaken confidence in reform and slow project delivery (Phaladi *et al.*, 2019b).
4. **Incumbent resistance.** Entrenched road-freight interests can oppose or undercut intermodal initiatives, shaping market rules and day-to-day operations (Jorgensen, 2004).
5. **Operational/technical gaps.** Inefficient handling, non-standard equipment, and weak interoperability between rail and road depress throughput and reliability (Kramarz *et al.*, 2022).

2.7.8.3 Use in methods

This list will seed the interview schedules: each item can be converted into prompts on mechanisms (“how/why”), boundary conditions (“where it applies”), and indicators (e.g., dwell, on-time, track condition, enforcement actions, incentive uptake). When the evidence is aggregated, it shows that the issue of implementing intermodal freight is not one of potential benefits, but rather one of optimising the right conditions for implementation. Once the conditions to integrate multiple modes of freight transport are favorable, the benefits are well documented. However, the conditions of the integrated transport system must include, but are not limited to, adequate and appropriate infrastructure, sufficient and securitised financing, reliable regulations, cooperation of multiple state actors, and contemporary digital systems. Interacting with many of the elements of emerging economies, including South Africa, the conditions necessary for the implementation are weak, and so are the results. Terminals have limited access; the operations of the terminals are unreliable; there is a significant financial risk that is not managed; and there is a lack of governance. In contrast, the cases that manage to make intermodal work from the wide range of possibilities available, also demonstrate that there is considerable digital infrastructure and strong public-private institutional relations with consistent and clear policy framework. As a whole, this indicates the thin definition of what readiness needs to entail in practice. This is also the basis of structuring the stakeholder interviews for this study and the basis of the empirical findings in the following chapters.

2.8 METHODOLOGICAL TRENDS IN THE LITERATURE

Intermodal transport studies have taken several methodological paths due to the complexities of corridor-level coordination. Three of these streams are primary. In the meso and macro levels, there are econometric studies that try to estimate costs, demand, and the effects of policies using, mostly, gravity equations or panel models that retrieve elasticities and counterfactuals (Chakamera & Pisa, 2021; Havenga *et al.*, 2011). Another uses simulation and optimisation, from geospatial network design to terminal-throughput analytics, to determine service configurations under physical and operational constraints (Notteboom & Rodrigue, 2008; Rodrigue, 2020). The third, purely qualitative, relies on the stakeholder's judgment and includes institutional logics, implementation frictions, multilingual case studies, and thematic analysis to retrieve context and meaning (Braun & Clarke, 2019; Creswell & Creswell, 2018).

Such pieces of work, however, do not always rely on the same methodological steps and approaches. In this case, the authors have varying methodological approaches and different streams of data to geospatial network data, performance dashboards, and administrative records, and their use of gravity and input-output models, which include dynamic programming or thematic triaging to design the framework for the interventions (Notteboom & Rodrigue, 2008; Rodrigue, 2020). Each approach carries strengths and limits. Quantitative models are well-suited to system-level efficiency questions and to testing policy levers *ex ante*, yet they can under-specify organisational behaviour and the credibility of governance arrangements. Qualitative designs expose feasibility conditions, adoption thresholds, and social licence, but they depend on transparent procedures and analytic rigour to support trustworthy claims (Braun & Clarke, 2019; Creswell & Creswell, 2018).

Given South Africa's corridor realities, a gap is visible. Perception-led, qualitative work remains under-represented relative to cost and optimisation studies, even though feasibility here is mediated as much by institutional reliability, terminal discipline, and access regimes as by tariffs on paper (Havenga *et al.*, 2011; Potter *et al.*, 2022; Rodrigue, 2020). This study responds to that gap by centring stakeholder perspectives and by treating governance and day-to-day operating practice as core explanatory variables alongside price and distance.

2.8.1 QUANTITATIVE MODELLING AND SIMULATION STUDIES

A substantial strand of intermodal freight scholarship is quantitatively led, notably through simulation modelling, linear/Integer programming, and multi-criteria decision analysis (MCDA).

These approaches are deployed to optimise routing, evaluate terminal performance, and estimate modal-shift impacts across policy scenarios and investment cases (Alvarez *et al.*, 2021).

Within this tradition, El Yaagoubi *et al.* (2022) develop a simulation of a French rail corridor (Le Havre-Paris) to test cost-efficiency, service dependability and last-mile arrangements (El Yaagoubi *et al.*, 2022). In comparison, Goodarzi *et al.* (2024) propose a stochastic resilience model that explores disruption-response through consolidation tactics and redundancy (Goodarzi *et al.*, 2024). Collectively, such studies offer mathematical precision and policy salience, especially for ex-ante appraisal and infrastructure prioritisation.

However, the constraints of these model-driven approaches are revealing for the present study. They frequently rest on simplified or static assumptions about network conditions, tend to overlook the adaptive behaviour of organisations and stakeholders, and seldom account for the institutional reliability and governance tensions that determine whether intermodal systems actually function in practice (Monios & Bergqvist, 2017). They also presuppose rich, reliable datasets, resources that are uneven in emerging economies such as South Africa, constraining calibration and external validity at the corridor level (Havenga *et al.*, 2011). These constraints justify a complementary qualitative, interpretivist lens in this dissertation to elicit stakeholder judgements about the conditions under which intermodal services become adoptable and credible in practice.

2.8.2 ECONOMETRIC AND STATISTICAL ANALYSES

Econometric methods are widely used to quantify links between freight rates, infrastructure investment, and modal-shift propensities, drawing on flow datasets, fuel-price series, tariff schedules, and emissions accounts to estimate elasticities and policy effects (Rodrigue, 2020).

Representative applications include Givoni and Banister's (2006) comparative statistical analysis of rail-road cost structures and modal competitiveness in Europe; Lafourcade and Thisse's (2011) use of transport-cost theory to examine the spatial distribution of freight investment and its links to economic development; and Chakamera and Pisa's (2021) macro-econometric investigation of logistics performance and GDP growth in South Africa.

While these approaches generate valuable macro-level insight and are valuable for policy planning and investment appraisal, they can be blunt at the corridor level. Econometric

designs seldom capture localised constraints, terminal layout and handling discipline, institutional resistance, or sectoral perceptions, which are often decisive for intermodal adoption in fragmented or transitional systems. The result is an evidence base that explains aggregate trends well but leaves important feasibility conditions underspecified in practice.

2.8.3 GIS AND NETWORK-BASED ANALYSES

A growing body of work applies Geographic Information Systems (GIS) and network-optimisation techniques to interrogate the spatial form, accessibility, and operational efficacy of intermodal corridors and terminals. In practice, GIS layers origin-destination matrices, infrastructure attributes, and service schedules to compute accessibility indices, identify shortest (or reliable) paths, and delineate terminal service areas; network metrics such as centrality and impedance help reveal bottlenecks and weak node-link interfaces (Rodrigue, 2020). These tools produce decision-ready visualisations of freight flows, pressure points, and modal junctions, making them particularly valuable for corridor planning and prioritising infrastructure upgrades.

Wang and Meng (2019) use GIS to assess China's dry-port development strategy, isolating spatial gaps in rail-port linkage. In Europe, Konings *et al.* (2008) use GIS to perform a tri-modal terminal integration and alignment along the Rhine-Alpine axis to identify the interface investment opportunities that would result in net benefits to the network.

Though spatial analytics provide excellent prognostic capability, they tend to underestimate the institutional, behavioural, and political factors. They are therefore best done in conjunction with the policy analysis or qualitative approach that considers the governance credibility, operational discipline, stakeholder risk perceptions that ultimately determine whether the solutions that are mapped can be actualised (Monios & Bergqvist, 2017).

From the managerial perspective, econometric findings and network diagnostics can be directly converted to business tactics. Elasticities and cost estimations can be used to determine the tariffs, frequency, and capacity to be set; scenarios can be used to direct the terminal to be sited, phased, and the concession to be made; and risk-adjusted reliability to be used in terms of contracts and KPIs. In short, models set lanes and capital mix, while qualitative evidence tests adoption and governance (Havenga *et al.*, 2011; Rodrigue, 2020).

2.8.4 CASE STUDIES AND MIXED METHODS APPROACHES

Case study work has become a credible way to make sense of intermodal freight where it actually operates, within specific corridors and terminals. By following decisions as they are made and tracing how they play out, case studies surface the interaction between governance design, commercial incentives, and policy delivery. They lean on triangulated evidence, policy files, operational records, and interviews with those who run and use the system, and, in doing so, show why apparently similar reforms succeed in one place and stall in another (Flyvbjerg, 2006; Yin, 2018). This is the thread in Monios and Bergqvist's comparative analysis of Sweden and Scotland, where regulatory architecture and local governance shape the trajectory of modal shift; Klapita's recent Slovak study adds a complementary view by pairing terminal performance metrics with interviews from management to reveal on-the-ground constraints and levers (Klapita, 2024; Monios & Bergqvist, 2017).

A smaller but valuable stream blends methods. Traffic and reliability studies often combine data from interviews or surveys with stakeholders to present an outcome and perception picture (Creswell & Clark, 2017; Greene, 2007). In intermodal planning, this integration helps translate model outputs into choices about siting, frequency, and capacity that organisations can actually implement (Caris *et al.*, 2008; Rodrigue, 2020). Yet the literature still offers few fully integrated mixed-methods studies in African or lower-income contexts, which means feasibility, social licence, and operating discipline remain under-examined where they arguably matter most.

2.8.5 UNDERREPRESENTATION OF QUALITATIVE, STAKEHOLDER-BASED RESEARCH

There remains a clear gap in the literature: few studies foreground stakeholders' views, especially in developing-country settings. The technical and economic foundations of intermodal systems are well covered, yet far less attention is paid to the lived experiences and strategic judgements of industry practitioners, corridor planners, and policymakers. The impact of qualitative data, in this case, sheds light on why this exclusion is an issue. According to Behrends (2011), the decision to shift to a different mode of transport is influenced more by the organisation's culture, familiarity with the system, and the level of risk involved than by the costs involved. Freight managers' price-related scepticism towards rail services in South Africa (Govender & Mbhele, 2014) is the result of service unreliability and poor inter-agency collaboration that constitutes price. It is this wide range of studies that illustrates the behavioural and institutional factors which often determine the success of intermodal

initiatives. These factors should be considered in emerging economies with poor infrastructure and inconsistent governance (Behrends, 2011; Govender & Mbhele, 2014).

2.8.6 REGIONAL IMBALANCES IN THE LITERATURE

The intermodal literature is still mostly focused on high-income regions of the world. These regions include Western Europe, North America, and East Asia. This obsession with the three regions influences and leads to the wrong foundations and assumptions for the most cited policy prescriptions, institutional blueprints, and data architectures that do not transpose to lower-income situations with different market structures, risk profiles, and state capacities. What is presented as “best practice” is, in most instances, an outcome of a Northern experience and not that of a truly universal one (Notteboom & Rodrigue, 2008; Rodrigue, 2020).

While Sub-Saharan Africa has a substantial reliance on long-distance freight corridors, urbanising trade nodes, and chronic infrastructure stress, it still remains the most underresearched of the regions. Where it has been studied, it has been of a narrow and exploratory nature, such as the East African dry ports (Karanja *et al.* 2018), or some of the revived railway projects in South Africa (George *et al.* 2018). While these are great contributions, they still do not address the greater regional context and the varying corridor conditions.

These geographical biases have two main consequences. First, external validity is limited when we are able to take findings from integrated systems and try to apply them to scenarios where there is terminal density, operational discipline, corridor security, and institutional alignment that is fundamentally different (Chakamera and Pisa, 2021; Havenga *et al.*, 2011). Second, the evidence available to African policymakers suffers from the greatest gaps in areas where the fiscal, operational, and governance constraints are the tightest. The mainstream literature often brackets out these constraints, but they are central to the feasibility questions at hand for the region (Phaladi *et al.* 2019b).

In light of the above, the present study self-identifies as a context-sensitive contribution. Specifically, the study focuses on South Africa and on the corridor environment and practitioner experience from rail, road, terminal, and policy actors. The study looks to construct a contextual understanding of the conditions under which intermodal solutions can realistically be achieved. The study helps to close the region’s literature gap. It also measures advanced global models against a system that is contending with asset decay, institutional reform, and

the applied challenges of node-mode integration (Chakamera and Pisa, 2021; George *et al.*, 2018; Karanja *et al.*, 2018).

2.8.7 TREND OVERVIEW

Intermodal freight scholarship continues to suffer from methodological unevenness. Quantitative approaches such as network modelling, cost-benefit analyses, and macro-logistic studies have been very useful in estimating cost, performance, and system configuration (Havenga *et al.*, 2011; Notteboom & Rodrigue, 2008; Rodrigue, 2020). However, such approaches tend to underaccount for the institutional, behavioural, and perceptual elements that shape the focus of adoption in practice. In developing-country contexts, this blind spot becomes especially problematic. Implementation often pivots on organisational trust, operating discipline, regulatory clarity, and perceived risk, and not on modelled efficiency (Chakamera & Pisa, 2021; Potter *et al.*, 2022).

The evidence base is also geographically constrained. Projections from developed, capital-rich system findings are often extended to developing, infrastructure-poor contexts. The prescription and feasibility mismatch is especially critical when terminal and corridor access, and service reliability are major constraints, as is the case in South Africa (George, 2018; Phaladi *et al.*, 2019b). In one sentence, there is a lack of understanding of the contexts where intermodal transport developed in the presence of fragile assets and volatile governance.

This study uses a qualitative, stakeholder-centred design to address both context and methodological gaps. Decision makers' trade-off considerations around intermodal time, reliability, governance risk, and decision path dependency were revealed by semi-structured interviews across rail, road, and terminals, as well as policy. The approach amplifies the repertoire of intermodal reforms from simulation and macro-metrics to a more granular context in South Africa. The analysis employed in this study follows the integrity of qualitative analysis to enhance trust and transparency (Braun & Clarke, 2019; Creswell & Creswell, 2018; Yin, 2018).

2.9 IDENTIFIED GAPS IN THE LITERATURE

Intermodal freight research is well established within high-income settings, and what is deemed as "best practice" typically relies on dense terminal networks, reliable slotting, interoperable data, and a stable operating discipline. These conditions seldom hold in South Africa. The result is a transferability problem: models and prescriptions developed for

integrated, capital-abundant systems are exported to transitional, corridor-dependent settings without sufficient attention to institutional capacity, risk premia, or the lived realities of operators.

Methodologically, the field remains dominated by simulations and macro-metrics that quantify costs and capacity but underplay how stakeholders perceive risk, build trust, and learn new systems. This leaves thin evidence on the node-mode interface, terminals, yard rules, appointment systems, and gate discipline, and on how corridor security and insurability shape feasibility. Likewise, firm-level adoption is often reduced to tariff comparisons, overlooking time-reliability risk, handling penalties, coordination costs, and sectoral differences between, for example, retail replenishment and bulk flows.

Finally, governance and market design are under-specified. There is limited empirical evidence on how access regimes, concession models, performance contracts, and data transparency work in practice, or on the sequencing needed to crowd-in private capital and allocate end-to-end accountability. This study responds by foregrounding practitioner perspectives in South Africa's corridor environment, generating context-attentive insights that complement quantitative models and speak directly to the policy-practice gap.

2.9.1 LIMITED CONTEXT-SPECIFIC RESEARCH IN EMERGING ECONOMIES

Much of the intermodal literature still clusters around high-income regions, North America, Western Europe, and East Asia, where systems operate at scale under relatively stable political and institutional conditions (Klapita, 2024; Rodrigue, 2020). Consequently, many off-the-shelf frameworks are built on preconditions, dense terminal footprints, predictable slotting, interoperable data, and disciplined operations, which seldom obtain in infrastructure-strained, institutionally fragmented contexts such as South Africa.

Where African cases are included, treatment is often thin: brief statistical overviews or isolated case studies with limited methodological depth and little attention to everyday implementation. This leaves the structural, political, and socio-economic constraints to intermodal integration, governance churn, corridor security, terminal scarcity, and uneven operating discipline as the predominant under-researched areas.

As a result, these models tend to underperform in any given context outside the scope for which they have been built. Models meant for capital-abundant contexts are transported to corridor-dominant contexts with minimal tailoring for higher risk premia, lower-tier

administrative capability, or varying market configurations. Thus, their usefulness to African policymakers is minimal. The present study is different, as it is grounded in the corridor context of South Africa, invoking the judgment of practitioners, in such a way that the analysis identifies attainable routings, rather than rehashing the same recommendations as the rest of the world (Klapita, 2024; Rodrigue, 2020).

2.9.2 UNDER-THEORISATION OF INSTITUTIONAL AND GOVERNANCE BARRIERS

In intermodal mobility studies, the reference to institutional theory is common, but the use of the theory as fully as it ought to be is rare. Policy, governance, and regulation are viewed as static arrangements with no attention given to them as a dynamic, contestable order that ultimately structures the pathways through which reforms are introduced and/or sustained (Scott, 2014). In multi-agency systems such as South Africa's transport sector, the institutional architecture, the overlapping of roles, the gaps in accountability, and the disparate performance theories become primary determinants of whether ambitions for a shift in the transport modalities are successfully delivered.

There is empirical evidence pertaining to this friction. South Africa has suffered from fragmented mandates, uneven implementation, and weak intergovernmental coordination, which have consistently undermined rail revitalisation (George, 2018; Phaladi *et al.*, 2019b). The literature, however, has yet to delve into the pathways of causation related to the intersection of institutional interconnectedness, political determination, and administrative culture concerning intermodal feasibility. There are imbalances in the distribution of incentive structures, rights to information, and authority to make decisions across different agencies and along corridors, which affect the thresholds of adoption, operational discipline, and the trust of users, yet these interconnections are not represented.

Public-private partnerships encounter the same problem. They tend to be assessed narrowly through the financial lens as opposed to governance mechanisms that reset accountability, retarget risk, and institutionalise operational parameters. They deserve more attention that examines the ways in which specific design features, such as access regimes, concession contracts, performance bonds, and data-sharing mandates, either enable or impede modal integration. Treating PPPs as institutional arrangements, rather than funding vehicles only, would bring such explanatory frameworks in line with the features that really matter in the credible delivery of corridors.

2.9.3 LACK OF STAKEHOLDER-CENTRED QUALITATIVE INQUIRY

Research on intermodal transport continues to be captured by the same set of technical, econometric, and simulation studies (El Yaagoubi *et al.*, 2022; Goodarzi *et al.*, 2024). These studies bring clarity to costs, transit times, and carbon impacts. They tell us much less about the actual functioning of freight networks, the divergence of plans in situ, the instantaneous trade-offs in decision-making, and the constraining routines of organisations that affect uptake. Consequently, the implementation drivers of behaviour, perception, and relations remain underscored.

An example of this gap is in the Global South, where the viewpoints of freight operators, infrastructure managers, policymakers, and cargo owners are not primary. However, these are the people who determine the extent to which intermodal propositions are implemented. Their decisions turn on perceived reliability, institutional trust, accumulated experience, and corporate strategy, factors that are difficult to capture through quantitative indicators alone and are better explored through qualitative, stakeholder-centred inquiry.

Where qualitative work does appear, it is instructive. Govender and Mbhele (2014) show that South African logistics decision-makers often hesitate to use rail because of reliability concerns and a weak service record. Yet such studies are rare. Mainstream transport scholarship continues to privilege infrastructural metrics over behavioural and perceptual drivers, leaving a substantive gap and dulling the strategic relevance of its conclusions.

2.9.4 FRAGMENTED TREATMENT OF THE ROAD-RAIL INTERFACE

A great deal of scholarship still treats road and rail as discrete systems, modelling their costs, emissions, and performance in isolation. Yet intermodality, by definition, depends on the disciplined integration of these modes within a single operating frame (Kumar & Anbanandam, 2020). What is too often missing is a close-up analysis of the hinge points: the interface itself, terminals, transshipment technologies, appointment and gate rules, liability and data-sharing arrangements, and the day-to-day logistics tactics that either synchronise or scramble flows.

This omission is most consequential in developing contexts, where the hardware for mode-switching is thin and governance is fragmented. We lack robust evidence on how transshipment actually works in practice; how small delays, security incidents, or paperwork frictions at the interface compound into system-wide viability problems; and how terminal design choices (yard layout, slotting discipline, cranes, staging capacity) shape coordination and asset utilisation.

Without this interface-level account, modal-shift prescriptions drift towards idealism. South Africa illustrates the point: the country hinged on the fact that the void of operational intermodal hubs and poor rail–road connectivity restrict plausible integration pathways. This pinpoints the importance of the need to practice an embedded case study of the node-mode transfer system (Havenga *et al.*, 2012; Kumar & Anbanandam, 2020).

