

***IMPERATIVES FOR THE ADVANCEMENT OF FREIGHT
INTERMODALISM IN SOUTH AFRICA: A SYSTEMS THINKING
APPROACH***

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Thesis submitted in fulfilment of the requirements for the degree

Doctor of Management in Technology and Innovation

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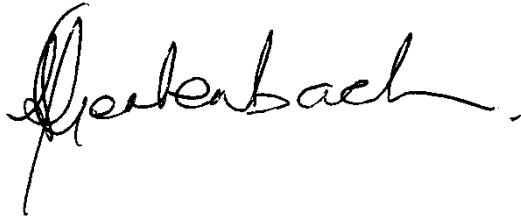
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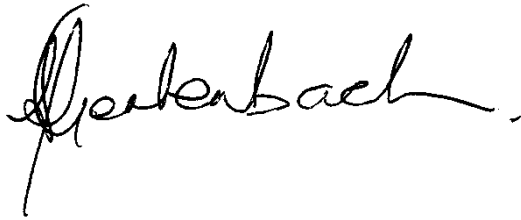
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Acknowledgements

The process of this lengthy journey was made possible by a number of people who deserve to be acknowledged.

I wish to thank Prof Paul Singh of the DaVinci Institute, who has guided me, from acceptance of my proposal to finalisation of my thesis. His contribution to my knowledge of the academic journey has been invaluable.

The DaVinci Institute's focus on systems thinking grounded my studies. I derived knowledge from online lectures and workshops by Prof Singh and his colleagues. I would like to thank Dr du Plooy-Cilliers who acquainted me with cynefin and transdisciplinary thinking principles. I especially acknowledge the absolute efficiency of Nare Mashiane at the library who was beyond helpful over the entire research period.

Heartfelt gratitude is extended to every single SME and system focus group actor for giving of their time and wisdom to enable me to collect valuable data that formed the backbone of my study. I was a stranger to most, and got to know others who stayed in touch, followed up and constantly shared ideas, thoughts, books and articles of interest; special thanks to Evert de Ruiter.

Thank you, Elvin Harris, for investing time and interest to facilitate my focus group discussions; this was most appreciated. Thanks to Lita for capturing the discussions in creative graphics that added a novel dimension.

My interest in the freight logistics industry was inspired by Prof Emeritus Jan Havenga more than three decades ago. He continues to share his incredible experience, knowledge and wisdom as the expert on macrologistics.

I am indebted to many past managers, mentors and colleagues at Transnet who have inspired me and from whom I learnt so much over decades.

I always appreciated the proud encouragement from my sisters and extended family members and close friends.

This thesis is dedicated to the memory of my husband Steve who always supported me as I pursued my studies. Our sons Matthew and Ian have continued that support in the most incredible way.

Matthew kept reminding me of the importance of setting goals and consistently adhering to the process. He encouraged me when I encountered significant hurdles and difficult times before and during this journey.

Ian astounded me with his deep grasp of the academic process and his understanding and appreciation for what I was trying to convey about freight intermodalism and systems thinking. He was a brilliant sounding board as was his partner, Megan Henderson. I am also indebted to Megan who spent hours listening to audio recordings to give assurance to the veracity of the research transcripts.

I sincerely acknowledge all the support.

Abstract

The overall high cost of logistics, freight system imbalances and inefficiencies detract from South Africa's competitiveness. Improved freight intermodalism has the potential to advance transport and logistics system performance. The objective of the study was to explore why the adoption of a systems thinking paradigm and the collective interactions between willing freight intermodal system actors, could contribute to the development of intermodalism for national outcomes. Data was collected for the qualitative study through multiple methods, viz. documentary analysis, SME interviews, and focus groups. Thematic analysis of data generated six themes, and with the application of systems thinking approaches, resulted in recommendations for possible application. The systemic and continuous fusion of technology, people and innovation are needed to promote effective interactions amongst actors to pursue opportunities and realise value. A novel contribution originated in conducting focus groups, as a proxy representation of actors in South Africa's real world freight intermodal system, to illustrate the many benefits of applying collaborative approaches to improve the system for the benefit of all stakeholders, and the country. A key finding was that advancements could be leveraged by working collectively and directing interventions to the improvement of key interfaces between system parts. Focus group discussions reflected the willingness of key actors to collaborate, cooperate and coordinate to advance system purpose and performance to effect change as an outcome. Actor interactions should strive for co-creation of priority interventions, to be collectively implemented by actors, for the betterment of the country's freight system. The study may have significance for application by freight intermodal industry and system actors, policy makers, academics, and lobbyists. It is in the interests of the country to advance freight intermodal practices to improve freight transport competitiveness, efficiency, supply chain resilience, transport infrastructure utilisation and condition maintenance. Freight intermodal system competitiveness could contribute to improvements in economic performance, environmental sustainability and the well-being of South Africa's people.

Key Words: Intermodal Freight; Systems Thinking; Interfaces; Collaborate; Cooperate; Coordinate; Innovation; Collective; Competitive

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List of Acronyms

Acronym	Definition
3PL	Third Party Logistics
AfCFTA	African Continental Free Trade Areas
CBD	Central Business District
CEO	Chief Executive Officer
COVID-19	Coronavirus disease 2019
DC	Distribution Centre
DoT	Department of Transport
DPE	Department of Public Enterprises
ERRP	Economic Reconstruction and Recovery Plan
FEU	Forty Foot Equivalent container
FG	Focus Group
FMCG	Fast Moving Consumer Goods
GDP	Gross Domestic Product
IT	Information Technology
IoT	Internet of Things
ISO Container	International Organisation Standard (for a shipping container)
KPI	Key Performance Indicator
LSP	Logistics Service Provider
MIDP	Motor Industry Development Programme
MST	Microsoft Teams (appointment and meeting application)
N3	National Road between Durban and Johannesburg
NATCOR	Natal Corridor Rail route between Durban and Johannesburg
NDP	National Development Plan
OEM	Original Equipment Manufacturer
PBS	Performance Based Standards
PFMA	Public Finance Management Act
PI (or π)	Physical Internet
PPP	Public Private Partnership
RFI	Request for Interest
RFP	Request for Proposals
RFQ	Request for Quotations
RSA	Republic of South Africa
RSR	Rail Safety Regulator
RTMS	Road Traffic Management System
SA	South Africa
SAAFF	South African Association of Freight Forwarders
SAASOA	South African Association of Ship Operators and Agents
SCM	Supply Chain Management
SANRAL	South African National Road Agency Limited

1. CHAPTER ONE

INTRODUCTION

1.1 Research introduction and background

This research project adopts a systems thinking approach to investigating the requirements for advancing the South African freight intermodal system. The research was conducted through a consideration of the elements that constrain or promote compacts and common objectives required amongst the various intermodal system actors. Improved working and system delivery would have positive outcomes for growth and development of the country's freight transport logistics system towards the achievement of national objectives for a fledgling (or floundering) developmental state.

At a fundamental level, the researcher defines freight intermodalism as the seamless movement of unitised freight (usually in containers to reduce handling of the actual freight) and using consecutive modes of transport to move goods for trade. Freight movement between transport modes is facilitated by *nodes* that link transport *modes* for efficient exchange and transfers through the chain from origin to destination. The information, data, equipment and interactions between system actors, at core interfaces, that enable complex processes, are the elements that distinguish intermodalism from multimodalism (the use of two or more modes). The definition of the phenomenon of freight intermodal is analysed in Chapter 2 which elaborates upon the concept and also considers advanced terminologies such as intermodal connectivity, transmodal connectivity and synchronomodality.

The researcher envisaged that a systems approach to the phenomenon may identify the impact and importance of key links and relationships that are required for the development and sustainability of intermodalism in the country. The study aimed to contribute to the freight logistics industry through the development of shared systemic objectives and common priorities to build a strategic conceptual framework that would assist in identifying interventions or points of leverage for improvement, with outcomes that add value to addressing freight transport challenges in the country.

This chapter sets out the context for exploring this paradigm and the foundation philosophies that influence the research direction and selected methodology.

1.2 Research Context

In the developed world, countries such as the United States and Australia as well those in Europe exhibit advanced freight intermodal systems that have continuously evolved since the growth of manufacturing industries and even before the introduction of standardised ISO shipping containers. These intermodal systems have been used to streamline processes for greater efficiency and cost-effectiveness of supply chains and global value chains. In many African countries, containerisation was adopted, bringing about the development of ports, terminals, transport and handling equipment to enable trade and support supply chains. In most African countries, including South Africa, greater focus was placed on the development and performance of supply chains for the export of raw materials. The performance and advancement of intermodalism is thus less mature as is reflected in measures of logistics performance.