2.9.5 ABSENCE OF INTEGRATED ECONOMIC-ENVIRONMENTAL MODELLING FOR LOCAL APPLICATION

International work routinely evaluates intermodal options with life-cycle costing, emissions modelling, and cost-benefit analysis. South Africa has far fewer studies of that kind, especially ones built on local supply-chain structures, corridor conditions, and environmental standards. The result is a thin evidence base for a persuasive, context-specific economic-ecological case for intermodal investment (Chakamera & Pisa, 2021; International Energy, 2024).

Market syntheses such as Mordor Intelligence (2024) report aggregate freight and carbon figures, yet there is no publicly available national model that estimates long-run savings from modal shift using rail- and route-specific inputs. This contrasts with European practice, where specialist institutes model whole corridors and quantify co-benefits over time, including reliability and externalities (Konings *et al.*, 2008). Without comparable tools, policymakers and shippers rely on partial metrics, and findings from capital-abundant systems are too easily projected onto very different operating realities.

What is needed is South Africa-specific modelling that couples rigorous financial appraisal with environmental externalities and service reliability effects. Corridor-level models should integrate tariffs, dwell and handling penalties, energy use and emissions factors, and realistic access and terminal assumptions, so that costs, co-benefits, and trade-offs can be assessed on a common basis (Havenga *et al.*, 2014; Mokobori *et al.*, 2022). A narrow critique on the cost of rail investment is likely to emerge in these cases, even in the presence of intermodal services that are integrated.

2.9.6 SYNTHESIS: FROM GLOBAL TEMPLATES TO LOCAL PATHWAYS

Systems of intermodal transport are still guided by the principles of intermodal transport, yet, systems of intermodal transport are still guided by the principles of intermodal transport. This is the case in South Africa where the systems of transport are intermodally transport systems,

and complex transport systems of intermodal transport are South Africa where the systems of transport are not intermodally constrained. The gaps are not a South African problem. The gaps are not a South African problem (Chakamera & Pisa, 2021; George *et al.*, 2018; Phaladi *et al.*, 2019b).

What is needed instead is research that prioritises stakeholders, considers the institutional context, and connects global models to the actual experience of corridor operations. This study takes that approach. By focusing on South African freight practitioners and using qualitative research to identify factors, barriers, and workarounds that quantitative models tend to ignore, the research provides context-sensitive knowledge on the extent to which intermodal solutions may realistically take hold and under what conditions these solutions may be sustained (Braun & Clarke, 2019; Potter *et al.*, 2022; Yin, 2018).

2.9.7 CONTRIBUTION OF THIS STUDY

This research shows how intermodal reform unfolds in a context characterised by pressure for infrastructure and complex institutions. Its contributions are twofold. First, it reframes a modal shift as a socio-technical transition as opposed to a loss in tariff revenue. Second, it demonstrates how credible delivery is contingent upon terminal discipline, access regimes, information rights, and trust. These factors shift operational reliability from a wish to a possibility that can be packaged and executed. Accordingly, the study adapts international frameworks to the conditions of South Africa, offering a blueprint for the intermodal corridors and indicating the underlying changes required for the viable and rapid adoption of intermodal transport services.

2.9.8 CONCEPTUAL: INTEGRATING INFRASTRUCTURE, INSTITUTIONS, AND PERCEPTIONS

This study integrates three usually siloed areas: the tangible infrastructure, the institutional architecture, and the people. The tangible infrastructure encompasses the terminals, the discipline of operations, and the reliable functioning of the system on a daily basis. The institutional architecture includes access policies, mandates, accountability, data ownership and accountability, and monitoring. The people component includes the trusting, the habitual, and the decision-making risks. Together, these components help explain why there is a level of intermodal adoption that is amenable not only to the price of intermodal transport and intermodal governance, but also to the credibility of interfaces (Notteboom & Rodrigue, 2008; South African Department of Transport, 2022).

It is an easy argument to make. Feasibility is more than just the calculation of tariffs. Where node-mode handovers are disciplined, access and information rights are clear, and users trust the timetable, price advantages can translate into actual volumes. Where these conditions are weak, even attractive rates struggle to shift traffic at scale (Havenga *et al.*, 2011; Potter *et al.*, 2022).

2.9.9 METHODOLOGICAL: ELEVATING QUALITATIVE, STAKEHOLDER-CENTRED INQUIRY

In a field dominated by simulations and macro-metrics, this study demonstrates the value of qualitative, stakeholder-centred methods. Semi-structured interviews, analysed reflexively, reveal how decision-makers actually weigh time-reliability risk, coordination costs, service reputation, and organisational priorities when choosing between modes. These mechanisms are difficult to capture numerically, yet they are decisive in practice (Braun & Clarke, 2019; Creswell & Creswell, 2018; Yin, 2018). The contribution is methodological as well as substantive. The design links modelled efficiency to situated judgement. It shows how claims that work on paper meet the choices firms and agencies make under corridor constraints, and it complements quantitative modelling with context-attentive evidence on adoption thresholds and implementation frictions (Havenga *et al.*, 2011; Potter *et al.*, 2022).

2.9.10 CONTEXTUAL: EXPLAINING SOUTH AFRICA'S FREIGHT PARADOX

This study helps to explain a visible paradox. South Africa is a freight-intensive economy with a long rail tradition, yet road transport continues to dominate most flows. The explanation begins at ground level. Each of the friction sources, such as underwhelming terminal capacity, unreliable and uneven provision of service, threats to security in the transport corridor, and fragmented and weak institutional data transparency, results in intermodal options being weak in day-to-day planning (George *et al.*, 2018; Phaladi *et al.*, 2019b). All of the friction sources together result in discouraging adoption, despite the fact that on paper, the rail tariffs seem to be favourable.

Disaggregating the contribution into a South African contextualised reading that makes sense across different corridors and nodes, as opposed to transplanting from higher-income systems, the contribution tracks localisation of systems. It crystallises how asset condition, access arrangements, and information rights, together, interact with shippers' risk/experience profile to pull choices toward road. It further identifies that moving multiple volumes back to

rail, particularly at a corridor level, the helpfulness in addressing additional terminal capacity, operating discipline, and governance that reduce perceived user risk (Chakamera & Pisa, 2021; Republic of South Africa & Ramaphosa, 2023).

2.9.11 EMPIRICAL: SURFACING LIVED EXPERIENCE AND STRATEGIC PERCEPTIONS

Focusing on practitioners, the study brings together material that is often left undocumented, that is, freight owners, carriers, terminal operators, planners, and policy stakeholders. It documents from participants the pinch points at the interface, the informal workarounds that keep loads flowing, the expectations around service failure and the reputation-based triage that controls experimental deployments. This is how the case makes visible the implementation gap, the distance between the policy intent and prevalent practice within logistics, and signals the points for designed, deliberate policies to effectively leverage.

A single “best practice” offer rarely aligns with all customers, and this is why there are distinct sectoral patterns. Bulk and mining flows are tolerant of longer lead times, as long as they are predictable. In contrast, retail and fast-moving consumer goods value time reliability over cost savings, as stockouts and missed delivery windows pose higher penalties than cost savings (Potter *et al.*, 2022). This explains why intermodal proposals should be customised to the corridor, commodity, and service promise rather than be costed in the abstract (Havenga *et al.*, 2011).

With triangulated perspectives, it is easier to disentangle the collective constraints from the isolated anecdotes. Reflexive thematic analysis preserves divergence and clarifies where it is risk (rather than noise), as seen in road incumbents who are supportive of a rail backbone, but in practice, are apprehensive of exposing their customers to fragile interfaces (Braun & Clarke, 2019). What we have is a grounded map of frictions and enablers that capture the operational constraints, including node discipline, access and information rights, that build trust in the daily operational flows.

2.9.12 PRACTICAL AND POLICY: TRANSLATING FINDINGS INTO IMPLEMENTABLE LEVERS

The analysis indicates that there are only a few levers that are feasible for companies and policymakers to influence. Constructing reliable access regimes founded on specific concession design and predictable slot allocation assists in reducing the risk incurred by users.

Operational guidelines for terminals that depend on appointment systems and overall agreed handover windows stabilise the schedules. Then, basic alignment of data-sharing obligations maintains cross-actor alignment to plans, while corridor security strengthens insurability and confidence. Taken together, these interventions reduce dwell, protect timetables, and make reliability something that users can recognise and price (Notteboom & Rodrigue, 2008; Republic of South Africa & Ramaphosa, 2023).

For firms, the implication is practical. A rail backbone with road feeders becomes competitive when handling penalties, time risk, and coordination costs are explicitly recognised and built into the offer. For policymakers, the findings suggest a workable sequence from intent to delivery. First, stabilise the node-mode interface. Second, lock in access arrangements and service slots. Third, mandate essential information rights so that actors plan based on the same data. Only then does it make sense to add further corridor capacity where demand is demonstrated (Potter *et al.*, 2022).

2.9.13 SCOPE NOTE

The claims made here are bounded by the actors and corridors included in the study. The form of generalisation is analytical rather than statistical. The mechanisms identified are intended to inform policy design and investment appraisal in comparable South African settings, and to guide future work that can link these qualitative insights with corridor-level economic and environmental models.

2.10 CHAPTER 2 CONCLUSION

This review has shown that, although the intermodal case is conceptually strong, delivery in South Africa is constrained by the country's freight paradox: a freight-intensive economy with a long rail tradition that remains dominated by road. International experience points to the same broad ingredients for successful intermodality: disciplined terminals, reliable trunk services, collaborative delivery models, and digital coordination across actors. However, these conditions presuppose corridor-ready infrastructure, coherent governance, and coordinated behaviour that are not yet consistently present in South Africa's priority corridors.

Read together, the literature and policy record clarify four gaps that sharpen the research problem. First, there is limited context-specific intermodal research for emerging economies, particularly in settings with infrastructure strain and institutional complexity. Second, institutional and governance barriers to modal shift are only partially theorised, even though

fragmented mandates and policy uncertainty are central to feasibility. Third, stakeholder-centred qualitative inquiry is under-represented, which means that the lived experience and strategic reasoning of practitioners are weakly reflected in mainstream accounts. Fourth, locally grounded eco-economic perspectives that link operational realities to corridor-level cost and risk dynamics remain underdeveloped.

These gaps point back to the core problem that guides this study: how experienced stakeholders within South Africa's freight system understand the feasibility of intermodal rail-road services on key corridors, and what corridor-level conditions they regard as necessary for a credible shift from road to rail. Addressing this problem requires an approach that can surface perceptions of reliability, risk, and institutional trust, and can connect those perceptions to node-mode interfaces and corridor operations, rather than relying solely on abstract models or tariff comparisons.

Chapter 3 sets out the methodological response to these conclusions. It explains the interpretivist stance and qualitative, exploratory-descriptive design, the purposive sampling of stakeholders across rail, road, terminals and policy, the use of semi-structured interviews to elicit decision logics and perceived risks, and the reflexive thematic analysis used to identify mechanisms along the corridors of interest. In this way, the research design is directly aligned with the gaps identified in the literature and with the freight problem that motivates the study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter sets out the study's philosophical stance, design logic, and operational procedures for assessing the feasibility of an intermodal freight system in South Africa. It explains the interpretivist foundation and the qualitative, exploratory-descriptive design, applied through a single bounded case of the national freight system. The unit of analysis is stakeholders' perceptions of intermodal feasibility within that system, with particular attention to the Gauteng–Durban, Gauteng–Cape Town, and Gauteng–Gqeberha corridors as principal flows.

The chapter then details the setting, target population and sampling approach, the mediated recruitment and consent pathway, and the development of the interview instrument, including the pilot. It describes the data collection procedures, the POPIA-aligned data management plan, and the analytic strategy, a reflexive thematic analysis. Steps taken to support trustworthiness are made explicit, covering credibility, transferability, dependability, and confirmability. Ethical safeguards, recognised limitations and delimitations, and an objective-method alignment matrix close the chapter.

Consistent with the purpose set in Chapter 1, the research seeks to understand whether, how, and under what conditions intermodal rail–road services could be feasible in South Africa by eliciting informed stakeholder judgements and triangulating these with documentary evidence. The objectives are to surface perceived barriers and enablers, identify contextual constraints and readiness factors, distil feasibility conditions and options, and translate these into practical measures that could be implemented within corridor realities.

3.2 RESEARCH PARADIGM

A research paradigm clarifies the study's assumptions about reality, knowledge, and inquiry (Rehman & Alharthi, 2016). This work is positioned within interpretivism, with a relativist-constructivist view of reality and a subjectivist epistemology. Operationally, the study treats social phenomena as co-constructed in interaction. It recognises that several context-specific accounts can hold at once, and that understanding is reached through dialogue and interpretation rather than by uncovering a single fixed truth (Creswell & Creswell, 2022; Thanh & Thanh, 2015).

These commitments shape both focus and method. The aim is not to fix a definitive story, but to elicit situated meanings from those involved in freight logistics, including rail and road operators, policy actors, and shippers, and to read areas of agreement and disagreement against their organisational and corridor contexts. This orientation warrants qualitative procedures attentive to depth, setting, and reflexivity, with explicit consideration of researcher positionality, the interactional character of interviews, and the interpretive labour of analysis (Creswell & Creswell, 2018).

3.3 RESEARCH DESIGN

A qualitative, exploratory-descriptive design is adopted to investigate an under-researched phenomenon in its real-world setting and to capture stakeholder accounts in their own terms with minimal prior imposition (Owusu-Ansah, 2018; Sandelowski, 2000). The analysis proceeds primarily inductively, allowing patterns to emerge from the data, while drawing selectively on the literature for sensitising concepts that shape an initial coding scaffold. These included infrastructure capacity, service reliability, regulatory governance, market structure, digital integration, and sustainability (Azungah, 2018; Thomas, 2006). Having various perspectives or stances also aids in interpreting data in a richer sense, thus avoiding the reduction of material into a priori categories.

3.4 RESEARCH STRATEGY: SINGLE BOUNDED CASE WITH EMBEDDED UNITS

The present study employs a single-case strategy (Yin, 2018), with the case being South Africa's freight system in transition towards potential intermodality. The embedded units of analysis comprise stakeholder groups, rail and road operators, logistics providers, policymakers and regulatory actors, freight owners, and documentary sources such as policies and legislation, industry reports, and academic writings.

The purpose of two complementary sources of evidence is to provide triangulation and context inference. First, nine semi-structured interviews were conducted to obtain in-depth testimonies from practitioners regarding the embedded units. Second, a documentary case analysis places these accounts within the public record and examines their claims against various authoritative sources. This approach works best with "how" and "under what conditions" questions, whereby context is important and where various evidence types reinforce the argument (Yin, 2018).

3.5 STUDY SETTING AND SCOPE

Empirical focus centres on the principal domestic corridors, Gauteng–Durban, Gauteng–Cape Town, and Gauteng–Gqeberha. These routes concentrate freight demand, expose the constraints of the rail network, and have the and have most important port-inland interchanges, with high road haulage. The time period of examination is 2000-2024, and for documents of 2025, such documents will be included if the most recent policy reform is relevant, so that path-dependent structures and policies can be analysed in relation to the time period most proximate to policy expectation.

The autonomy of the unit of analysis for different empirical settings is public, private, and hybrid partnerships. This configuration is intended to elucidate the maximum heterogeneity in experiences for the transferability of findings, and to the wider contexts by interrogating different ownership, mandate, and operational settings.

3.6 POPULATION, SAMPLING AND SAMPLE SIZE

3.6.1 RESEARCH POPULATION

The empirical research population consists of three clusters of stakeholders, each of whom has been confirmed to have direct and practical familiarity with the South African freight system. These clusters have differentiated roles of operational delivery, market analysis, and market demand; hence, they provide a comprehensive description of the inherent constraints and opportunities.

1. Rail and road freight operators

Senior staff members from Transnet Freight Rail, intermodal logistics, and other private sector companies, and members of trucking associations and road freight companies. These players provide comparative knowledge on service configurations, operational reliability, daily, and mode selection.

2. Industry analysts and economists

Transport economists and researchers, as well as independent consultants, focus on the logistics of performance, trade, and infrastructure. Their perspectives locate practitioner accounts within established evidence and policy debates.

3. Freight end-users and supply-chain professionals

Exporters, manufacturers, agricultural producers, and major cargo owners, together with logistics coordinators and supply-chain managers responsible for modal selection

and contract oversight. These participants ground the analysis in customer requirements and risk tolerances.

By integrating operational, analytical, and user perspectives, the study assembles a population capable of speaking to both system performance and adoption decisions, which supports a holistic appraisal of freight inefficiencies and intermodal options. Table 3.1 shows how the nine interview participants are distributed across these three stakeholder groupings in the realised sample.

Table 3.1: Distribution of interview participants across stakeholder groupings (n = 9)

Stakeholder grouping	Participants	Count
Rail and road freight operators	P4, P6, P7	3
Industry analysts and economists (incl. academics, MDB)	P1, P3, P5, P9	4
Freight end-users and supply-chain / terminal actors	P2, P8	2
Total	P1-P9	9

3.6.2 SAMPLING STRATEGY

3.6.2.1 Sample composition

Individual, semi-structured interviews are conducted with critical stakeholders in South Africa's logistics sector. Nine interviews are completed (n = 9). The final sample size reflects thematic saturation, the point at which additional interviews no longer yielded novel themes or perspectives (Brinkmann, 2022).

Participants are selected purposively, and the frame is widened through maximum-variation criteria and ethically bounded snowballing. The approach targets information-rich experts across roles, operations, strategy, and policy; across modes, rail and road, and across organisation types, public and private, with exposure to the principal corridors. This ensures that feasibility conditions are examined from multiple vantage points and that minority views are not lost in aggregation (Patton, 2015).

Interviews are scheduled for 45 to 60 minutes and are held on Microsoft Teams to balance depth with scheduling flexibility. Participation proceeds only once informed consent has been recorded. Personal information is handled in line with the Protection of Personal Information Act, with access restricted and identifiers removed in the research record.

3.6.2.2 Inclusion criteria

Participants are purposively selected for their professional expertise, sector experience, and active involvement in South Africa's freight transport system. This seeks to obtain real decision accounts, especially concerning the rail-road interface and considering intermodal alternatives.

1. Minimum sector experience

Every participant is required to have around three years of experience related to either rail or road freight logistics or in a closely related field, such as transport infrastructure or supply chain management. This minimum requirement ensures quality contributions, in addition to sometimes offering long-standing historical perspectives.

2. Current role relevance

Participants must have current employment in freight logistics operations, infrastructure planning and development, transport policy and regulation, and must have practical experience in intermodal integration. This guarantees that the contributions are based on current realities rather than a hypothetical outlook.

3. Professional seniority and experience-based eligibility

Participants are selected based on professional seniority, role complexity, and sectoral exposure rather than chronological age. Inclusion focuses on individuals occupying mid-to-senior-level managerial, specialist, or advisory positions within the freight and logistics sector, where sustained involvement in freight operations, infrastructure planning, or policy environments enables informed, contextually grounded contributions.

4. Decision authority

All participants must be in positions of strategic or operational decision-making, such as network planning, service configuration, pricing, governance, compliance, or program delivery. Decision-makers are the primary focus to ensure the results of the study are aligned with operational realities and practical constraints.

3.6.2.3 Exclusion criteria

Participants are excluded under two conditions.

1. Consent and recording

Anyone who did not consent or who did not allow their audio to be recorded and later transcribed is not a participant. Also, we cannot create genuine auditing material and defend analyses without recording. Before any decisions are made, we explain the confidentiality clauses, anonymity measures, and their limitations.

2. Conflicts of interest

Disregarding the situation where constraints will result from the situation, or the mere existence of constraints is problematic, participants will be excluded. This applies to the researcher having a direct employer-employee relationship, any current or recent financial or business ties, and close personal ties, such as family or romantic relationships. These measures protect the independence of the evidence base.

3.6.3 RECRUITMENT PROCEDURES

3.6.3.1 Sampling strategy

Purposive sampling is used to select participants for their expertise, experience, and relevance to the study aims (Thorne, 2016). A single-stage approach gives the researcher direct access to identified individuals without further subdivision (Creswell & Creswell, 2018). Given the targeted focus, recruitment combines network-based identification, formal invitations, and structured follow-ups to secure participation from key stakeholders.

Ethically bounded snowballing complements this frame. Initial informants refer additional information-rich participants only with explicit permission and subject to eligibility checks (Kristensen & Ravn, 2015). The blend draws in professionals active across rail and road, and ensures variation by role, mode, organisation type, and corridor exposure. This supports coverage of the main perspectives shaping intermodal feasibility.

3.6.3.2 Recruitment approach

Recruitment draws on industry networks, professional affiliations, academic links, and relevant associations to identify suitable participants. Initial contact is ordinarily made by the researcher via email, LinkedIn, or mobile, where available, to explain the study's purpose, procedures, and expected contributions. In the limited instances in which ethically bounded snowball sampling is used, the referring participant makes the initial approach to the nominee to avoid perceived pressure and preserve voluntariness. Once interest is indicated, the researcher follows up with complete study information and next steps.

Targeted email invitations set out the purpose, scope, and significance of the work and link to an onboarding pack that describes time commitments, ethical safeguards, and the voluntary basis of participation. Where clarification is required, a short online information session is offered before consent and scheduling.

3.6.3.3 Participant recruitment and availability

Step 1: Identify participants on public platforms

Professionals are located on LinkedIn and on official organisational websites. Examples include Transnet, Imperial Logistics, and the Road Freight Association. Searches use job title and expertise keywords such as “logistics manager” and “transport economist”.

Step 2: Broaden the pool through events and publications

Speaker rosters and attendee lists from relevant public events are reviewed to identify additional candidates. Author affiliations in recent intermodal and freight logistics scholarship are also scanned to surface potential participants.

Step 3: Establish initial contact

A professional email or LinkedIn message introduces the study. The Participant Information Sheet and the Informed Consent Form are attached. Communication emphasises voluntariness, confidentiality, and POPIA-aligned handling.

Step 4: Apply ethical snowball sampling

Demonstrated participants can still nominate additional candidates after the interview. Addressed referred candidates only after the referrer validated their permission to be contacted (Kristensen & Ravn, 2015).

Step 5: Draw on academic or alumni networks (as needed)

If agreed with the supervisor, access to relevant professional or alumni networks is sought to access underrepresented roles. The same ethical measures apply.

Step 6: Monitor interactions

A secure recruitment log has the record of outreach, decisions made on consent, the scheduling of the interview, and withdrawals. This is to ensure accountability and a visible audit trail.

3.6.3.4 Participant information and consent

Participants have been provided with an information sheet which details the purpose of the study, as well as the structure of the interview stages, confidentiality, the protection of the data, and the right to withdraw at any time with no effect. Discussing informed consent, signing, and returning the document to the administrators is required before participation. The

consent form details the rights of the participants, which include the right to opt for anonymisation, and describes how the data, to which the participants are shielded, is stored, used, and reported to preserve the confidentiality of the participants and the credibility of the research (Daykin et al 2018).

Participants have the right to choose the time at which the interview will take place. To facilitate this, the interview will be conducted on Microsoft Teams, which will eliminate the need for participants to spend time and effort on transport. To eliminate no-shows, reminder emails are sent to participants with joining instructions and information (if required) to prepare in advance of the discussion. Participants receive a confirmation message with a thank you and answers to any remaining questions after the interview. Additionally, they are asked if they want an executive summary and/or the dissertation that compiles the research, once the study is concluded.

The invitation and recruitment of participants for this research have a bona fide contingency plan in case recruitment challenges arise. If an invited participant is unable to attend, other professionals with similar expertise will be invited to ensure diversity and breadth of expertise in the field. At every stage of the recruitment process, there is order and ethics in the recruitment of professionals within the road and rail sector, and in accordance with POPIA, participants' details will be kept confidential and protected.

3.6.4 INFORMED CONSENT

Before taking part, prospective participants review, sign, and return the Informed Consent Form (Annexure A) in advance of their interview. The form serves as a formal agreement that they understood their rights and the scope of involvement.

3.6.4.1 Voluntary participation

Voluntariness is protected through several safeguards:

- **Removal of pressure.** Recruitment materials state clearly that participation is at the individual's discretion. No managerial, organisational, or social pressure is applied.
- **Independent contact routes.** Contact details are obtained only with specific authorisation and in line with legal and ethical requirements, including POPIA. Open invitations are circulated via professional networks so that individuals can opt in directly.

- **Transparent rights communication.** The Participant Information Sheet and consent form explain the right to withdraw at any time without adverse consequence.
- **No inducements.** No incentives are offered, and no coercive tactics are used.
- **Ethically bounded snowballing.** Where snowball referrals occur, the referrer confirms that the nominee had agreed to be approached before any contact is made.

The consent form is sent ahead of scheduling. Participants complete and sign the document, return it electronically, and their signed consent confirms acceptance of the interview invitation.

3.6.4.2 Confidentiality, privacy and anonymity

Confidentiality and privacy are protected through a set of practical controls. Names and organisational identifiers are removed from the research record and do not appear in any outputs; participant codes are used for analysis and reporting. Audio files, transcripts, and field notes are stored on encrypted, password-protected systems, with access limited to the researcher and, where required, the supervisor. Procedures align with North-West University ethics requirements and are subject to oversight by the relevant committee.

3.6.4.3 Key components of the consent form

1. Purpose of the study

The objectives are described in plain language. Participants are told that the research examines facilitators and barriers in South African freight and assesses the feasibility of intermodal solutions.

2. What participation involves

Individuals are informed that they will take part in a semi-structured interview. Interviews are audio-recorded for accurate transcription and analysis.

3. Confidentiality and data protection

Data are stored securely for five years and then scheduled for secure destruction. Identities remain anonymous in all notes, datasets, and reports.

4. Potential risks and benefits

There are no risks to participants, and participants have the option to refrain from answering any of the questions throughout the process, and they are also free to opt out of the process at any time.

5. POPIA compliance

Students' personal data are obtained with their knowledge and consent and used for research purposes. It will not be incorporated in any of the reports and publications

resulting from this research. Interviews may be recorded, and documents will be maintained on secure, maintained on password-protected systems for a period of five years, and after that, they will be permanently deleted from the systems.

6. Right to withdraw

Participants may request to withdraw at any time, and their data will be purged to the extent that this is possible.

7. Contact details

To assist with any concerns or for further explanation, the researcher and the research supervisor's contact details are made available.

Signing the Informed Consent Form indicates that participants recognise that they may decline to take part in the study and that they voluntarily accept the terms of the study, including the data privacy and confidentiality provisions. The form can be signed digitally or in person. The signed documentation is stored in a secure location, and access is controlled in accordance with the requirements of the ethics approval.

3.7 ETHICAL CONSIDERATIONS

Ethical considerations are taken into account throughout the research process in line with institutional requirements and accepted qualitative research practice. Ethical clearance for the study is obtained prior to data collection, and all participants are informed of the purpose and nature of the research before taking part.

Participation is voluntary, and informed consent is obtained from all participants. Participants are informed that they may withdraw from the study at any point without penalty. To protect confidentiality and anonymity, no identifying personal or organisational information is disclosed in the reporting of findings, and participants are referred to using coded identifiers.

Data are handled with care to minimise any potential harm to participants. Interview recordings and transcripts are securely stored and accessed only by the researcher. Ethical considerations are applied not only procedurally, but also reflexively, with attention given to respectful engagement with participants and responsible interpretation of their perspectives.

3.8 INSTRUMENTS AND PILOT

3.8.1 INSTRUMENT DEVELOPMENT

An interview guide is created based on the written works on intermodal accessibility and the performance of corridors. Sensitising domains include infrastructure capacity and reliability, operational integration and service design, market and customer requirements, pricing and total logistics cost, governance and regulatory clarity, digital visibility and data interoperability, and environmental performance and sustainability. Open prompts and probes elicit concrete, decision-proximate accounts. Examples include, “Can you walk me through a recent corridor move where an intermodal option would have helped or failed?”, counterfactuals such as, “If rail reliability were at X, how would your decision shift?”, and prioritisation prompts, “Of the barriers discussed, which two are binding constraints?” The final interview schedule is provided in Annexure B.

3.8.2 PILOT AND REFINEMENT

A brief pilot with an experienced sector professional tests clarity, ordering, and timing. Minor revisions follow. Wording is tightened, leading phrasing is removed to preserve neutrality, and the sequence is streamlined to support a natural flow from context to decision criteria to feasibility conditions (Rehman & Alharthi, 2016). The revised guide is then used for all subsequent interviews.

3.9 QUALITATIVE DATA ANALYSIS PROCESS

The qualitative data generated through interviews and documentary sources are analysed through a structured, iterative process. This process focuses on familiarisation with the data, the identification of meaningful data segments, and the development and refinement of themes that inform interpretation. Figure 3.8 provides an overview of the qualitative data analysis process applied in this study, while the resulting themes and findings are presented in Chapter 4.

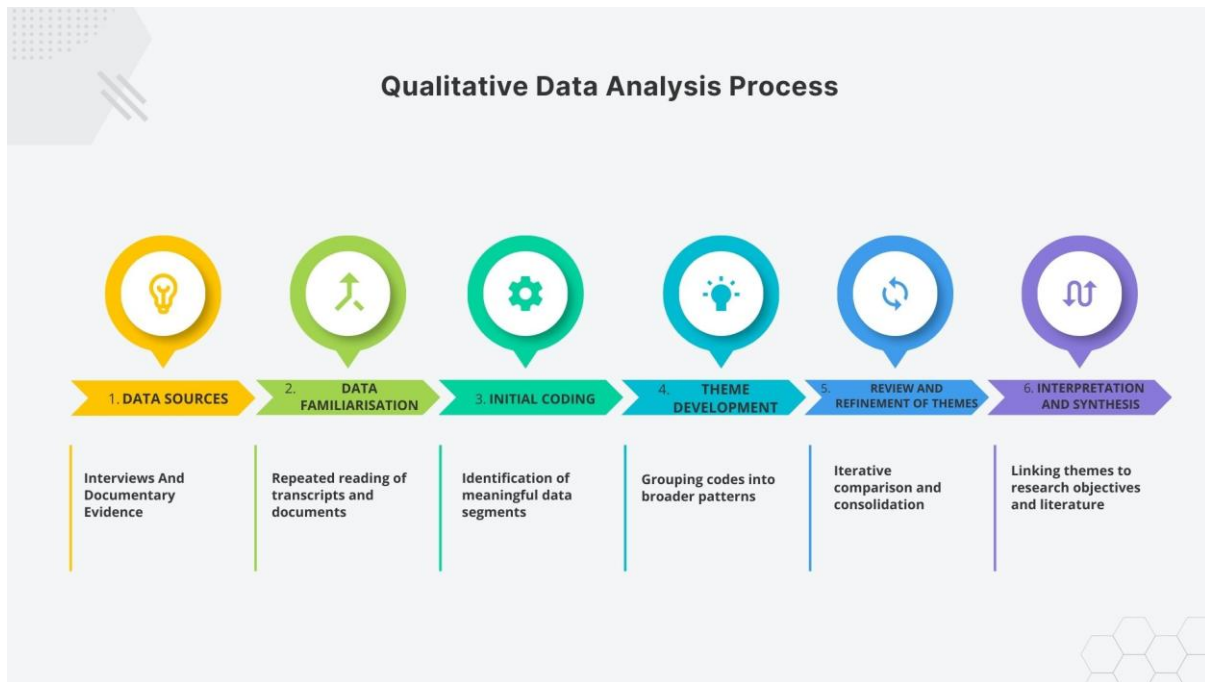


Figure 3.1: Qualitative Data Analysis Process (author's own compilation)

3.10 CHAPTER SUMMARY AND BRIDGE TO FINDINGS

Chapter 3 establishes the interpretivist stance, the qualitative, exploratory-descriptive design, and the single bounded-case strategy that guide this study. It clarifies the South African freight system and the three principal corridors as the empirical setting, outlines the stakeholder groupings from which participants are drawn, and explains the purposive and snowball sampling strategies used to recruit experienced decision-makers. The chapter then describes the development and pilot of the semi-structured interview guide, the POPIA-aligned consent and data-handling pathway, and the complementary documentary case analysis. Procedures for reflexive thematic analysis, together with measures to support trustworthiness, reflexivity, and an auditable analytic trail, complete the methodological account.

Chapter 4 turns to the empirical material. It briefly restates the data collection and analytic procedures, then presents the thematic map that emerges from the nine interviews and the documentary record. Each theme is illustrated with anonymised extracts labelled by participant ID and is read alongside relevant policy and industry sources, to show how participants understand intermodal feasibility and how these understandings play out across South Africa's principal freight corridors.

CHAPTER 4: FINDINGS AND THEMATIC ANALYSIS

4.1 INTRODUCTION

This chapter presents the empirical findings from nine semi-structured interviews with senior stakeholders across South Africa's freight system, read alongside a targeted documentary case analysis. The focus is on how participants understand the feasibility of intermodal rail–road services and how they describe the conditions under which a shift from road to rail could be achieved on the main domestic corridors. The analysis follows a reflexive, hybrid inductive-theoretical approach to thematic analysis to surface patterned meanings in participants' accounts of freight system performance, constraints, and options. To support transparency and auditability, I indicate how the data were generated, managed, and analysed, including how codes were developed, how themes were constructed and reviewed, and how illustrative quotations were selected.

4.2 DATA COLLECTION PROCEDURES

4.2.1 SEMI-STRUCTURED INTERVIEWS

The interviewer conducted nine interviews through Microsoft Teams. Each of them had an average duration of 45 to 60 minutes. Upon receiving consent, the sessions were recorded. During each session, the interviewer took field notes describing the session context, participant emotions, and key body language. During the interviews, the researcher used the interview protocol as a guide, modifying questions to be more specific and using follow-up questions to explore the answers more deeply, but still addressed the response in terms of the interviewee.

4.2.1.1 Participants and context

Participants included shippers, rail and road operators, terminal developers, financiers, and sector advisers with direct exposure to key corridors and ports. Interviews took place during August–September 2025. Quotations are presented verbatim, with only light tidying (e.g., filler words) and anonymisation where necessary to protect identities and commercially sensitive information. Collectively, the set offers a system-level view spanning policy, operations, infrastructure, and financing, which helps understand not only modal preferences but also the institutional and node-level factors that enable or block intermodal solutions. Table 4.1 summarises the professional roles, organisational settings, and modal vantage points of the nine interview participants, showing how their perspectives collectively span the main segments of South Africa's freight system.

Table 4.1: Demographics of interview participants

Participant	Stakeholder grouping*	Current role/position	Sector/organisation type	Primary modal vantage	Corridor/port focus	Base/geography
P1	Industry analyst/economist (academic)	Academic lecturer in rail/logistics; also involved in running a small railway; PhD on long-run South African rail and policy trends	University-based academic and small rail operator	Rail and intermodal	National freight system; references NLCC, domestic intermodal and Cape Town	South African university; precise city not stated
P2	Freight end-user / supply-chain professional	Head of grains for commercial development, responsible for generating business in grains / agri-bulk flows	Private international logistics / agri-bulk firm	Port-rail-road interface (export flows)	Export corridors , especially coal and agri-bulk via major ports (e.g., Richards Bay)	Not explicitly stated (national / port-focused)
P3	Industry analyst/economist	Former senior Transnet practitioner (35 years across divisions, mainly rail and	Former SOE executive; now independent/academic	Rail and port operations; intermodal	National system, with strong emphasis on Durban,	South Africa (exact base not stated)

		ports); now researcher/consultant on freight and intermodal		systems	N3, and major distribution hubs	
P4	Rail/road operator and terminal developer	Entrepreneur developing bimodal road–rail operations; signed rail access agreement to operate on Transnet rail; extensive hands-on rail operations	Private bimodal / al logistics technology operator	Bimodal road–rail and domestic intermodal	Domestic long-distance freight; potential dry-port to dry-port / inland terminals	South Africa (exact base not stated)
P5	Industry analyst/economist (policy / MDB)	Freight logistics economist and policy adviser; World Bank team member on logistics reform; STC role; supports DoT rail master planning	Multilateral development bank and national government	Macro-logistics across modes	National rail and road network; Western Cape freight demand; African corridors	South Africa and wider African region
P6	Rail and road freight operator (road)	Operations manager at a national road freight company,	Private road-freight operator	Road freight, port-truck	Major port-inland corridors ; contain-	Johannesburg, South Africa

		based in Johannesburg, working at the road side of the port/rail interface		interface	er flows from ports to inland customers	
P7	Rail freight operator (SOE)	General manager in a large state-owned rail operator, responsible for operational risk across ~21-22,000 km of rail network	State-owned rail operator	Rail operations and risk management	National rail network; key general-freight and bulk flows	National scope (South Africa)
P8	Inland terminal/logistics hub operator	CEO of an inland port and logistics hub; leads development of inland terminals; engages in rail policy to position inland ports in new frameworks	Private inland port/logistics hub	Inland intermodal terminals	Inland-port corridors ; corridor aggregation for containerised freight	South Africa (inland region; city not specified)
P9	Industry analyst/economist (academic & consultant)	Professor of logistics / macro-logistics; external adviser to	University academic and international consultant	Macro-logistics and rail-suita-	South African export lines and domestic corridors	Based in the Western Cape (university role stated)

		Transnet; global consultant on modal shift and externality cost models		ble freight	: compa- rative internatio nal cases	
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4.2.2 DOCUMENTARY CASE ANALYSIS

Policy and legislative texts, industry reports, and peer-reviewed literature were sampled against predefined inclusion criteria: relevance to South Africa, freight or intermodal scope, authority and credibility, and a time span of 2000 to 2024, with selective 2025 updates where material was relevant. An AACODS-style appraisal (Authority, Accuracy, Coverage, Objectivity, Date, and Significance) informed selection. These sources contextualised participant accounts and enabled pattern matching between narratives and the public record.

4.2.3 TRANSCRIPTION AND LANGUAGE

All recordings were transcribed verbatim. Where Afrikaans or code-switching occurred, the material was translated into English for analysis while preserving meaning and idiom. Original language excerpts were retained in an appendix for auditability. Simple transcription conventions were applied consistently, including markers for short pauses, emphasis, and interruptions.

4.2.4 DATA MANAGEMENT AND SECURITY (POPIA-ALIGNED)

A formal Data Management Plan governed the full data lifecycle. Files were controlled through a standard naming convention (StudyID_PType_Date_Version), supported by a version log and a fixed directory structure. Storage was encrypted and password-protected, with a secondary two-factor cloud backup to guard against loss. Access was restricted to the researcher and to the supervisor where required.

Personal identifiers were removed at the earliest point. Names were replaced with pseudonyms, and organisational references were rendered generically to reduce deductive disclosure. A minimal linkage file, stored separately from the main corpus, enabled participant transcript checks while preserving confidentiality.

4.2.4.1 Retention and disposal

Materials will be held securely for five years from the date of collection, after which they will be scheduled for certified deletion using an auditable data-wipe process. Participants were informed of their POPIA rights, including lawful research exemptions that apply to academic processing, and of the arrangements for secure storage, controlled access, and ultimate disposal.

4.3 DATA ANALYSIS: REFLEXIVE THEMATIC ANALYSIS (HYBRID)

4.3.1 ANALYTIC STANCE AND SOFTWARE

Analysis followed Braun and Clarke's (2019) reflexive thematic approach across six phases: familiarisation, coding, initial theme development, theme review, definition and naming, and reporting. ATLAS.ti was used to support systematic coding, to link excerpts to memos, and to maintain an auditable trail of code applications and revisions (Braun & Clarke, 2019). Familiarisation involved repeated reading of transcripts alongside field notes. Coding then proceeded iteratively, with regular returns to the data to refine candidate themes and to test their scope against disconfirming material. A dated memo file recorded interpretive moves, alternatives considered, and reasons for keeping or discarding theme boundaries, which fed into the chapter's trustworthiness evidence.

4.3.2 CODING APPROACH

A hybrid strategy combined deductive and inductive coding. Deductive "families" informed by the literature provided a light scaffold at the outset and prevented early drift: infrastructure and capacity; operations and service; market and commercial; governance and regulation; digital integration and visibility; and sustainability. Within these families, inductive codes captured novel or context-specific material, for example, corridor workarounds, informal interface practices, perceptions of access regimes, and emergent PPP designs. Codes were merged, split, or relabelled as patterns clarified. Short analytic memos accompanied these changes to preserve decision logic.

To check the stability and clarity of the developing scheme, an external reader reviewed a subset of anonymised transcripts against the emerging themes. Feedback was treated as a reflexive prompt rather than a reliability test, leading to minor adjustments where resonance and scope could be improved. Final themes were then refined against the whole corpus,

ensuring that each was internally coherent and distinct from its neighbours, before being named with plain, descriptive labels suitable for Chapter 4 reporting.

4.3.3 FROM CODES TO THEMES

Codes were clustered into candidate themes through iterative comparison and memoing. Working across interviews and documents, the analysis traced links between infrastructure condition, operating practice, cost exposure, and reliability. Candidate themes were then tested for internal coherence and external distinction. Disconfirming material was actively sought and, where it shifted scope, themes were revised rather than defended. To preserve context, patterns were examined across stakeholder groups to surface both convergence and principled divergence. Thematic propositions were then checked against policy and industry texts to assess plausibility through pattern matching. Labels were kept plain and descriptive to aid later reporting, for example, binding constraints at terminals, reliability as a decisive threshold, governance clarity and investor risk, and digitally visible lanes as market makers.