Over the past two decades, supply chains around the world have been exposed to shocks (for example, geopolitical events, financial crises, disease, volcanic eruptions, climate change flooding and drought) that have disrupted trade flows and transport systems. The effects of the Covid-19 global pandemic and its impact on supply chains and transport systems have exposed weaknesses in freight logistics and transport systems. The increasing intensity and frequency of such events have prompted countries to place increased national focus on risk management, business continuity and strategies for transport and logistics to improve the sustainability and resilience of supply chains.

This study focuses specifically on freight intermodalism in South Africa and its advancement in the country such that challenges may be addressed, opportunities harnessed and to contribute to the country's economy. South Africa's freight transport sector, as highlighted by the Logistics Barometer South Africa 2016, is significant in that logistics costs of the country (relative to Gross Domestic Product (GDP)) were estimated at "R429 billion in 2014 and equated to 11.2% of GDP or 51.5% of transportable GDP" (Havenga, Simpson, King, De Bod & Braun, 2016, p. 5). Furthermore, a developing country requires a competitive logistics system for future prosperity and prospects (Havenga, Simpson, De Bod & Viljoen, 2014; Havenga, Simpson, De Bod & Pienaar, 2013).

South Africa's land freight transport sector is dominated by road transportation in that approximately 85% of freight is transported by road hauliers and only 15% of freight is transported by the country's rail system (Havenga *et al.*, 2016). This modal imbalance results

in high externality costs to the country with roads being congested; road infrastructure requiring frequent and costly levels of maintenance and expansion; high incidence of accidents on roads; and increasing carbon emissions (Guo & Peeta, 2015). This distorted modal share indicates that the South African road system is over-burdened (to the detriment of public users) and the rail system is not fully utilised despite rail inherently being a cost-effective and more environmentally friendly means of freight transportation.

The current situation, and forecasts for the country's freight transport demand (which is projected to more than double over the next three decades) (Havenga *et al.*, 2016), require that alternative, innovative solutions are sought to address the country's freight transport task.

Modal imbalances between road and rail modes exist in many countries and contesting for market share in the freight transport industry is highly competitive (Akinlabi & Mbohwa, 2016). Modal imbalances contribute to a less-than-effective overall freight transport system. This is the case in South Africa, especially on general freight corridors that evidence a road market share of 79% of Tonne-km (Havenga *et al.*, 2016). Modal imbalances and less-than-efficient terminals and port performance all contribute as indicators of low levels of freight intermodalism in the country.

South Africa's freight transport system reflects various imbalances, in addition to the road-rail modal imbalance, inefficiencies are apparent in the fundamental interfaces between shipping, ports, terminals and transport modes resulting in costly and less than effective solutions to the country's freight transport task. This challenge is of extreme inconvenience to the general public of road users and is exacerbated by growing freight transport demands in South Africa. Intermodalism comprises seamless interfaces between modes and nodes such that road operators, terminal operators, logistics service providers, ports, terminals and distribution centres; and the railway fulfil appropriate roles and effort in the freight system as part of the solution to addressing this national challenge.

Developments and advances in intermodalism in South Africa are immature and have not been successfully implemented. For more than two decades South African policy-makers have advocated a shift of traffic from road to rail and for greater levels of intermodalism to be developed to address the country's freight system challenges. Notable policy developments

since the early 1990s and as recently as 2022 reflect the intent to develop intermodalism for freight in the country, for example:

- i. Moving South Africa, 1999 – indicated, *inter alia* the need for intermodal system development to address modal imbalances, improve terminals functioning to fulfil roles of critical links in the system, invest in container ports, integrate sub-systems and develop intermodal solutions to meet customer demand and needs (South Africa: Department of Transport, 1999).
- ii. National Rail Policy White Paper, 2017 – indicated that intermodal development is hindered by the lack of symbiotic relationships between modes and the need for rail to collaborate to develop intermodal technologies and solutions on dense corridors. (Government of South Africa, 2017)
- iii. Road Freight Strategy, 2017 – called for a more optimal modal split, better coordination between all role players, improved logistics and intermodal coordination (Government of South Africa, 2017).
- iv. The National Infrastructure Plan 2021 – provides a vision for mission-critical infrastructure networks, including freight transport, with detailed attention given to the development of intermodal freight infrastructure that is integrated with intermodal hubs, Special Economic Zones (SEZs) and efficient border posts (Government of South Africa, 2022).
- v. National Rail Policy White Paper, 2022 – an aim of the policy is "to place the rail on a sound footing to play a meaningful role as a backbone of a *seamlessly integrated transport value chain* able to make a meaningful contribution to the economy". (Government of South Africa, 2022, p. 7). The reference to integrated value chains supports the notion of intermodalism and the role of rail in contributing to competitive supply chains.