4.3.4 RIGOUR IN ANALYSIS

Auditability was maintained through a dated memo trail, versioned code lists, and decision logs. Where clarifications were needed, participants were approached for brief member checks on points of fact, which improved descriptive accuracy. An audit trail recorded code changes, dated memos, and decision points, creating a transparent link from raw excerpts to theme claims and supporting dependability.

4.3.5 REPORTING

Findings will be presented with thematic maps, exemplar quotations (anonymised, with role descriptors), and integrative commentary linking perceptions to contextual facts from documents. Reporting follows COREQ to maximise transparency.

4.3.6 RESEARCHER POSITIONALITY AND REFLEXIVITY

The researcher brings professional familiarity with logistics and operations. The interviewer's perspective can be an advantage in terms of having conceptual sensitivity, but it can also create expectancy bias. To mitigate the effect of this bias, the interviewer took the following steps: (i) documenting their reflexivity in the field journal following each interview; (ii) using a 'bracketing off' technique with their preconceptions prior to conducting their analysis; and (iii) conducting debriefing sessions with a seasoned qualitative researcher with inversion of control

to provide counterarguments to the interviewer's findings. These reflexive notes, at the interviewer's choice, formed part of the audit trail to demonstrate how bias with sensitivity was traced and addressed (Freeks, 2017).

4.3.7 TRUSTWORTHINESS

Methodological triangulation (interviews, documents) retains credibility, along with member-checking, peer debriefing, looking for negative cases, and selection of quotes for illustration that reflect diversity rather than mere consensus (Lincoln & Guba, 1985). Descriptions of context (corridor characteristics; organisation role; market conditions) enhance readers' ability to make their own determination, which supports transferability. Dependability is shown through protocols (guides, recruitment scripts) and their evolution alongside documented memos and decision logs that make up an audit trail. Evidence of confirmability is provided through reflective documentation that explicates code and theme linkages to prove that findings are based on data, and not their preferences for the outcome. Addressing authenticity (optional) can be through fairness (s representing multiple stakeholders) and ontological authenticity (participants' understanding is articulated), which should be preserved where possible.

4.3.8 ETHICS

Ethical clearance was granted by the North-West University Scientific and Ethics Committee (Annexure C). Participation was voluntary, and the right to withdraw without penalty was made explicit. Confidentiality and anonymity were protected through de-identification, careful selection of quotations to avoid deductive disclosure, and secure handling of all records. Risk was assessed as minimal, primarily reputational. Mitigations included anonymisation, aggregation of sensitive details, and optional review of potentially identifying quotations. Data protection complied with POPIA: purpose-limited collection, secure processing and storage, retention for five years from the date of collection, and certified deletion thereafter. Participants were informed of their rights within the lawful research exemptions that apply to academic work.

4.3.9 LIMITATIONS AND DELIMITATIONS

4.3.9.1 Limitations

First, self-reported perceptions may diverge from operational performance data. Second, a single time-point design cannot capture subsequent improvement or decline. Third, the sample size, while sufficient for depth, restricts breadth and statistical generalisability.

4.3.9.2 Delimitations

First, the study focused on experienced professionals aged 30 or older with at least three years' experience in the role. Second, attention centred on domestic corridors most salient for intermodal feasibility. Third, qualitative depth was prioritised over metrics, consistent with the interpretivist frame. Fourth, the documentary horizon spanned 2000 to 2024 with selective 2025 updates where material referred to recent reform.

4.4 THEMES OVERVIEW

The analysis yielded five interlocking themes (T1-T5). A thematic map (introduced visually later in the chapter) positions T3 (nodes/interfaces) as the practical lever between T1 (policy intent) and T2 (current operating reality), with T4 (access/PPP/security) enabling bankable investment and T5 describing the adoption calculus moderated by sector dynamics and ESG.

- **T1: Policy says “shift”; practice says “stuck”.** Long-standing modal-shift intent contrasts with fragile, crisis-led implementation. Recent access-reform signals suggest cautious momentum, but capacity and accountability gaps persist.
- **T2: Rail deterioration = Road dominance.** Rail unreliability and asset decline have pushed volumes to road, visible in queues, congestion, and heightened safety and social costs.
- **T3: Nodes as levers – Inland terminals and operating discipline.** Intermodal performance is decided at the interface: fit-for-purpose inland terminals, aggregation to train-lengths, disciplined slotting, and aligned port-inland operations.
- **T4: Access reform, PPPs, and corridor security crowd-in capital.** Credible, long-dated access regimes and corridor-level security/social licence are prerequisites for private capital and rolling-stock deployment.
- **T5: Adoption calculus - time, reliability, TCO, sector dynamics, and ESG.** Beyond tariff comparisons, firms weigh time-risk, handling penalties, and ease of doing business. Large road players often support a rail-trunk/road last-mile model. ESG opens doors to finance/markets but seldom overrides cost/time locally.

To support interpretive clarity, the themes presented in this chapter may also be considered in relation to four feasibility dimensions that underpin the study's feasibility question, namely operational, technical, economic, and environmental feasibility. References to corridor reliability, service discipline, coordination across actors, and the functioning of the rail–road interface are relevant to operational feasibility, while infrastructure condition, terminal readiness, and capacity considerations relate primarily to technical feasibility. Economic feasibility is reflected where participants discuss cost pressures, pricing structures, investment constraints, and service trade-offs, and environmental feasibility appears as a cross-cutting consideration where modal shift is linked to emissions reduction, congestion relief, road preservation, and sustainability objectives. A fuller synthesis of how these dimensions are integrated across the findings is developed in Chapter 5.

4.5 T1 – POLICY SAYS “SHIFT”, PRACTICE SAYS “STUCK”

4.5.1 THEME FOCUS

Participants consistently compare long-running modal-shift intent with fragile, crisis-led delivery. In line with a reflexive thematic analysis and a hybrid (inductive-led) coding posture, T1 is organised into four analytic codes capturing patterned meanings across interviews.

4.5.2 CODE T1.1 – POLICY-EXECUTION GAP AND ‘CRISIS MODE’

4.5.2.1 Interpretation

Across accounts, the problem is not scarcity of policy, but chronic execution weakness. Respondents describe a cycle of announcement without meaningful delivery and a lingering sense that the system operates in “crisis mode”, which destabilises planning horizons and erodes confidence in intermodal follow-through.

P1, 063 – “But we have a lack of implementation, and that is not only... So we’re in crisis mode still.”

P1, 040 – “We write it in the plans ... but there’s no implementation plan, and no accountability attached.”

P3, 083 – “If you look at where we are ... the gap is in the implementation of policy.”

P8, 020 – “They work, start implementing. We have enough plans; it is easier to steer a moving system than to start a static one.”

4.5.2.2 Implications for intermodal feasibility

A system that lives in crisis management mode struggles to do the slow, cumulative work that intermodal adoption depends on. Rather than building discipline about timetables, terminal readiness, and dependable train routings, attention keeps getting sucked back into firefighting. This weakens planning horizons for operators and customers alike, as no one can depend on policy promises getting translated into actual service levels. It also presents governance risk to prospective investors. Without firm assurance that declared reforms will start getting actually put into practice, private capital is likely to shy away from long and illiquid corridor assets like inland terminals, siding upgrades, or new intermodal service offerings, even when the underlying freight demand is evidently there.

4.5.3 CODE T1.2 – REFORM MOMENTUM AND ACCESS SIGNALS

4.5.3.1 Interpretation

Participants, in addition to the disappointment, also highlight new opportunities such as third-party access, more defined concession negotiation, and a reasserting guiding role from the Department of Transport. The unifying theme is signalling of potential stability in the competitive environment, which can warrant both investment and operational flexibility.

P3, 013 – “But what’s becoming most clear lately is the swift pace of implementation ... not just talk and strategic intent. It’s really starting to emerge.”

P8, 002 – “The key shift is the opening of the national rail network ... reducing ‘operator risk’ and creating opportunities for private operators.”

P8, 025 – “We’re seeing a lot of change happening, especially in the rail framework and policy.”

P9, 583 – “It is, it is supporting it... There’s clear support for that. In the rail policy of 2022... There will be ... understanding required. I think that’s the problem, but the support is there,”

4.5.3.2 Implications for intermodal feasibility

Emerging signals around network access and a more active stewardship role do not resolve operational weaknesses overnight, but they begin to reset expectations in the system. When operators and investors start to believe that third-party access will stick and that policy will be backed by enforceable frameworks, it becomes rational to plan for longer trains, to design terminal upgrades, and to explore service-level contracts that span road and rail. These steps are not cosmetic. They are the practical precursors to shifting significant volumes off-road, because they underpin the reliability, volume aggregation, and contractual certainty that intermodal services require to be credible alternatives rather than policy aspirations.

4.5.4 CODE T1.3 – INSTITUTIONAL FRAGMENTATION AND WEAK ACCOUNTABILITY

4.5.4.1 Interpretation

Respondents repeatedly highlight fragmentation across entities and unclear lines of accountability. Structural splits without strong interface management complicate terminal use and blur who is answerable for execution, which, in turn, dilutes the traction of otherwise sound policies.

P1, 129 – “Mm ... I think we’ve come a long way. My whole thing is about leadership, stewardship and accountability... But there is also no accountability attached to it.”

P8, 010 – 012 – “The Department of Transport is reasserting its system-steward role ... an intermodal policy is being drafted ... streamlined, predictable frameworks are needed ... policy must be explicit about roles, boundaries, and enforcement.”

P9, 376 – “Strategy is part of the oversight, logistics strategy ... they should have had the right people, then, you know, it makes up a lot of sense ... it worries me that by now they should have been much stronger.”

P7, 010 – “Complex, slow, and fragmented regulatory processes reduce momentum and raise costs. Streamlined, harmonised regulations and predictable approval timelines would accelerate projects ... reducing red tape and ensuring institutional alignment are critical.”

4.5.4.2 Implications for intermodal feasibility

Intermodal freight lives or dies at the interfaces, not in abstract strategy documents. When responsibilities are fragmented, and nobody has clear, enforceable accountability for how ports, inland terminals, and train paths work together, the very points where coordination is most critical become failure points. Operators and customers then experience policy as noise rather than as a dependable rules-of-the-game framework. In that environment, even well-crafted intermodal policies struggle to gain traction because there is no single steward with the mandate and authority to resolve bottlenecks, align incentives, and hold actors accountable for service performance across modes.

4.5.5 CODE T1.4 – SYSTEM STEWARDSHIP AND CAPACITY (DOT’S ROLE)

4.5.5.1 Interpretation

Many participants argue for a visible system steward to coordinate delivery, align roles, and remove regulatory friction. The Department of Transport is mentioned as reasserting this role, but respondents are clear that stewardship must translate into resourced execution capacity and predictable rules.

P5, 131 – 133 – “They have the tools ... rail policy is part of the oversight ... strategy is part of the oversight.”

P7, 009 – “Yes. Public finances face competing priorities, private capital is available, but investment-friendly frameworks are essential to crowd in capital.”

P7, 012 – “In principle, yes. Policy frameworks envision a seamless, efficient, intermodal system that enhances competitiveness and sustainability. The gap lies in execution and political will.”

P9, 550 – “Having said all of that, there are massive capacity issues there ... the mistakes that are being made ... things they just don’t realise. I’m concerned about the capacity in the Department of Transport.”

4.5.5.2 Implications for intermodal feasibility

A credible system steward is the mechanism through which policy stops being aspirational and starts to shape behaviour along the corridors. Visible stewardship, capacitated, and backed by predictable rules can set corridor-level access conditions and performance standards, broker solutions at congested nodes, and align public and private investment decisions around an agreed service vision. Without that capability in practice, intermodal policy risk remains on paper, because there is no institution with both the mandate and the technical depth to manage trade-offs, enforce compliance and keep programmes on track. For intermodal services, and this matters directly: operators will only invest in rolling stock, terminals, and digital integration if they trust that a competent steward, such as a strengthened Department of Transport supported by an accountable corridor PMO, will maintain a stable, enforceable framework over time.

4.5.6 SYNTHESIS

‘Policy abundance’ co-exists with fragile execution capacity. Participants acknowledge genuine reform signals, especially third-party access and a clearer stewardship stance from the Department of Transport, but stress that institutional fragmentation and weak accountability remain binding constraints. In practical terms, intermodal feasibility will depend on moving from crisis talk to corridor-level delivery, with: (i) enforceable access regimes; (ii) named, accountable owners for key nodes; and (iii) a lean, empowered implementation office tracking service levels, slot adherence, and terminal readiness. This sets up Chapter 5’s implementation blueprint.

4.6 T2 – RAIL DETERIORATION = ROAD DOMINANCE

4.6.1 CENTRAL IDEA

Participants describe how the decline in rail reliability has pushed freight onto roads. The result is visible congestion (especially at ports and on arterial routes), safety risks, and wider social costs that are absorbed by firms and communities rather than the transport system itself.

4.6.2 CODE T2.1 – RAIL RELIABILITY FAILURES AND STOPPAGES

4.6.2.1 Interpretation

Respondents link the road surge to concrete rail performance problems, stoppages, failures at key export nodes, and a general loss of reliability that forces shippers to default to road transport.

P9, 116 – 118 – “Richards Bay Port is one of the largest coal terminals in the world, and I think the largest in Africa ... there would be queues for 20 to 30 kilometres ... to the detriment of the consumer and of people travelling on the road.”

P6, 009 – “At ports, frequent strikes and equipment breakdowns cause stoppages; shipping activities can’t always be rescheduled quickly (e.g., windbound/rough water), compounding delays.”

P9, 004 – “My honest answer, I see more and more failure ... that’s how I see it. It’s not me being negative. I’m just being honest.”

P3, 015 – “The other thing, of course, that anyone can now see is the trucks on all sorts of roads and not just main arteries like the N3, you see them.”

4.6.2.2 Implications for intermodal feasibility

When shippers cannot rely on trains running as scheduled or on predictable terminal turnaround times, they are compelled to design their supply chains around road rather than rail. In the interim, a defensive posture will likely become the norm: contracting, fleet allocation, storing, and even making promises to customers will all be predicated on the expectation that rail will be an underperformer. The first-order consequences are clear: more lengthy truck queuing, increased congestion, and the logistics costs spike. The more serious consequence, however, resides in rail losing its position in the hierarchy of levels of consideration that shippers ascribe to a given mode, at least for the time being. In that context, intermodal options are no longer judged on their theoretical efficiency, but against a lived history of stoppages and failures, which makes it much harder for new or improved rail services to win back volume, even when performance starts to recover.

4.6.3 CODE T2.2 – TRUCK SURGE, PORT QUEUES, AND VISIBLE CONGESTION

4.6.3.1 Interpretation

Participants consistently reference truck build-ups and extended port dwell, describing a predictable pattern: when rail falters, trucks absorb the flow, and the choke points relocate to gates, stacking areas, *and arterial roads*.

P4, 053 – “We experience that as well with our citrus guys ... three, four days in a queue and not even offload or something happens.”

P6, 003/008 – “Road volumes are increasing while rail volumes are decreasing... Customers, therefore, prefer the road for on-time, accurate deliveries. Discourager: Concerns about the accuracy/reliability of the transport of goods given current performance issues.”

P3, 016 – “I saw a couple this morning down the Modderfontein Road ... massive tipper trucks going with mining commodities.”

4.6.3.2 Implications for intermodal feasibility

The visible build-up of trucks at ports and along arterial roads is not simply a congestion problem; it is a symptom of rail demand that has been displaced onto roads. When rail underperforms, trucks step in as the only dependable way to clear cargo. Still, the cost of that substitution is carried elsewhere in the system: extended queues, higher fuel and labour costs, disrupted delivery windows, and increased wear on public roads. None of this is priced or managed as part of a coherent network strategy. For intermodal feasibility, this matters because shippers internalise these patterns. As long as congestion is treated as an acceptable by-product of rail failure rather than a signal to fix rail, the incentives favour more trucks, not better rail–road integration, and the window for credible intermodal solutions narrows.

4.6.4 CODE T2.3 – EXTERNALITIES: ACCIDENTS, ROAD WEAR, INSURANCE, AND ‘UNSUSTAINABLE’ WAITING

4.6.4.1 Interpretation

Interviewees point to safety and cost externalities that proliferate when road carries what rail was designed to move: accidents, infrastructure damage, insurance exposure, fuel burn, and lost time that nobody can fully recover.

P3, 047 – “Massive insurance costs for road ... We need to do it economically ... we need to be more globally competitive, but we are not.”

P6, 006 – “It’s feasible. Rail is generally more cost-effective, reduces traffic, and lowers road wear and tear.”

P3, 048 – “The waiting’s all night, every man for himself, and let me survive.”

P4, 172 – “The logistics in South Africa are unsustainable at the moment ...”

4.6.4.2 Implications for intermodal feasibility

The external costs of over-reliance on roads do not show up neatly on a single freight invoice, but they accumulate across the system. Higher accident risk, accelerated road damage, rising insurance premiums, fuel waste, and long, unpaid waiting times all weaken corridor competitiveness, even when a truck move looks cheaper on paper. Households bear more risk on public roads, the fiscus carries the rehabilitation burden, and operators absorb volatility that erodes margins. For a country that explicitly seeks modal shift to rail to reduce precisely these externalities, this pattern is a warning signal. Unless corridor decisions start to factor in these system-wide costs, intermodal rail will continue to be undervalued in comparison with road, and politically important arguments for freight reform will lose force.

4.6.5 SYNTHESIS

Across the dataset, rail performance failures trigger visible truck surges and port queues, which in turn generate safety and social costs borne outside the rail ledger. Participants see this as a structural pattern rather than a temporary spike. In Chapter 5’s implementation framework, we translate these findings into corridor-level design choices: stabilise rail

reliability on trunk segments; install disciplined node operating models (staging windows, predictable slots, train-length aggregation); and measure externalities explicitly (accident exposure, dwell-time losses) so that the economics of modal choice reflect real system costs.

4.7 T3 – NODES AS LEVERS: INLAND TERMINALS AND OPERATING DISCIPLINE

4.7.1 CENTRAL IDEA

Participants frame intermodal performance as an interface problem more than a mode problem. Fit-for-purpose inland terminals (and the operating discipline they enforce) are the decisive levers: they aggregate flows into train lengths, standardise handoffs, and reduce dwell and risk at ports.

4.7.2 CODE T3.1 – TERMINAL SCARCITY AND FIT-FOR-PURPOSE DESIGN

4.7.2.1 Interpretation

Respondents stress that South Africa lacks a workable network of inland terminals/freight villages. Where nodes do exist, they are often not designed or empowered to act as true intermodal “funnels”.

P9, 022 – “Number one is terminals don’t exist, and we have no examples... With road, I’ve got that guarantee you know what you’re going to get ...”

P5, 045 – “A logistics service centre... a logistics park... freight villages with some really good terminals and some dry ports, and those things simply do not exist.”

P1, 071 – “If you look at our papers that we’ve written ... from the findings ... the domestic intermodal space that we are actually not utilising.”

P1, 111 – “It is not something that government can do... There are companies that’s starting to think about setting up terminals.”

4.7.2.2 Implications for intermodal feasibility

Intermodal services cannot be built in the abstract; they require a functioning lattice of inland terminals and freight villages that can aggregate volume, stage cargo, and manage handovers

between road and rail. Where such nodes are absent, undersized or not empowered to act as true “funnels”, policy intent has nowhere concrete to land. Operators then revert to point-to-point road solutions because they offer certainty, even if they are more expensive at the system level. In that environment, domestic intermodal potential remains largely theoretical, and the externalities highlighted under T2, from congestion to road wear and safety risks, continue to compound. Without deliberate investment in fit-for-purpose, commercially viable terminals, especially on the main corridors, intermodal rail is unlikely to move beyond niche or pilot use.

4.7.3 CODE T3.2 – NODE-MODE ALIGNMENT AND MANAGING INTERFACES

4.7.3.1 Interpretation

Participants insist the real work lies at the interfaces (ports, inland terminals, and distribution hubs), where containers are staged, consolidated, and repositioned. Aligning nodes and modes is the heart of intermodal.

P3, 030 – “... with shipping lines aligning... not only the modes but also the nodes, the terminals, the ports and all of those align...”

P3, 031 – “Freight is consolidated and about the interfaces between road and rail... something we lose sight of when we are so close to road or so close to rail as a mode.”

P8, 006 – “It is essential and feasible with disciplined execution at hand-offs and partners between modes; without these, a true shift cannot occur. Success depends heavily on leadership intent”

P2, 058 – “The real work is at the interfaces, at the terminals and hand-offs, otherwise you don’t get reliability end to end.”

4.7.3.2 Implications for intermodal feasibility

Intermodal performance is ultimately determined less by the individual modes than by the quality of the interfaces that connect them. If ports, inland terminals, and distribution hubs are not engineered and governed as shared responsibility zones, hand-offs become points of slippage rather than points of leverage. Predictable transfer windows, aligned port-inland

processes, clear information flows, and explicit accountability for what happens “in the gap” between road and rail are therefore not marginal details. They are the conditions under which end-to-end reliability becomes possible. Without disciplined interface management, even well-specified rail services and capable road fleets cannot deliver a persuasive intermodal product, and shippers will continue to experience mode changes as risk rather than as value.

4.7.4 CODE T3.3 – OPERATING MODEL DISCIPLINE: AGGREGATION, SHUTTLES, SLOTS

4.7.4.1 Interpretation

Interviewees emphasise train-length aggregation, short-haul shuttle legs, and predictable slotting. This operating discipline converts fragmented truck flows into rail-suitable blocks while keeping trucks focused on the first/last mile delivery.

P8, 012 – “Not fully yet, but they are moving in that direction. A single primary rail terminal to aggregate volumes effectively. We need a focal node to pull volumes together for train-length departures.”

P6, 034 – “You need port and inland processes aligned, same windows, same expectations; otherwise the interface becomes the delay.”

P4, 321 – “That’s very doable, but we don’t want to be a milk train... You can just make a stop, they can load it, and they can go ...”

P5, 366 – “It gets into people’s faces when they don’t get a slot on a train... they will sacrifice the environmental impact for your delivery, on time.”

4.7.4.2 Implications for intermodal feasibility

Operating discipline is where intermodal moves from concept to service. Suppose volumes are not deliberately aggregated into train-length blocks. In that case, if shuttles are not designed around short, repeatable legs, and if slots are not predictable and enforced, rail will continue to underperform road in day-to-day decision-making. Shippers then fall back on trucks for the entire journey, because they cannot risk missing a sailing or a delivery window while waiting for a train path. When aggregation and reliable slots are in place, however, the

logic reverses: rail can handle the trunk movement at scale. At the same time, trucks concentrate on first- and last-mile feeders that are synchronised with train departures and arrivals. In that configuration, road and rail become complementary rather than competing, and intermodal services start to look like a sensible default rather than an experiment.

4.7.5 CODE T3.4 – ADMINISTRATIVE ENABLEMENT AT NODES

4.7.5.1 Interpretation

Several participants argue for moving administrative frictions (customs, bond, documentation) from congested ports into inland nodes, and for simplifying the commercial experience (fewer contracts; “single-touch” processes).

P4, 139 – “Just make things flow easier. So we will have agents at the inland port, and we want to take all those admin things out of the ports. And put them in the inland port”

P4, 216 – “... every step in the way is a different contract.”

P3, 135 – “When technology systems at the terminals ... manage the interfaces such that we reduce unnecessary dwell times ... reduce double handling and in doing so reduce the cost ... the benefits start to become clearer.”

P8, 008 – “Port operating models are not fit for current volumes... inland ports/freight villages must act as ‘funnels’... keep assets productive while reducing congestion and risk.”

4.7.5.2 Implications for intermodal feasibility

Administrative design is as essential as physical design at intermodal nodes. When customs, bond, and documentation processes are concentrated at congested ports, and each leg of the journey involves a different contract and system, the end-to-end move becomes fragile and opaque. Shippers then experience intermodal as a chain of risks rather than as a single, managed service. Shifting formalities to inland nodes, simplifying commercial touchpoints, and using terminal systems to coordinate hand-offs can reverse that logic. Fewer counterparties, clearer process ownership, and reduced double-handling translate directly into shorter dwell times, lower ancillary costs, and a cleaner value proposition for intermodal rail. In that context,

inland ports and freight villages not only act as physical funnels for volume but also serve as administrative consolidators, making the intermodal option more straightforward to use and sell.

4.7.6 SYNTHESIS

Participants consistently position nodes, not modes, as the decisive levers. A scarcity of capable inland terminals (T3.1) compounds misaligned interfaces (T3.2). Where operating discipline exists (aggregation, shuttles, slots) (T3.3) and admin is enabled at the node (T3.4), intermodal becomes viable: trucks specialise in feeders, trains run full and punctual, and ports decongest. Chapter 5 translates these insights into corridor-level design: (i) a minimum viable network of inland terminals; (ii) standard operating windows and slot contracts; and (iii) administrative relocation (customs/bond) to inland nodes with clear accountability for the interface.

4.8 T4 – ACCESS REFORM, PPPS, AND CORRIDOR SECURITY CROWD-IN CAPITAL

4.8.1 CENTRAL IDEA

Participants argue that private capital will commit where access regimes are credible, concessions are long-dated and bankable, and corridors are made secure (both physically and institutionally). Where these conditions cohere, rolling stock, terminal builds, and operating platforms can be financed; where they don't, investment stalls.

4.8.2 CODE T4.1 – COMPETITIVE ACCESS & LONG-DATED CONCESSIONS

4.8.2.1 Interpretation

Bankability rests on clear, durable access rights and sufficient concession length to amortise assets. Participants reference concrete progress (e.g., signed or draft access agreements) as the type of certainty investors require.

P8, 009 – “Long-dated investments require policy certainty and predictable frameworks... capital is available, but rules of engagement must be clear and consistent.”

P1, 016 – “... with the network access, it makes it a little bit more complicated in terms of... now... terminals if people want to use existing infrastructure.”

P7, 041 – “Transport policies need to be harnessed so that they attract capital investment and not obstacles going forward.”

P8,089 – “In order for investment to happen... long-dated commitments are needed, 15 or 20 years in which to recoup that funding plus profit.”

4.8.2.2 Implications for intermodal feasibility

Long-dated, enforceable access rights are the foundation on which intermodal investment decisions rest. Without clarity on who may operate, on what parts of the network, and for how long, financiers cannot model risk, operators cannot plan rolling-stock or terminal strategies, and developers cannot justify the upfront capital required for inland ports or siding upgrades. Once a 15-20-year right to run is credible and bankable, the rest of the capital stack can form: lenders can price risk, equity investors can model returns, and operators can structure services with confidence. In this sense, competitive access frameworks and concession horizons are not administrative details; they are the gating conditions that determine whether intermodal rail remains an aspiration or becomes an investable reality on South Africa’s main corridors.

4.8.3 CODE T4.2 – BANKABILITY, BLENDED FINANCE & ROLLING-STOCK READINESS

4.8.3.1 Interpretation

Respondents emphasise that capital is available for credible operating models, particularly when rolling stock, terminal capacity, and service-level contracts are aligned. Bankability improves with blended structures and proven cash-flow visibility.

P4, 293 – “It’s been one of my biggest obstacles in raising money... As long as you’ve got a good business plan and a bankable system, the money is there. Once the operating model is credible, funding becomes the easy part.”

P6, 022 – 023 – “The funding required for nodes is small and easily obtainable from the private sector. It’s the operating discipline and contracts that make it work.”

P7, 036 – 037 – “Private sector funding will easily get into this... but to fix the infrastructure and the maintenance backlog... you’re talking hundreds of billions. That’s not going to be financed on commercial terms alone.”

P9, 327 – 328 – “Our state-owned entity doesn’t have it. That’s why they... went out to the public and said, ‘Come bid on this corridor, invest in it and manage it accordingly’... They went out to the public as a test of how appealing it is to put money up. The concession structure is what will bring private players in.”

4.8.3.2 Implications for intermodal feasibility

The constraint, in participants’ accounts, is not a shortage of capital but a shortage of bankable operating models. Investors are wary of policy and contract risk, not of wagons, terminals or locomotives as such. When access arrangements, service-level contracts, and rolling-stock deployment are joined up in a coherent business plan with visible cash flows, funding for terminals, operating platforms, and lighter rehabilitation becomes relatively easy to mobilise, often through blended structures that combine commercial finance with development or concessional capital. By contrast, the significant, lumpy investments needed to clear core rail infrastructure and maintenance backlogs remain unlikely to be financed on commercial terms alone and still depend on public or quasi-public balance sheets. For intermodal feasibility, this distinction matters: credible corridor operating models can unlock private investment at the “service layer” relatively quickly, but only if the underlying access regime and contracting environment give financiers confidence that the rules will hold over time.

4.8.4 CODE T4.3 – CORRIDOR SECURITY & SOCIAL LICENCE (THEFT, VANDALISM, PROTECTION)

4.8.4.1 Interpretation

Physical security and community alignment determine whether corridor operations are reliable enough to warrant private investment. Respondents stress theft, vandalism, and “every man for himself” dynamics as investment-killers unless addressed at the corridor level.

P4, 226 – “... we’ve got to talk about security because everybody is stealing goods from the railway.”

P2, 133 – “The amount of money and the extent of damage we look at from a rail perspective is so significant.”

P2, 060 – “Empower the people so that they can help protect the line... investing in communities, building schools, etc., so that the local chiefs can [buy in].”

P9, 107 – “Cable theft, local failures, issues with the line ... crippling rail reliability...”

4.8.4.2 Implications for intermodal feasibility

Corridors that cannot protect their own assets are complicated to finance or operate credibly. Persistent cable theft, vandalism and unchecked pilferage do more than disrupt individual trains; they signal to investors that any business case is built on unreliable foundations and that losses will be socialised rather than managed. Credit committees then discount projected cash flows heavily or walk away altogether. Participants’ emphasis on community alignment is therefore not a soft add-on. Practical measures such as involving local leaders, investing in community benefits, deploying technology-enabled surveillance and agreeing on clear, insured service-level regimes become part of the core risk-mitigation package. Only when there is a believable plan to reduce theft and vandalism, and to respond quickly when incidents occur, will corridor concessions and PPP structures be able to clear financing hurdles and support sustained intermodal operations.

4.8.5 CODE T4.4 – REGULATORY CLARITY & THE ACCESS ROADMAP

4.8.5.1 Interpretation

Participants connect investment appetite to visible stewardship (DoT), regulatory certainty (e.g., legislation/regulator), and a private-sector participation roadmap that shows how access will be administered and enforced.

P5, 035 – “It’s a pity the National Department of Transport is not providing any guidance here... in the Rail Master Plan, this issue has been seriously underdeveloped... we need a national plan, which doesn’t exist. We need a single view of who administers access and who enforces standards.”

P9, 582 – “We see it now... Transnet’s separated into [an] infrastructure manager and Transnet Freight Rail selling the service... government is much more open to private participants, it’s a step in the right direction, though implementation still has far to go.”

P7, 041 – “Transport policies need to be harnessed so that they attract capital investment and not obstacles going forward.”

P5, 191 – “The most significant change is the opening of the national rail network to private participation... the National Logistics Crisis Committee was established to address sector-wide bottlenecks.”

4.8.5.2 Implications for intermodal feasibility

Regulatory clarity is one of the main ways in which policy translates into investable reality. Acts, regulators, and access roadmaps are not symbolic “wins”; they are the instruments that tell operators and financiers who administer access, who enforce standards, and how disputes will be handled over the life of a concession. When these roles are vague or contested, private partners assume that rules may shift midstream and either load that uncertainty into pricing or decline to participate. By contrast, a visible steward in the Department of Transport, a functioning economic regulator, and a clear roadmap for private participation on the national rail network give credit committees something concrete to underwrite. For intermodal rail, this is decisive, because long-dated investments in terminals, rolling stock, and operating platforms will only proceed if the access framework is perceived as stable, fair, and enforceable across the main corridors.

4.8.6 SYNTHESIS

Participants converge on a simple investment logic: (1) lock down credible access/concessions; (2) show bankable operating models (rolling stock + terminal capacity + service contracts); (3) make corridors secure with community and technology; and (4) sustain regulatory clarity/stewardship. Do these, and private capital flows to nodes and operating platforms; neglect them, and projects remain PowerPoints. Chapter 5 turns this into a corridor playbook: access term templates (15-20 years), a PPP risk-allocation matrix, security/maintenance standards tied to payments, and a stewardship PMO that monitors performance and enforces the access code.

4.9 T5 – ADOPTION DRIVERS: RELIABILITY, TIME-RISK, TCO, AND ESG

4.9.1 CENTRAL IDEA

Participants emphasise that adoption pivots on total cost of ownership (TCO) and reliability, not tariffs alone. Handling/transfer penalties and ease of doing business (e.g., single contract, predictable slots) are decisive. Many large road players favour a complementary model (rail trunk, road-first/last-mile). ESG opens doors to finance and export markets, but rarely overrides time and cost locally.

4.9.2 CODE T5.1 – SINGLE-TOUCH TCO: TIME RISK, HANDLING, ADMIN FRICTION

4.9.2.1 Interpretation

Beyond a nominal tariff, shippers price in delays, variability, extra lifts, and admin friction. Confidence increases when offers are “single-touch” (one contract, one SLA) and when slots/windows are predictable; it collapses when every interface adds paperwork, parties, and risk.

P2, 320 – “There’s handling losses that occur when you’re switching modes... The more you minimise it, the more attractive intermodal transport would be... the more losses you incur, the more of a deterring factor it would be... from a pure cost point... largely rail is cheaper than road.”

P3, 054 – “So the rail system performance at the moment ... people just don’t even pursue it. They don’t even talk about it, because it means a whole lot of other costs.”

P4, 214 – “Origin to destination, but every step in the way is a different contract... The definition of multimodal is you have one contract... one contract from origin to destination, not all these contracts and admin.”

P2, 030 – “Do I need buffer stock or do I need just-in-time?... cost will be a big motivator. One of the most important factors should be the timing, how long does it take for my goods to reach me?”

4.9.2.2 Implications for intermodal feasibility

Shippers do not only compare tariffs; they also compare the total experience and risk of the move. When intermodal offers are structured as “single-touch” products, with one contract, one service-level agreement and predictable slots or delivery windows, the total cost of ownership improves because time risk, handling losses, and administrative friction are contained. In that configuration, rail’s intrinsic cost advantage has a chance to register. Where the journey fragments across multiple contracts, parties, and interfaces, each with its own paperwork, uncertainty, hidden costs, and operational complexity, the nominal price benefit quickly gets overshadowed. In that environment, road retains its appeal as the simpler, more controllable option, and firms are unlikely to shift meaningful volumes to intermodal services, regardless of policy encouragement.

4.9.3 CODE T5.2 – FROM RIVALRY TO PARTNERSHIP: RAIL BACKBONE WITH ROAD ALLIES

4.9.3.1 Interpretation

Respondents describe a complementary steady-state: rail provides the linehaul backbone, while road focuses on agile feeders. Several note that major road operators explicitly support a reliable rail core, because it stabilises the wider system and creates quality last-mile work.

P5, 219 – “Many of the road hauliers, like Imperial... want to cooperate with rail to do the last mile... buy whole trains and run a system.”

P4, 174 – “None. I’m going to create more truck driving jobs ... because the first- and last-mile remains on road ... truck drivers drive domestically so they can sleep at home at night.”

P4, 099 – 102 – “Everybody has got to understand ... the one relies on the other, and we must use the strengths of [road/rail]. I think if everybody had that mindset ... the pie is big enough so that everybody can get a slice. Make the pie bigger. That’s what we’ve got to do.”

P3, 104 – “It’s growing in Europe, it’s growing in Australia ... proper operating models, proper business models, proper interface models.”

4.9.3.2 Implications for intermodal feasibility

Recasting road and rail as complementary rather than competing modes changes the design problem. Suppose the rail is understood as the backbone for trunk movements and the road as the agile feeder at origin and destination. In that case, collaboration becomes a way to unlock train-length volumes rather than a threat to trucking jobs. In that steady-state, large road operators have clear incentives to back a reliable rail core, because it stabilises the wider network, reduces exposure to long-haul risks and creates higher-quality, predictable last-mile work. This partnership framing matters for intermodal feasibility: it supports the commercial logic for aggregation, shared service design, and co-investment in terminals, rather than perpetuating a zero-sum narrative in which every gain for rail is assumed to be a loss for road.

4.9.4 CODE T5.3 – ESG AS ENABLER (NOT OVERRIDER)

4.9.4.1 Interpretation

ESG is acknowledged as a gateway to finance and export markets, and rail's emissions advantage is clear. Yet participants repeatedly say that, in current local conditions, time and reliability trump "green" considerations; when slots are scarce, firms will sacrifice environmental gains for delivery certainty.

P4, 328 – 330 – “All decisions in logistics are made on the basis of cost, and rail is cheaper... and has lower noise and carbon emissions... Trains don't jump off the rail and kill pedestrians either.”

P7, 014 – “A rail [option is] an environmentally friendly option ... producing less than a third of the emissions that are generated by road transport.”

P5, 101 – “At the moment, [ESG] doesn't influence it a lot... externalities are emissions, congestion, accidents, noise...”

P5, 363 – The environmental agenda is much stronger; right now, it's a moot point because we don't have an alternative.”

4.9.4.2 Implications for intermodal feasibility

ESG considerations strengthen the case for rail, but they do not substitute for reliable capacity. Participants are clear that, in current conditions, time and delivery certainty still dominate routing decisions, even when shippers recognise rail's emissions, safety and noise advantages. As long as credible rail paths and slots are scarce, firms will continue to choose options that protect production schedules and export windows, even at a higher environmental cost. ESG therefore operates as an enabler rather than an overrider: once dependable intermodal services are in place, rail's lower externalities can help unlock finance, support compliance with customer and investor requirements, and consolidate rail-based corridors' competitive position. Until then, however, environmental arguments alone are unlikely to shift meaningful volumes off road.

4.9.5 SYNTHESIS

Participants reframe adoption as a risk-weighted TCO problem shaped by interface quality and commercial simplicity. Where offers provide single-contract coverage, predictable slots, and low-friction hand-offs, rail's inherent cost/ESG edge is unlocked. Where they do not, time risk and handling penalties erase tariff advantages, and users revert to the road. Sector dynamics are complementary at steady state (rail trunk, road feeders), and ESG functions as an enabler, but only after reliability and slots are secured. This informs Chapter 5's design choices: (i) single-bill, corridor-level SLAs; (ii) standardised slot windows and performance metrics; (iii) node-centred operating models to minimise handling; and (iv) capacity disclosures that make ESG benefits visible without penalising on-time delivery.

4.10 IMPLICATIONS FOR CHAPTER 5

Taken together, the findings depict a system with clear intent but uneven delivery, where intermodal feasibility turns less on abstract policy than on what happens at the interfaces, terminals, slots, service windows, and enforceable access rules. Chapter 5 converts these insights into an implementation blueprint at the corridor level. It specifies the minimum viable network of inland terminals and their operating models; sets out standardised slotting and performance metrics to stabilise trunk-haul rail; details the access and concession templates that make private participation bankable; and embeds corridor security, administrative enablement (customs/bond), and single-contract commercial offers to reduce handling penalties and time risk. The chapter consolidates these and other proposed steps in terms of

stewardship structure, role allocation, responsibility, as well as a thin PMO to oversee implementation, and ensure that policy remains responsive to real-world practice. Effectively, chapter 5 goes from the ‘why intermodal’ to the ‘how, where, and by whom’ in a seamless way that translates T1- T5 into multiplex executable sequences that have selectable budgets and governance.

The five themes align with a multi-level taxonomy of intermodal possibility. On a foundational level, T1 outlines the governance and accountability conditions which shape confidence in the system. On that basis, T2 shows the operational failures that stem from weak foundations, shifting freight to the road and system-wide costs of rail unreliability. T3 articulates the stabilising operation of the physical and administrative interfaces at the node level. T4 articulates the investment logic that sits above these interfaces, indicating when it becomes viable for corridor concessions, rolling stock, and terminal upgrades. Finally, T5 integrates these layers into the commercial logic of the shipper. This taxonomy shows the interdependence of these layers. T1 governance enables stable operations. T2 system stability enables functional nodes and interfaces. T3 functional nodes enable corridor models T4 that are investable, which in turn creates the commercial shift in shipper behaviour T5. This chapter leverages this taxonomy to organise the action plan implementation, translating the interdependent conditions to the specific corridor actions. This is shown in Figure 4.1.