Intermodalism in the form of collaboration and investment in intermodal technologies has been implemented in Europe, the US and Australasia. In these countries, road hauliers have been willing to partner with the railway due to the perceived benefits of reducing the costs of transport, road maintenance and insurance (Havenga, Simpson & De Bod, 2012). Intermodal implementation has been slow in South Africa with road-only solutions dominating the freight system (Government of South Africa, 2017).

The concept of intermodalism implies the use of two or more transport modes and cooperation amongst service providers. The concept is emphasised by Mathisen and Hanssen (2014) who highlight that “successful promotion of intermodal transport, using rail or sea on the long haul part, has been identified as the most critical action to achieve a sustainable transport sector” (Mathisen & Hanssen, 2014, p. 611). As indicated by policy papers, descriptions of intermodalism emphasise not only the transport modes but also terminals, ports and hubs that are the links between modes.

An array of possible interventions have been proposed to address freight transport system challenges. These include such actions as the review of transport policy and regulations; institutional reform of the rail sector; “meso level collaboration between government and industry” (Havenga *et al.*, 2014, p. 6), the introduction of new (and digital) technologies and intermodal solutions. The imperative for intermodalism was also highlighted in the National Transport Master Plan (NATMAP) 2050 Synopsis Report which indicated that one of the strategies required for future freight system planning in South Africa was to contract studies to develop “a legislative framework for sustainable intermodal rail freight systems” (Department of Transport South Africa, 2019, p. 6) and emphasises co-operation across modal operators in providing services to meet transport demands. This report also includes an implementation approach by providing sets of priorities and time horizons indicating mostly legislative or policy proposals but does not indicate how the operators themselves should work together to pursue solutions.

The range of proposals for furthering intermodalism indicates that the challenge requires a comprehensive implementation approach, and that no single mechanism (for example, legislative, infrastructural, institutional, technological, business relationships, etc.) represents a comprehensive outlook that would bring about fundamental change. It is proposed that a systemic and integrated approach would add value for practical outcomes.

This research uses a systemic approach to determine interventions that could be leveraged for improvement, and especially, to explore the requirements for forms of how and why interaction between road hauliers, logistics service providers, port and inland terminal operators, technology providers and rail operators may advance intermodalism as a key means of addressing the country’s freight system challenge.

Intermodalism may be defined as moving goods seamlessly as a single “parcel” or loading unit from one mode to another in a manner that reduces packing or re-packing (multiple handling) of the goods whilst changing modes (Mathisen & Hanssen, 2014). The seamless movement of goods from one mode to another requires complex forms of interaction between operators to facilitate interfaces and transfers between modes. At the very least, a sharing of information is required to improve performance by harnessing the competitive strengths of each mode and facility to achieve this integrated transfer within the freight logistics value chain.

Guo and Peeta (2015) explored the factors that foster or deter collaboration, an essential prerequisite for intermodal transportation, from the perspective of road truck carriers in the United States. Their study addressed technological, operational and behavioural (perceptions of rail company performance) characteristics that are required to develop solutions with rail service providers. The work by these authors strengthens the argument for the necessity of collaboration among players in the industry. It is not known if the factors identified in the US will apply similarly to the South African situation and South African industry role-players.

The concept of collaboration, at the most basic level, means working together towards a common goal. For the research, the concept was preliminarily defined in a broader sense as is applied in strategy, transportation or logistics management disciplines and is considered in the context of a systems thinking framework. The concept of system collaboration may thus encompass cooperation and working together to share knowledge, ideas, information and resources to achieve a common goal or purpose that jointly creates additional value for the system as a whole. Value-creating collaboration would ideally also require interactions and relationships of trust in sharing risks, rewards and benefits. Intermodal system actors may go so far as to create a joint entity that is more competitive or offers a more competitive solution, than a single entity operating on its own (Barratt, 2004; Camarinha-Matos & Afsarmanesh, 2014; Okdinawati, Simatupang & Sunitiyoso, 2015).