Intermodal Feasibility Pyramid

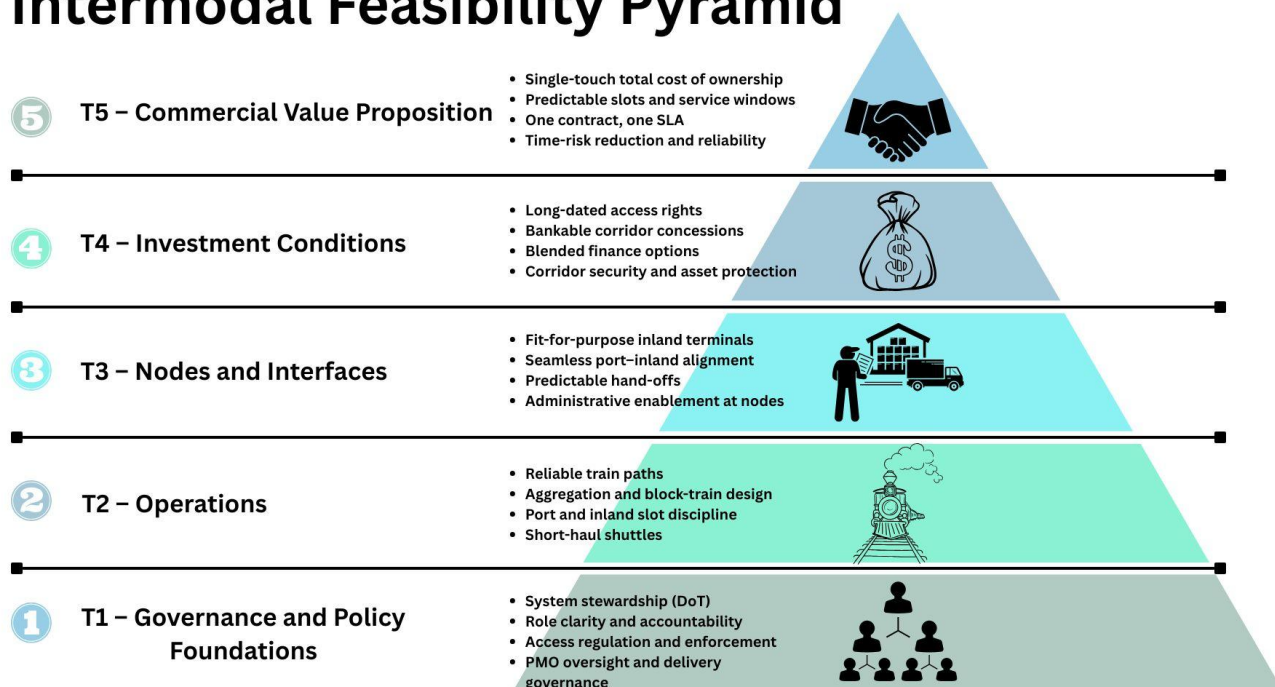


Figure 4.1: Intermodal feasibility pyramid (author’s own compilation)

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 SOUTH AFRICAN LOGISTICS

South Africa has a large rail network, yet the freight system continues to lean heavily towards road. Most domestic cargo now travels by truck, a pattern that sits uneasily with international experience and with the country's own sustainability goals. Rail's share of general freight has fallen over several decades as road haulage was deregulated in the late 1980s, capital investment in rail infrastructure slowed, and operational performance within the state-owned system became increasingly uneven. Policy documents tell a different story on paper. Strategies such as the National Rail Policy White Paper and the National Freight Logistics Roadmap set out a clear intention to shift long-distance freight back to rail, although implementation has not kept pace with the ambition they describe (South African Department of Transport, 2022). Intermodal transport, understood here as the coordinated use of at least two modes within a single freight movement, has appeared in these policy discussions since the early years of containerisation. Even so, consistent, corridor-level intermodal services remain the exception rather than the rule. Against this backdrop, the chapter turns to the current freight landscape and considers why building a workable national intermodal system is at once necessary and difficult.

Inefficiencies are now visible across the network. As rail reliability weakened, shippers diverted volumes to road. The consequences are familiar: congestion on primary corridors, accelerated pavement wear, and heavy vehicles spilling onto secondary routes never designed for such loads. A number of sectors experienced rapid increases in road capacity to address service delivery gaps; however, growth continued to exceed the infrastructure's ability to withstand the pressures of continued increases in the external costs that arose, such as maintenance backlogs, heightened collision risks, and increased environmental costs. The scale effects were illustrated by the Durban to Gauteng corridor. Respondents described the N3 and N2 as "permanently under pressure". They observed that the road diversion has caused secondary routes to "carry loads they were never designed for", creating noticeable safety and maintenance deficits. Business as usual is therefore not sustainable. Policy and industry assessments converge on a remedy: revitalise rail through credible intermodal solutions that restore dependable corridor services and reduce total logistics cost and risk at the chain level.

5.2 CURRENT ROAD AND RAIL DYNAMICS IN SOUTH AFRICA

5.2.1 RAIL DECLINE AND ROAD DOMINANCE

Recent freight patterns reflect a pronounced shift from rail to road. Public reporting and sector analyses record sustained declines in general-freight rail volumes alongside rapid growth in long-distance road haulage. The drivers are well established. Ageing permanent way, deferred maintenance, rolling-stock constraints, and security incidents on key sections have eroded schedule reliability. Where possession planning is irregular, and asset availability is tight, cycle times lengthen and on-time running deteriorates, prompting shippers to reprice risk and default to road for time-sensitive flows, even where rail would ordinarily hold a scale advantage. Several respondents framed the problem less as single incidents and more as a pervasive timetable drift that makes day-to-day planning a guess rather than a schedule.

The road sector has adjusted more quickly than rail. Trucking fleets expanded, routing remained flexible, and door-to-door control reduced the number of operational handovers in a typical movement. Together, these features allowed road operators to absorb cargo that rail could no longer move reliably. The effects are now visible across the network. Key arterial routes such as the N2 and N3 are consistently congested, while secondary routes are over-utilised in terms of heavy vehicular traffic, resulting in a surplus of transport operations. These external costs manifest as accelerated service deterioration of the road network, increased crash risk, and greater greenhouse gas emissions.

Rail capacity shortages are especially evident at port approaches and export terminals, creating pressure points in the supply chain. Participants described port gates as “the daily choke point”, as they are the points of rapid truck queue formation when planned rail legs do not arrive as scheduled. At the supply chain level, the risk premium incorporated in road tariffs allocated to the supply chain promotes increased total logistics costs. This is especially evident when flows are bulked and in theory could be more efficiently managed with scheduled rail for the primary transport legs, and road for the first and last mile.

For planning pragmatic implications, intermodal possibilities link to redeveloping reliable rail services along priority corridors and reducing the friction points where road and rail infrastructures can meet. Minimum service standards are the fulcrum: predictable slot access, disciplined terminal operations that limit dwell, and possession planning that protects cycle times. Where these conditions are met, rail’s inherent scale advantage re-emerges, the risk premium on road-linked legs falls, and the business case for scheduled rail–road combinations strengthens. The policy reforms detailed in Chapter 2 establish the enabling frame for such

recovery; the implementation task is to translate that frame into corridor-level reliability that shippers can monitor, contract for, and trust.

5.2.2 COMPETITIVE VERSUS COMPLEMENTARY RELATIONSHIP

In principle, road and rail are complementary. Rail is best placed to carry long-distance trunk hauls at scale, while road provides first- and last-mile connectivity in a hub-and-spoke arrangement. Policy statements in South Africa echo this logic, and comparative studies show that intermodal systems perform when modal roles are explicit and interfaces are disciplined. In practice, the relationship has often been competitive. A prolonged trust deficit in rail reliability has encouraged shippers and road operators to optimise for near-term, mode-specific performance rather than system efficiency, with point-to-point trucking expanding to capture long-haul flows even where rail would ordinarily hold an advantage. Interviewees remarked that long-haul road became the “default insurance policy” against missed cut-offs, even where rail pricing looked attractive.

There are clear incentives for complementarity. Long-haul road movements expose operators to fuel, driver, and maintenance costs, as well as safety and congestion risks. When rail offers predictable slots and disciplined terminals, large trucking firms can pivot to shorter hauls that stabilise utilisation and reduce uncertainty at the chain level; smaller hauliers also gain through tighter pick-up and delivery windows that cut idle time. The obstacle is less the logic of the model than the credibility of the service. Where rail is perceived as unreliable or as a threat to market share, road interests rationally default to self-protection, entrenching a fragmented equilibrium in which each mode chases its own margins and the system under-delivers.

For intermodal reasonable prospects, the implications are simpler to understand. Complementarity is possible when there is contractibility and enforced corridor-level consolidation, retention, and alignment of competitive incentives. This is achieved through service-level agreements that maintain guaranteed slot control, terminal dwell time limits, and visibility of control, along with integration of access-pricing models and contract frameworks that neutralise substitution default. Within this framework, road can refocus on high-reliability collections and deliveries, while rail can recapture the trunk line haul, all while shippers benefit from lower total risk and costs in the logistics chain.

5.2.3 AWARENESS AND UNDERSTANDING OF INTERMODAL CONCEPTS

Another limitation is what seems to be a patchy understanding of intermodal logistics within the operating ecosystem. In the academy and strategy policy arena, the case for integrated road–rail solutions is unequivocal, and research demonstrates that cost, reliable, and environmentally sound solutions are attainable when roles are defined and node interfacing are disciplined. In contrast, operational practice often defaults to unimodal biases whereby the shipper and carrier optimise within the mode of control, focusing on short-term margins and ignoring chain efficiencies. Such path dependence continues to prevail, even when an intermodal leg is available that reduces total logistics costs or corridor risk exposure.

Misconceptions also narrow the perceived scope of intermodal transport. In South Africa, intermodal is frequently equated with port-related container flows, especially on the Durban–Gauteng axis, while domestic opportunities for inland distribution receive less attention. Yet scheduled rail legs for retail goods, agricultural commodities, and bulk-adjacent inputs become viable when minimum service standards are met, particularly where terminal discipline and predictable paths stabilise cycle times. Adoption, therefore, depends not only on assets and rules but also on comprehension and confidence. Three practical enablers follow: clear service definitions with predictable slot access and terminal dwell limits, transparent access-pricing and contracting templates that make cooperation investable, and demonstration services on priority corridors to show time, cost, and reliability outcomes in practice (Monios & Bergqvist, 2017).

5.3 FEASIBILITY FRAMING ACROSS THE FINDINGS

Feasibility is assessed in this study through the integrated consideration of operational, technical, economic, and environmental dimensions, as reflected across the findings. Operational feasibility is evaluated through stakeholder accounts of corridor reliability, service discipline, interface coordination, and institutional capability to plan and sustain intermodal operations. Technical feasibility is considered in relation to infrastructure readiness, terminal capacity, equipment and handling requirements, and the functional integration of the rail–road interface. Economic feasibility is examined through perceptions of cost competitiveness, pricing structures, investment conditions, and the cost–reliability trade-offs that shape shipper decision-making. Environmental feasibility is assessed through stakeholder recognition of emissions reduction potential, congestion mitigation, and broader sustainability benefits associated with shifting suitable long-distance freight flows from road to rail. These dimensions are treated as interdependent conditions rather than isolated criteria, and feasibility is

understood to emerge where they align at corridor level, rather than through the optimisation of any single factor in isolation.

5.4 FEASIBILITY OF A NATIONAL INTERMODAL SYSTEM: KEY BARRIERS AND CHALLENGES

Transforming a fragmented freight landscape into a coordinated intermodal system requires clearing a set of structural and behavioural barriers. The literature and sector reporting consistently identify constraints in five clusters: infrastructure and asset condition, operational discipline at nodes and along corridors, financing and incentives, institutional governance and contracting, and perceptual factors that shape shipper confidence. The sections that follow set out the major obstacles and indicate the corridor conditions that must be met for intermodal feasibility at scale.

5.4.1 RAIL INFRASTRUCTURE AND RELIABILITY ISSUES

Capacity has tightened, and variability has increased across priority corridors. The causes are familiar: years of under-investment; deferred maintenance and asset losses; long single-track sections without effective passing loops; signalling faults and speed restrictions that slow operations; and recurrent security incidents that interrupt traction power and train control. Rolling-stock shortfalls add further pressure where locomotive availability and wagon condition remain uneven. Operators highlighted repeated speed restrictions and vandalism-related energy interruptions as routine rather than exceptional.

In this environment, shippers price in time risk. Slipped possession plans and uncertain terminal handovers erode punctuality, inflate buffers, and push time-sensitive flows onto the road even where rail should carry the scale advantage. The appropriate response is to specify corridor-level minimum service standards that are clear, enforceable, and transparently monitored, supported by access rules that make those standards contractible in practice (Department of, 2023).

Recent reforms create an enabling frame. The separation of infrastructure management from above-rail operations, the publication of a Network Statement with access tariffs, and the establishment of an economic regulator supply tools to stabilise service and enforce standards. Feasibility rests on execution. Once published standards for slot adherence, terminal dwell, and cycle time are consistently met, confidence returns and the rail leg can function as a dependable trunk within a railroad chain.

5.4.2 LACK OF INTERMODAL TERMINAL INFRASTRUCTURE

An intermodal system depends on physical transfer hubs, such as inland terminals, freight villages, and dry ports, where loads can move cleanly between rail and road. South Africa has few true inland rail–road terminals beyond legacy sites such as City Deep; the network is instead dominated by highway-oriented distribution centres designed for trucking rather than rail interface. The result is thin node coverage away from ports, long drays to reach the nearest rail point, and limited scope to run scheduled rail legs that connect to dense local delivery.

Institutional design has compounded the gap. Historically, above-rail operations and infrastructure decisions sat within a single state-owned ecosystem that was not configured for partnering with independent terminal developers. Securing spurs, capacity commitments, and operating interfaces were slow and uncertain, which discouraged private investment in shared nodes. Where roles are siloed and access rules opaque, intermodal nodes struggle to emerge or to coordinate reliably with train paths and terminal resources (Monios & Bergqvist, 2017).

The consequence is a classic chicken-and-egg problem: without inland terminals, reliable services are hard to sell; without visible services, terminal projects struggle to bank. Recent reforms have begun to lower these barriers. The Economic Regulation of Transport Act, together with the published Network Statement and access tariffs, sets out clearer pathways for access rights, information disclosure, and contractable service standards, prerequisites for investable terminal projects. The national Roadmap adds direction by identifying corridor priorities and by linking maintenance sequencing, slot allocation, and terminal discipline. What remains is execution at the node level: translating these instruments into bankable projects on priority corridors through standardised access agreements, transparent performance obligations, and staged demand commitments that de-risk early services. Several interviewees argued for standardised access templates and staged volume commitments to “get the first services banked”.

5.4.3 OPERATIONAL INTEGRATION AND COMPLEXITY

Intermodal transport adds handovers by design. Loads must transfer between modes on defined windows, with appropriate handling equipment and common information standards. Each interface introduces coordination risk and cost; unless processes are disciplined, shippers experience extra touches, longer cycle times, and uncertain cut-offs. Shippers described missed windows as “contagious”, with one slip cascading through the day’s plan.

Performance turns on the quality of the interfaces. Misaligned capacity, such as a train arrival without matched truck slots, and equipment shortfalls, drives dwell and disrupts cycle times. Where node processes are standardised, operating windows are published and enforced, and roles are clearly allocated across infrastructure managers, operators, and terminal managers, reliability improves materially.

The management layer is as important as the hardware. Minimum operating standards should set out how the interfaces work in practice: gate appointment systems, pre-advice and time-stamped handovers, target dwell thresholds, and clear exception routines for late trains or missed slots. Digital visibility is integral. Terminal operating systems need to link with train control and fleet management so that plans can be adjusted in real time.

Commercial terms must reinforce the same discipline. Service-level agreements should couple access to delivery at the interfaces, with concise metrics for slot punctuality, handling productivity, gate turn times, and information latency. Well-designed incentives that reward adherence to booked windows and charges that internalise avoidable dwell shift behaviour from substitution to cooperation.

5.4.4 FINANCIAL AND INVESTMENT BARRIERS

Intermodal implementation demands large, front-loaded investment in terminals, rolling stock, and enabling systems. Funding capacity is thin. Transnet's persistent financial strain, reflected in losses and a heavy debt load, limits its ability to finance network renewals at the scale required. Private capital could close part of the gap, yet investors seek bankable projects with clear returns. Intermodal schemes often carry long gestation periods because volumes build slowly and interfaces must stabilise before revenues mature. Investors consulted characterised early volumes as "thin but provable", provided the service standard is published and independently monitored.

Participants stressed that meaningful progress will hinge on even more innovative approaches to financing. According to them, well-structured public-private partnerships and concession agreements could be beneficial, as long as there are transparent risk-takers and assets are shielded over the long term. They noted that there is ample international evidence to support this approach when public finances are stretched, and there is a high collaboration cost. However, they also stated that investor interest is likely to stay at a low level unless the institutional fundamentals strengthen. There has to be clarity in the regulatory frameworks,

access provisions must be enforceable, and there has to be assurance that assets can be managed and protected without high levels of political or operational risk.

The effect of pricing on road and rail transport creates barriers to investment. Exacerbating the problem, road freight does not include the full cost of road damage, congestion, and emissions, while rail has its costs locked in at high levels due to regulated tariffs. The outcome is a price signal that underestimates road while making it easy to assume rail is underpriced, especially on a distance basis, leading to an apparent inter-modal inequity. Policies vary to make the inequity less vexing. Higher road user charges that internalise external costs, or targeted rail support where public benefits are material, strengthen the underlying business case for intermodal investment in settings with fiscal and delivery constraints.

5.4.5 INSTITUTIONAL AND REGULATORY CHALLENGES

South Africa's rail system evolved under a long-standing monopoly that cultivated inward-facing routines and weak customer orientation. Many industry actors became frustrated with slow reform and a protective stance that complicated basic coordination. Track access, timetabling, and service negotiation with a single state owner proved cumbersome in practice. Policy now signals a shift toward open access, yet translating that intent into working arrangements requires detailed rules on safety, pricing, and capacity allocation, supported by credible enforcement.

Change has been gradual. Until recently, private operators could not run on the Transnet network; all movements flowed through TFR. Early steps toward access are underway, but institutional inertia remains a material barrier. Participants described a persistent implementation gap, with policy documents often aligned in principle, while delivery failed to follow. The pattern of instability is partly explained by governance design. As there is no singular executive authority to coordinate an overall governance strategy, multi-actor systems prevail. No executive guidance is designed and decided for NLCC. The stagnation of some freight-rail reforms is not an uncoordinated web, though governance is a central feature of design stagnation. Interviewees highlighted that the dichotomy between 'strong policy words' and 'thin operational follow-through' begs the question of having dominant corridor ownership that would grant decisions around bounded operational timeframes.

Optimal investment is conditioned on the assurance of the rule of law, with zone access, price setting, service levels, and service complaint resolution procedures that are formalised. Informed investors will not make commitments if they are not provided with a formalised

framework, a situation that has delayed or scaled down investment. Reflections on the labour and political economy, the possible impacts of modal rebalancing on trucking and rail (Sebitlo et al, 2022). The link to intermodal feasibility is clear. Without predictable rules, aligned mandates, and enforceable access, the service reliability and terminal discipline that give intermodality its competitive edge are unlikely to materialise.

5.4.6 STAKEHOLDER RESISTANCE AND CULTURAL BARRIERS

Soft constraints of trust, identity, and habit slow change. Many road hauliers remain sceptical of rail, and within Transnet, there is residual resistance to opening access or sharing profitable flows. Large organisations tend to exert control. Smaller trucking firms fear revenue loss and push back against rail-favouring measures. As one senior expert put it, actors often default to “own interests, own profits” rather than system outcomes. The result is thin collaboration. Rail and road operators seldom design truly integrated offers, and even basic information exchange, such as volume forecasts and schedules, is hard to sustain. Shippers add another layer. Their operations are built around the road, with routines, contracts and service expectations that are difficult to unwind without clear and immediate gains.

Reputation matters as much as infrastructure. Years of decline have left many shippers viewing rail as unreliable and dated, while trucking is associated with flexibility and quick response. Participants felt that changing this narrative would rely less on slogans and more on visible performance. Several argued for early, repeatable wins, such as a dedicated daily intermodal service that runs on time for an extended period and is actively communicated to the market. Concrete proof of this kind begins to rebuild trust and gives both public and private actors the confidence to commit to deeper partnerships. In that sense, the reputational recovery of rail is not a side issue, but a direct condition for intermodal feasibility. Cultural and behavioural frictions are not peripheral. Addressing them through targeted strategies, practical joint offerings, and consistent leadership is as important as funding assets or refining regulation, and it underpins the Department of Transport’s reform emphasis on coordinated, corridor-level delivery (Department of Transport, 2023).

5.5 ENABLERS AND RECENT DEVELOPMENTS SUPPORTING INTERMODAL FEASIBILITY

Set against the barriers, several shifts now point in the right direction. Policy signals have strengthened, market conditions are changing, and stakeholders are beginning to test more collaborative operating models. Taken together, these developments improve the practical

prospects for an intermodal offer that can compete on time, cost, and reliability. South Africa's main commodity corridors are shown in Figure 5.1, which illustrates the concentration of flows along a few high-volume routes. Key enablers include:

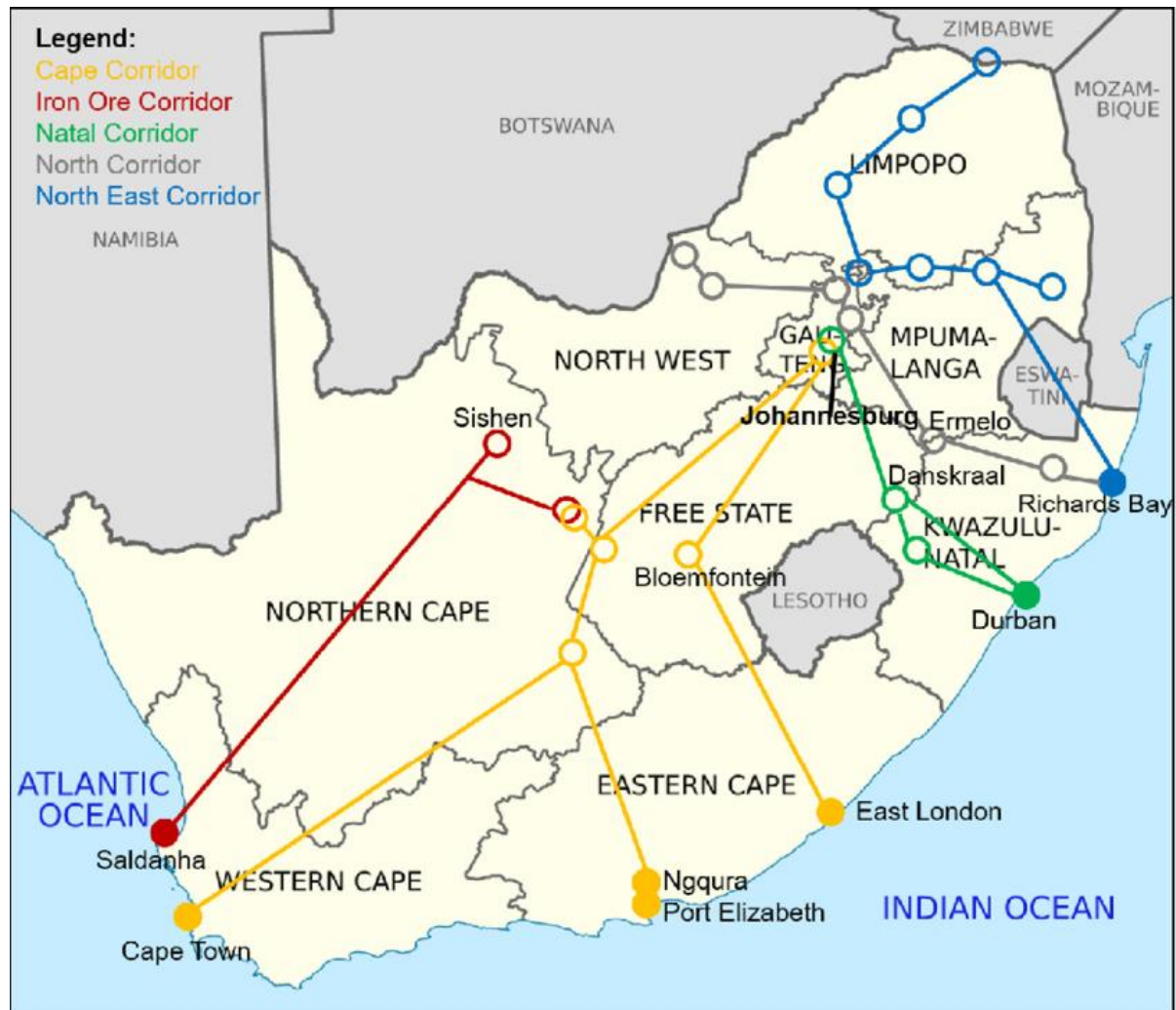


Figure 5.1: South African major commodity corridors (Van Niekerk, 2023)

5.5.1 POLICY REFORMS AND GOVERNMENT INITIATIVES

Freight reform has moved up the public agenda. The 2022 White Paper on National Rail Policy endorses open access to the state network, permitting licensed private operators to secure slots on core corridors (South African Department of Transport, 2022). Implementation followed in 2023-24 as the Department of Transport and Transnet opened access processes on priority routes. By mid-2025, there were 25 applications, with 11 firms shortlisted, a clear sign of market appetite and emerging competitive pressure. As one interviewee noted, “25 applications for 41 routes... 11 operators chosen. This tells me there’s interest... an opportunity to make things better and make money”.

Reform has also been organised institutionally. The National Logistics Crisis Committee, established in 2022, provides the coordination platform. The 2023 Freight Logistics Roadmap then sets out actions to rehabilitate assets, lift service reliability, and integrate networks across modes. These measures align with longer-standing signals, including support for intermodal facilities and modal-shift targets in the Green Transport Strategy, with the emissions case reinforced by recent assessments of South Africa's transport footprint (Climate, 2022). Respondents want the NLCC to publish corridor scorecards so "we can see reliability move from talk to numbers".

Taken together, the policy direction is now explicitly pro-intermodal. Open access, coordinated implementation, and a clear decarbonisation rationale provide a mandate for Transnet and private operators to build credible corridor offers that compete on time, cost, and reliability, which is the practical test of feasibility in this study's framework.

5.5.2 PUBLIC-PRIVATE PARTNERSHIPS (PPP) AND PRIVATE INVESTMENT APPETITE

A clearer role for private capital has matched policy reform. Transnet has indicated that it "will go to market for partners as well as funders" on major schemes, signalling openness to shared delivery models and off-balance-sheet investment where appropriate. Early moves include the planned concession of Durban's Pier 2 container terminal to a private operator and co-investment by mining houses to safeguard export capacity on key corridors. Intermodal facilities sit within this pivot, with private developers and logistics firms bringing forward new terminal and siding proposals. Developers emphasised the need for bankable risk allocation and clear step-in rights to unlock institutional funding.

One illustrative case is the Tshwane Freight Terminal & Logistics Hub in Gauteng. Led by Mzansi Rail Technologies in partnership with the City of Tshwane, the scheme has secured environmental and safety approvals and obtained Transnet's agreement for rail access. Construction is slated for 2025 and will be privately financed. Operators noted that one or two visible early wins on inland terminals would "unlock a queue" of copycat projects. Project materials advertise a projected internal rate of return of about 23% to attract partners, signalling confidence in the revenue model, provided service reliability is delivered in practice. Parallel activity is visible at a smaller scale. One participant noted, "firms such as Grindrod are developing or reopening intermodal sidings, for instance, a private siding in Denver, Johannesburg, to support rail-road transfers and test volume build-up on urban links".

This appetite matters for feasibility. Where policy clarifies access and operating rules, investors are prepared to commit. Over time, well-structured PPPs can attract additional private capital into rolling stock, terminal development, and train operations, which relieves pressure on Transnet's balance sheet and speeds delivery on corridors where public funding would lag. Momentum then builds. Each bankable project that proves predictable slots and disciplined terminals lifts market confidence and enlarges the pipeline of investable intermodal schemes.

5.5.3 INFRASTRUCTURE UPGRADES AND TECHNOLOGY

There is visible movement on the asset base. Transnet's recent budgets earmark roughly R24 to R25 billion per year for corridor modernisation and related reliability work. Maintenance has been intensified: for example, in late 2024 and through 2025, the operator executed extended shutdowns, including a ten-day stop on the iron ore line, with accelerated repairs on coal and manganese routes to restore schedule integrity. Portside upgrades are underway as well. Additional lifting equipment in Durban is intended to speed vessel and yard operations, thereby shortening port dwell and supporting intermodal cycle times inland.

The simultaneous rail road planning is for the adoption of technology. Intermodal services require real-time visibility, scheduled and seamless integration of rail and road. The need for reliable transport has motivated participants to pilot digital logistics systems and shared communication platforms. Communicating with road vehicles, delaying trains to reduce container congestion and task streamlining to reduce fill and repeat documentation technologies.

The assessments confirm that rail electrification and hybrid locomotives are cost-saving to the economy, and have a pivotal role in the decarbonisation of the rail and road freight to reduce emissions. Modern intermodal operations automate cranes and applications programmed to increase terminal throughput. The current technology in South Africa would reduce intermodal transport costs with more accurate time and fewer economic disincentives than the current state of intermodal South Africa.

5.5.4 ENVIRONMENTAL AND SUSTAINABILITY DRIVERS

Environmental commitments now reinforce the commercial case for intermodality. The transport sector produces roughly 10 to 11% of South Africa's greenhouse-gas emissions,

with road freight a major share of that total. Policy direction is clear. The Green Transport Strategy sets a target to shift 30% of freight to rail by 2050, which raises intermodal transport from a niche option to a national objective. Corporate behaviour is moving in parallel. Large shippers with sustainability targets increasingly consider rail to reduce supply-chain emissions where reliable services are available. The signal is consistent: decarbonisation incentives, reputational gains, and compliance pressures all point toward a greater role for rail within door-to-door solutions.

Safety and road preservation add weight to the argument. Every long freight train can remove dozens of heavy vehicles from major highways, improving safety outcomes and lowering road maintenance requirements over time. Stakeholders described the present growth in heavy-truck movements as “simply unsustainable”, saying they “cannot carry on like this”, which creates urgency for alternatives that work at scale. While environmental and social gains are harder for individual firms to price, they strengthen the public-interest case for intermodality and increase the likelihood of supportive instruments, such as grants for terminal development, tax relief for rail shipments, or access to green finance for qualifying projects.

5.5.5 SUCCESSFUL MODELS AND INTERNATIONAL EXAMPLES

South Africa is drawing on mature intermodal models abroad. In Europe and parts of Asia, systems have evolved around modern terminals, coordinated schedules, and stable policy support. The literature highlights consistent success factors, notably long-term planning, public–private cooperation, and targeted technology adoption. Interviewees noted that global carriers, including MSC and Maersk, are investing in inland intermodality to tighten supply-chain control and reduce dwell time. Interviewees noted European freight-village designs as “the closest fit” for South African inland hubs. The methodology demonstrates how operators interlink nodes and corridors in real-time.

These insights are already incorporated into domestic reform. The Freight Logistics Roadmap incorporated worldwide experts and case studies, and its recommendations localised corridor planning and terminal integration. These case references suggest practical designs, including corridor-centred hubs that emulate European freight villages to streamline services, enhance transfers, and increase throughput.

In summary, credible templates enhance confidence that the transition is possible and offer tangible design possibilities for timing investments and synchronising rewards. With the

convergence of policy, investments, technology, and the will of stakeholders, the balance may tip towards a more intermodal-friendly system.

5.6 INDUSTRY-SPECIFIC IMPACTS AND COST CONSIDERATIONS

The economy does not treat every industry the same. While some can quickly adopt the benefits of moving intermodally, other industries will take longer as new volumes, contracts, and locations of plants are established. The key variable is the economy. Companies consider the total delivered cost and consider the trade-offs of speed and service risk. The purpose of this section is to identify where the greatest gains are possible and why. This is done by factoring in an industry's profile, the geographical characteristics of the corridor, the nature of the product, and then comparing to the cost differential of rail vs. road to find the most cost-effective. The purpose is clear to identify the sectors that can readily access intermodally to create value and the manner in which the cost differential drives the mode choice.

5.6.1 INDUSTRIES POISED TO BENEFIT

5.6.1.1 Mining and minerals

Bulk mining is compatible with the use of rail. Coal, iron ore, and manganese are high-density materials that are most efficiently transported across long distances in large amounts. This coincides with the energy and scale benefits of rail. Participants stressed that bulk commodities belong on rail. They reported that when rail service slipped, miners shifted to thousands of truck trips, visible in coal queues into Richards Bay. Interviewees described a straightforward intermodal pattern as the remedy, trucks feeding nearby load-outs with the trunk haul on rail. A credible intermodal design would reverse that pattern. Mines and processing plants would feed nearby rail-loading points by truck, with the trunk haul on rail, stabilising costs and reducing pressure on the highway network.

South Africa already possesses dedicated export corridors. The Sishen-Saldanha line for iron ore and the Ermelo-Richards Bay route for coal provide the backbone; running these assets at sustained, reliable capacity while linking smaller producers through disciplined road feeders would lift throughput and predictability. Industry behaviour points in the same direction. Mining houses have been among the most vocal advocates for rail recovery and, in some cases, have co-financed maintenance on the routes they depend on to protect export volumes and schedules. For the sector, the gain is straightforward: more tonnage moved at a stable unit cost, with lower externalities and fewer operational shocks. This is the type of corridor-level reliability that underpins intermodal feasibility on the broader system.

5.6.1.2 Agriculture (grains and bulk agri)

Interviewees stressed that grain producers stand to gain from a credible rail-linked offer. In strong harvest years, they observed that limited rail capacity means only a small share of grain moves by train, with most volumes shifting to road, at a higher cost. The suggested remedy is practical rather than grand: use bulk rail containers or grain wagons for the trunk move from rural silos to ports and mills, keep trucks for short collection and delivery, and coordinate schedules so the two legs meet cleanly.

The current pattern is already multi-modal in form but not in function. Loads move truck to the silo and back to the truck, with no continuous rail leg to stabilise cost or time. Interviewees argued that developing rail-served silos and containerising selected agricultural flows would unlock scale benefits. Rail's relative insulation from road traffic and driving-hour limits could also smooth peak-season operations and cut fuel exposure.

Feasibility hinges on fit-for-purpose loading points in farming districts and seasonal timetables aligned to harvest windows. Where those basics are met, stakeholders expect lower effective tariffs, fewer weather- or protest-related road disruptions, and steadier cycle times across the chain.

5.6.1.3 Manufacturing and retail (fast-moving consumer goods)

Manufactured goods and FMCGs typically move in containers or on pallets, with huge volumes travelling between Gauteng and coastal distribution centres. Interviewees noted that much of this traffic never leaves the country, yet still defaults to a point-to-point road. They argued that, on suitable flows, an intermodal leg could lower cost without sacrificing service. The condition is reliability. Retailers run tight replenishment cycles, so any rail offer must be both predictable and economical.

A workable pattern emerged from the accounts. Use scheduled, possibly overnight, container trains for the long line-haul and retain local trucking from rail hubs to stores. This configuration can cut per-tonne costs and reduce exposure to driver shortages, route closures, or peak-season congestion. Trials have already occurred on the Johannesburg to Durban route, although inconsistent train performance has constrained uptake. As reliability improves and terminal processes become more disciplined, manufacturers and retailers are likely to expand intermodal use on long-distance corridors while preserving road for the first and last mile.

5.6.2 COST CONSIDERATIONS

The decision between road and intermodal freight is ultimately shaped by three factors: cost, transit time, and reliability. In the current South African context, road transport often appears cheaper and faster on many routes because prevailing tariffs typically exclude external costs, while operational inefficiencies in the rail system push up its effective cost base. Against this backdrop, the sections that follow compare the main cost components that influence shippers' choices between the two options.

5.6.2.1 Direct cost comparison

In principle, rail should have a clear cost advantage for heavy, long-distance movements due to economies of scale and lower fuel consumption per tonne–kilometre. When services run reliably, Transnet Freight Rail's tariffs are often discounted relative to road transport on selected flows. In practice, however, this advantage is frequently diluted. Where rail is slow or unreliable, shippers incur additional costs, including higher inventory holding, increased exposure to damage or theft, and the need to retain standby road capacity as a hedge. Participants repeatedly stressed that these hidden costs erode the apparent price benefit of rail and can tilt the balance back toward road, even when published tariffs seem to favour rail on paper. For intermodal services to be genuinely feasible, rail must therefore do more than offer a competitive per-tonne rate. The additional handling, coordination, and reliability risks introduced by a rail leg need to be more than compensated for by savings on the line-haul component if the overall cost is to compare favourably with a direct road option (Borgi *et al.*, 2017).

5.6.2.2 Handling and transfer costs

Each transfer between road and rail introduces handling costs. Where terminal charges are high, these can quickly erode any line-haul savings that rail might offer. For instance, if a terminal charges around R2 000 to lift a container at each end of the journey, this adds roughly R4 000 per move that a direct road trip would not incur. Rail must therefore generate savings in excess of these additional charges before a shipper will perceive a net benefit. Participants consistently emphasised that efficiency and pricing at terminals are crucial to making the numbers work.

Modern intermodal systems address this by using bulk handling, automation, and higher volumes to reduce per-unit transfer costs. The same principle applies in South Africa. Achieving sufficient, repeatable volume on priority corridors will be necessary to drive down handling charges. Several participants argued that this will likely require more integrated pricing structures, such as through-rates that offer a single, door-to-door price rather than itemising every lift and move. Their concern was that customers currently “see the added handling fees” and disengage, even where the total chain cost might be competitive. Suggested remedies included targeted pilot services in which rail operators and trucking firms partner to offer promotional intermodal rates, with the explicit aim of demonstrating door-to-door value rather than foregrounding individual handling charges.

5.6.2.3 Externality costs and incentives

From a broader societal perspective, intermodal freight with a greater rail share is cheaper when external costs are taken into account. Each tonne shifted from road to rail reduces pavement damage, lowers the burden on publicly funded road repairs, and cuts accident and pollution costs. Participants repeatedly returned to this point, arguing that current price signals understate the true cost of long-distance road haulage. This provides a clear rationale for the government to incentivise rail use in order to recognise these external benefits. International practice includes measures such as eco-rebates for firms that use rail, or higher tolls and user charges for heavy trucks on key corridors to narrow the gap between private and social costs. Interview participants observed that similar instruments have already been discussed in South Africa, including higher tolls for heavy vehicles on strategic routes and port fee rebates for containers that move by rail rather than road. If implemented consistently and with clear rules, measures of this kind would strengthen the cost competitiveness of intermodal services. Existing policy tools already point in this direction. With a carbon tax already in place for large emitters, firms have a direct financial incentive to shift suitable flows towards lower-emission modes, particularly where electric or otherwise more efficient rail traction is available and delivers a markedly smaller carbon footprint per tonne–kilometre than diesel trucking. Several participants further noted the role of green finance, pointing out that investors are increasingly willing to back intermodal infrastructure at preferential rates when projects qualify as sustainable development, a trend that can materially strengthen the business case for terminal and corridor investments.

5.6.2.4 Service quality vs. cost trade-off

Interview accounts made it clear that many shippers place reliability and speed ahead of absolute price. Where rail cannot meet agreed delivery windows, firms are willing to pay a premium for road transport to protect production schedules and customer service. Participants described how unreliability on the rail leg forces them to build costly contingencies into their logistics, such as additional safety stock, parallel road capacity, or more expansive delivery windows. Improving rail service quality, in terms of punctuality, security, and real-time tracking, is therefore a central enabler of intermodal competitiveness because it allows these buffers to be reduced. Several participants emphasised that if rail could consistently guarantee, for example, a 24-hour delivery between Durban and Johannesburg, many businesses would be prepared to switch even at a slightly higher nominal rate, simply because predictable transit times are easier to plan around. Over the longer term, a well-utilised intermodal network is expected to lower overall logistics costs for the economy. Existing studies suggest that a more balanced modal split results in lower aggregate costs when externalities are correctly accounted for. The practical challenge is to reach the critical volumes at which these efficiencies begin to materialise.

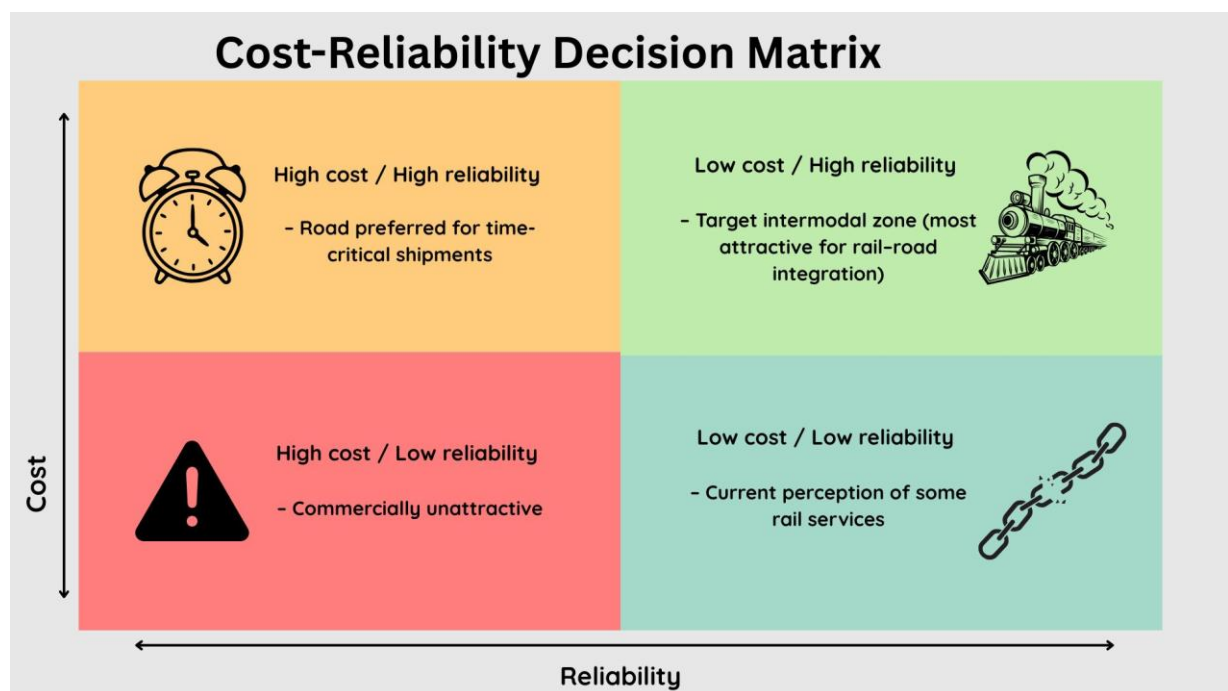


Figure 5.2: Cost-Reliability Decision Matrix (Author's own compilation)

Taken together, the cost analysis suggests that sectors such as mining, agriculture, and retail are the most likely early adopters of intermodal services. These industries offer the combination that intermodality requires: sufficient, repeatable volume and corridor profiles that lend themselves to rail-linked movements. Whether intermodality can compete based on cost will depend heavily on the consistency of rail operations and on terminals that handle transfers quickly enough to offset the extra steps in the chain. If policy instruments are designed so that users face a closer approximation of the full cost of their transport choices, and if industry players work together to simplify operations and pricing, intermodal freight can shift from a largely theoretical option to a commercially viable alternative for a growing share of South Africa's cargo flows.

5.7 CONCLUSION

Developing South Africa's intermodal road–rail freight is a case of intermodal road–rail freight system is both necessary and complex. Currently, there is an over-reliance on road transport, which is unsustainable in a multitude of ways. It increases the cost of transport logistics, quickly deteriorates the condition of critical transport routes, increases the level of accidents, raises the level of emissions and decreases the level of safety.

An operational intermodal system will bring about positive changes by decreasing road traffic and accidents, reducing road maintenance, cutting down on fuel, and lowering vehicle pollution as well as emissions. In addition, for several long corridors, intermodal transport is likely to provide transport cost stability and, in some instances, reduced transport costs for businesses. There was consensus that the transition towards intermodal transport is not merely an option but rather an urgent necessity for South Africa in order to avoid having an already overused freight system act as a major obstacle to economic growth.

At the same time, it is evident that the transition will not be done quickly, nor will it be done by a single step, and this is where the research shows evidence. The support and progress on the different fronts do not appear to be in sync, and this is where the research shows evidence. Rail still remains the biggest challenge; intermodal transport is unlikely to attract and retain users without consistent intermodal transport.

Recent reforms, including moves toward open access and greater private participation, together with early investment signals, point in the right direction, but they will need to be deepened, sequenced, and managed carefully. Intermodal feasibility is therefore better understood as a trajectory than a binary judgement. In the near term, viable services are most likely to emerge on a limited set of high-volume corridors, such as the main links between Gauteng and the ports and the established mineral export lines, where conditions for success can be created and demonstrated. Over the medium to longer term, as trust in rail is rebuilt, as inland nodes become operational and as corridor-level performance is proven, the scope for intermodal solutions can widen to additional routes and commodities.

5.8 RECOMMENDATIONS

Based on the findings of this study, a set of practical actions is proposed to strengthen the feasibility of intermodal freight and to accelerate its implementation in South Africa. The recommendations reflect both the structural issues highlighted in the literature and the lived experience of participants who work daily within the freight system.

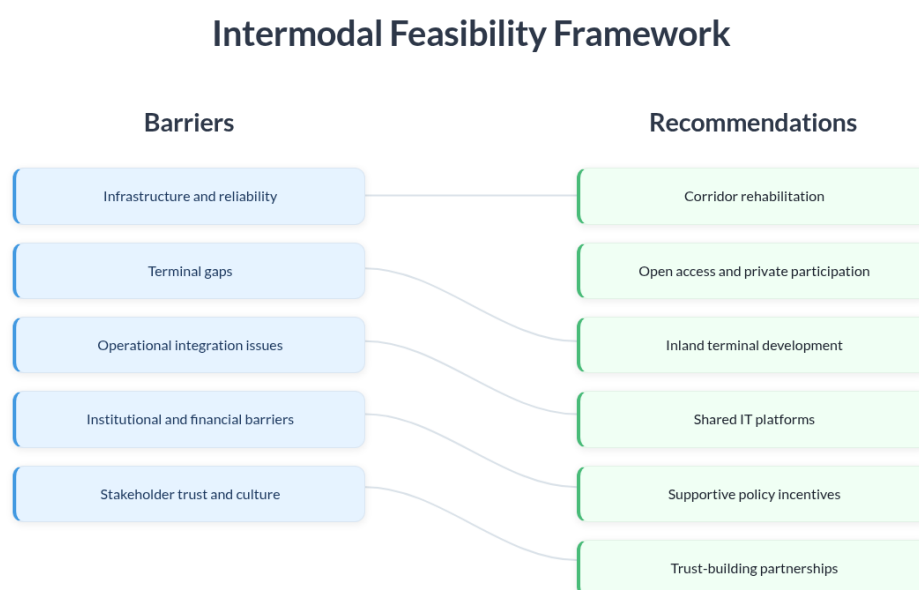


Figure 5.3: Intermodal Feasibility Framework (Author’s own compilation)

5.8.1 REHABILITATE AND MODERNISE RAIL INFRASTRUCTURE AS PRIORITY NUMBER ONE

There is no substitute for fixing the basics. The priority is to stabilise and upgrade the core rail corridors that carry, or could carry, significant freight volumes. This requires sustained programmes to repair tracks, modernise signalling, address locomotive and wagon shortages, and protect the network against theft and vandalism through strengthened security and appropriate technologies. Funding for these works should be treated as a critical infrastructure investment, not discretionary spending.

Participants stressed that visible improvements in day-to-day service, such as shorter transit times, fewer cancellations, and more predictable departures and arrivals, will do more to persuade shippers to return to rail than any marketing campaign. Restoring consistent operational performance on a small number of key corridors will create the credibility on which intermodal services can be built.

5.8.2 EXPAND OPEN ACCESS AND PRIVATE SECTOR PARTICIPATION

The emerging momentum on opening the rail network to third-party operators needs to be maintained and deepened. Clear, workable frameworks for private train operations should be finalised, including transparent track access charges, safety requirements, and fair mechanisms for resolving disputes.

Bringing credible private operators into the system can do more than fill a funding gap. It can introduce additional capital, fresh operational discipline, and a more explicit focus on the needs of customers. Participants noted that if mining houses, logistics companies or specialist rail operators can run trains reliably or secure dependable contracted services, they are far more likely to commit to building and upgrading intermodal terminals, sidings, and associated equipment. A more competitive operating field can also create constructive pressure on Transnet Freight Rail to lift its own performance.

At the same time, there was a strong sense that the first cohort of private operators would need both support and careful oversight. Suppose these early entrants are seen to operate safely and deliver consistent services. In that case, their track record can help to rebuild confidence in rail and make it easier for additional operators and investors to follow.

5.8.3 DEVELOP A NETWORK OF INLAND INTERMODAL TERMINALS

A coherent approach to inland intermodal terminals is essential if intermodality is to move beyond isolated projects. The state, working either on its own or in partnership with the private sector, needs to identify and develop freight hubs at strategic points along priority corridors. Likely locations include sites in Gauteng, consolidation points in KwaZulu-Natal, inland hubs linked to the Eastern Cape ports, and suitable nodes in the Western and Northern Cape.

These terminals should be planned from the outset for efficient transfer between road and rail. In practical terms, this means modern handling equipment, disciplined gate processes, sufficient stacking capacity, and the ability to turn both trucks and trains around quickly. Government can play a catalytic role by encouraging logistics park developers to incorporate rail sidings in their designs and by simplifying approvals where rail-linked layouts are proposed. Participants also drew attention to opportunities at a smaller scale, such as district-level intermodal yards or silo-to-rail transfer facilities in grain-producing regions. Taken together, investments of this kind would begin to create the hub-and-spoke network that intermodal flows require to operate at meaningful, repeatable volumes.

5.8.4 ENHANCE COORDINATION AND INFORMATION SYSTEMS

Operational integration will not happen on its own. Stakeholders need shared information systems and forums that allow them to plan and problem-solve together. One practical step is to expand existing rail and port scheduling systems into a more integrated logistics platform that enables customers to track shipments across modes, from origin to destination. Real-time visibility of train running, terminal status, and truck movements would help reduce delays and improve planning.

In parallel, there is a need for regular coordination forums at corridor level, particularly on the main Gauteng–Durban route and other high-volume links. These platforms should bring together rail operators, road carriers, terminal managers, and major shippers to identify bottlenecks, align operating windows, and adapt plans when disruptions occur. Existing national coordination structures could, over time, evolve into a more permanent freight oversight function with a clear mandate to intervene early when signs of congestion or operational failure emerge. Participants also highlighted the importance of targeted education and outreach, for example, practical workshops for freight forwarders and transport managers

that explain how new intermodal services operate in practice and what users need to do to succeed.

5.8.5 IMPLEMENT SUPPORTIVE POLICIES AND INCENTIVES

Policy instruments can help shift behaviour where intermodality offers a clear public benefit. The government should consider measures that gently tilt the playing field in favour of rail for appropriate flows, while still recognising the essential role of trucking. Options include adjusting road freight levies on heavy vehicles along specific corridors, earmarking part of the revenue for rail and terminal improvements, and providing time-bound tax incentives or rebates for companies that move a defined share of their freight by rail where rail services are available.

Regulatory frameworks for truck sizes, weights, and driving hours can also be reviewed to ensure that they support a complementary model in which road focuses on first and last mile, and rail on the trunk haul, rather than encouraging long-distance point-to-point road movements by default. Public entities can reinforce this direction by specifying intermodal or rail-linked solutions in their own tenders where feasible, thereby creating early baseline demand for new services.

5.8.6 BUILD STAKEHOLDER TRUST AND PARTNERSHIP

Finally, the softer issues of trust, identity, and habit need explicit attention. Participants spoke about deep-rooted scepticism in parts of the road sector toward rail, and about a reluctance within some rail structures to share control or open up established practices. One way to begin shifting this pattern is to create dedicated public–private task teams for major corridors and flagship projects. If road freight associations and trucking firms are involved early in the design of intermodal services, and if clear last-mile roles and contracts are agreed, the conversation can move from fear of displacement toward more balanced, mutually beneficial arrangements.

Within the rail environment itself, a visible commitment to customer-centred behaviour and transparency is just as important. Regular, publicly available reporting on key corridor performance, and, in time, limited service guarantees or compensation mechanisms for repeated failures, would signal a serious intent to improve reliability. Participants often returned to the idea of early, well-run pilots, such as a dedicated daily intermodal train on a core corridor that runs on schedule for an extended period. They argued that concrete

demonstrations of this kind, if communicated clearly to the market, can begin to shift entrenched perceptions.

Taken together, the analysis suggests that an intermodal freight system in South Africa is attainable if these actions are pursued in a coordinated and sustained way. The interview material indicates that the concept is not only technically viable but is also widely supported by practitioners who are acutely aware of the limits of a road-dominated model. The next few years are likely to be decisive. With clear political intent, focused investment, and genuine partnership across the freight community, South Africa can move towards a more balanced, resilient, and sustainable freight system that makes better use of the respective strengths of both road and rail.

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ANNEXURE A: INFORMED CONSENT FORM

Assessing the feasibility of a local intermodal transport freight system in South Africa.

Principal Investigator:

Riaan Muller

Master of Business Administration Candidate

North-West University

Purpose of the Study:

You are invited to participate in a research study that forms part of a Master of Business Administration (MBA) degree at North-West University. This study aims to examine the **feasibility of a local intermodal transport freight system in South Africa**, focusing on the main barriers and facilitators surrounding the implementation of an intermodal freight solution in South Africa.

Your participation is **voluntary**, and you are encouraged to read this document carefully before making a decision.

What Will Be Expected of You?

If you agree to participate, you will be required to:

- Take part in a **semi-structured interview (45-60 minutes)**.
- Provide insights related to rail freight transport, policy, infrastructure, and intermodal integration.
- Allow **audio recording** of your session for research purposes (you may request to review the transcript).
- Understand that your identity will be kept **confidential** and anonymised in the study's findings.

Voluntary Participation & Right to Withdraw

- Participation in this study is **completely voluntary**.
- You **may withdraw** at any time without providing a reason and without any consequences.
- You can **decline to answer** any question that makes you uncomfortable.
- If you withdraw, all data provided up to that point will be **deleted upon request**.

Confidentiality & POPIA (Protection of Personal Information Act) Compliance

This study complies fully with the Protection of Personal Information Act (POPIA), Act No. 4 of 2013. The following measures are in place to ensure your personal information is protected:

- **Anonymity:** Your name and personal identifiers will not appear in any published material. A unique participant code will be used in all documentation and data files.
- **Informed Consent:** By signing this form, you acknowledge that your participation is voluntary and that you have been informed of your rights concerning personal data protection.
- **Secure Data Handling:** All audio recordings, interview transcripts, and notes will be stored on a password-protected device accessible only to the researcher and supervisor.
- **Limited Use and Access:** Your information will only be used for the purposes of this academic study and will not be shared with any third parties.
- **Retention and Deletion:** Data will be retained securely for five years in line with the university research policy and POP

Potential Risks & Benefits

Risks:

- **Minimal risk** is associated with this study. You will not be asked to share sensitive or confidential business information.
- You may stop the interview at any time if you feel uncomfortable.

Benefits:

- Your insights may **contribute to policy discussions and infrastructure development** in South Africa's freight logistics sector.
- You will receive an **executive summary** of the findings upon completion of the study, if requested.

Ethical Approval

This study has been approved by the **NWU Economic and Management Sciences Research Ethics Committee (EMS-REC)** and complies with the ethical standards of North-West University and international research guidelines.

Further Information & Contact Details

If you have any questions regarding this study, please contact:

Researcher: Riaan Muller

Email: 26989182@mynwu.ac.za

Phone: 084 627 3304

Supervisor: Professor Wim Roestenburg

Email: wim.roestenburg@nwu.ac.za

Consent Statement

I, **(Full Name)** _____, confirm that:

- ✓ I have **read and understood** the purpose, procedures, and risks of this study.
- ✓ I **voluntarily agree** to participate in this research.
- ✓ I consent to an **audio recording** of my interview/focus group discussion.
- ✓ I understand that my identity will remain **confidential**, and data will be securely stored.
- ✓ I understand that I can **withdraw at any time** without consequence.

Please tick one option:

- ☐ I **agree** to participate in this study.
- ☐ I **do not agree** to participate in this study.

Participant Signature: _____ **Date:** _____

Researcher Signature: _____ **Date:** _____

ANNEXURE B: INTERVIEW SCHEDULE

Semi-Structured Interview Schedule

Title of Study: Assessing the feasibility of a local intermodal freight transport system in South Africa

Researcher: Riaan Muller

Institution: North-West University Business School

Format: Online (Microsoft Teams)

Estimated Duration: 45-60 minutes

Introduction to Participant

Thank you for taking part in this interview. I'm interested in understanding expert perspectives on the feasibility of intermodal freight transport in South Africa. Intermodal freight refers to the movement of goods using more than one mode of transport, in this case, road and rail, in a coordinated and efficient way, without handling the cargo itself when switching modes. So, for example, a container might start on a truck, then be placed on a train at a local intermodal hub, and then go back on a truck for final delivery, without the goods being unpacked in between.

You were selected because of your experience in freight logistics. Your insights will remain confidential, and you can skip questions or withdraw at any time. May I confirm that you're comfortable proceeding and that I have your consent to record this interview?

Section A: Context and Background

1. Can you briefly describe your current role in the freight logistics sector and your main area of expertise (e.g., rail, road, policymaking, infrastructure, etc.)?
2. What major changes or trends have you noticed in the South African freight transport sector in recent years?
3. How would you describe the current relationship between rail and road transport in South Africa?
4. How familiar are you with the concept of intermodal freight transport?
5. In your view, is this concept widely understood and discussed in your professional environment?

Section B: Exploring Feasibility, Barriers, and Enablers

1. Given the current political, economic, and infrastructure landscape, how feasible do you believe a national intermodal freight system is in South Africa?
2. What motivates or discourages the pursuit of such a system in your view?
3. What infrastructural or operational issues make integration between rail and road difficult?
4. Do you believe funding limitations or capital investment requirements are significant obstacles?
5. How do regulatory or institutional challenges affect the intermodal shift?
6. Is there resistance from within the freight sector, for example, from dominant road freight operators?
7. Are current government or transport policies supporting intermodal development?
8. What role do public–private partnerships play in making intermodal transport viable?
9. How do environmental and sustainability goals influence strategic logistics decisions?
10. Which industries (e.g. mining, agriculture, manufacturing) would benefit most from improved intermodal systems?
11. Are there technological tools or innovations that could improve cargo coordination across modes?
12. How do cost comparisons between road and rail affect decision-making in logistics?
13. What can be done to strengthen cooperation and collaboration across the logistics sectors?

Section C: Final Thoughts

1. If you had one message to share with South African policymakers about intermodal freight systems, what would it be?
2. Is there anything we haven't discussed that you believe is important to include in this research?
3. Would you be willing to refer other professionals in your network who might have relevant expertise? If so, are you comfortable contacting them first to introduce the study?

ANNEXURE C: ETHICS APPROVAL LETTER



Private Bag X1290, Potchefstroom
South Africa 2520
Tel: 018 299-1111/2222
Fax: 018 299-4910
Web: <http://www.nwu.ac.za>
Senate Committee for Research Ethics
Tel: 018 299-484
Feziwe.Mseleni@nwu.ac.za

23 June 2025

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **North-West University Economic and Management Sciences Research Ethics Committee (EMS-REC)** on 23 June 2025, the Economic and Management Sciences Research Ethics Committee hereby **approves** your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-REC) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title:	Assessing the feasibility of an intermodal rail freight system in South Africa														
Study leader/Supervisor (Principal investigator/Researcher:	Prof W.J.H. Roestenburg						University no.:	13285262							
Student:	A.W. Muller						University no.:	26989182							
Ethics number:	N	W	U	-	0	0	6	9	7	-	2	5	-	A	4
Institution Study number Year Status Status: S = Submission; R = Re-submission; P = Provisional authorisation; A = Authorisation															
Application type:	Single study - Postgraduate research						Risk level:	Low/minimal risk							
Commencement date:	6/23/25														
Expiry date:	6/23/26														
<i>Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.</i>															

Special in process conditions of the research for approval (if applicable):

None.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- The study leader/supervisor (principal investigator)/researcher must report in the prescribed format to the EMS-REC:
 - annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and
 - without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.
- The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the EMS-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.
- Annually a number of studies may be randomly selected for an external audit.
- The date of approval indicates the first date that the study may be started.
- In the interest of ethical responsibility, the NWU-SCRE and EMS-REC reserves the right to:
 - request access to any information or data at any time during the course or after completion of the study;
 - to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;
 - withdraw or postpone approval if:
 - any unethical principles or practices of the study are revealed or suspected;
 - it becomes apparent that any relevant information was withheld from the EMS-REC or that information has been false or misrepresented;
 - submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or
 - new institutional rules, national legislation or international conventions deem it necessary.
- EMS-REC can be contacted for further information or any report templates through the secretariat. Botlanyana Maluleka (Botlanyana.Maluleka@nwu.ac.za/ +27 18 2852436) or the chair Prof Diana Viljoen-Bezuidenhout (Diana.Viljoen@nwu.ac.za / +27 16 9103403).

The EMS-REC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the EMS-REC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,

Prof Diana
Viljoen-
Bezuidenhout

Digitally signed by Prof
Diana Viljoen-
Bezuidenhout
Date: 2025.06.27
08:53:16 +02'00'

Prof Diana Viljoen-Bezuidenhout

Chairperson: NWU Economic and Management Sciences Research Ethics Committee

ANNEXURE D: LANGUAGE EDITING CERTIFICATE

RUAN FOURIE

COPYEDITING CERTIFICATE

ASSESSING THE FEASIBILITY OF AN INTERMODAL FREIGHT TRANSPORT SYSTEM IN SOUTH AFRICA

by AW Muller

Be it hereby certified that the abovementioned mini-dissertation has been copyedited and proofread for accuracy, clarity, and proper English usage.



ruanfourie23@gmail.com

082 068 6077

ANNEXURE E: TURNITIN REPORT

26989182:RiaanMuller_26989182_Mini_Dissertation_Assessi...

ORIGINALITY REPORT

4%	3%	2%	1%
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ANNEXURE F: EXAMINER REPORTS



Examiner report
2.pdf



Examiner report
1.pdf