Liu, Li and Li (2015) have related the term “coopetition” – an amalgamation of the concepts of competition and cooperation – to the timing of investment decisions and behaviours of competitive pricing decisions within the intermodal freight transport supply chain. The study by these authors on coopetition supports the paradigm that collaborative relationships (as opposed to competing relationships) may be mutually beneficial to many parties in advancing intermodalism.

Collaboration in the form of public-private partnerships (PPPs) for the development of transport infrastructure has been explored (Ittmann, 2017), implying the need for collaboration and risk-sharing between the state-owned rail organisation and the private sector. Ittmann (2017) also highlighted the opportunities for public-private sector partnering in the freight transport sector, particularly in the development of intermodal transport hubs to contribute to freight system effectiveness and growth. Ittmann (2017) further emphasises the need for an appropriate framework to facilitate the development of such partnerships. The identification of the mechanisms at play, and an understanding of the importance of such factors in value-creating relationships, would potentially contribute to constructing partnership frameworks in a freight intermodal system.

The concept of value co-creation may also be considered in the context of the intermodal system as value co-creation is essentially an approach for interacting and building relationships between companies, customers and other role-players to develop innovative and non-traditional business methods to jointly create value, and this is what intermodalism in South Africa requires. In his paper on the mechanisms of value co-creation, Saarijavi (2012, p. 381) emphasises that there is “a lack of models or theoretical frameworks for understanding how customers and other actors engage with the company in collaborative value co-creation activities”.

One may thus posit that forms and levels of cooperation, collaboration or co-creation are required to advance intermodalism. The extent to which the private sector would be willing and predisposed to co-operating or partnering with the state-owned railway, ports and port terminals to achieve this relationship, for the betterment of the freight system in the South African context, has not been specifically researched and is explored in this study.

In a doctoral study conducted on Australian rail organisations, the researcher examined processes and methods deployed by Australian rail organisations to carry out rebranding initiatives. Rebranding has been embarked upon to transform the corporate identity of rail companies from bureaucratic, inefficient government organisations to commercial entities appropriately positioned with stakeholders (Spriggs, 2017). It is not known if such rebranding contributes sufficiently to positioning the railway such that private entities would be more willing to co-create with the railway (or other state-owned transport entities and agencies).

The concept of collaborative value co-creation has also been studied in the context of restructuring and other types of reform to improve the public sector and government organisations in Finland. The authors highlighted the benefits (and the challenges) of a platform economy, that is, deploying information and digital technologies such as artificial intelligence, big data and cloud computing as the impetus for the transformation of public sector and government departments to better serve customers, deploy resources efficiently and build a business culture (Hautamaki & Oksanen, 2018). The deployment of digital technologies could thus potentially benefit the development and implementation of actual intermodal solutions amongst role-players. In addition, government-owned organisations demonstrating their use of modern, digital technologies, may also positively contribute to reputation which could encourage the development of collaborative relationships for intermodalism.

Perceptions are often held that state-owned enterprises are less efficient than private enterprises and that such assumptions and perceptions could conceivably detract from the willingness of private enterprises to collaborate with a state-owned enterprise (SOE). In his study (a critical review of published literature, surveys or reports on SOE performance predominantly in North America, Europe and Canada) on re-assessing the efficiency of state-owned enterprises, Muhlenkamp (2015) concluded that state-owned enterprises could be deemed efficient depending on the type of performance measures used to assess them, the extent of regulation the market is exposed to and whether they are in developed or emerging countries. These concepts are considered in the South African context in this research.

Regardless of whether South Africa's State-Owned Company Transnet (a significant actor in the freight logistics industry) can be classed as an efficient enterprise, the perceptions that potential stakeholders hold and the impact of those perceptions on their willingness to cooperate, to advance intermodalism, is not known and needs further exploration.

1.3 Research Problem Statement

The advancement of freight intermodalism is a national development priority. The lack of freight intermodal solutions development and implementation in South Africa hinders total freight logistics system performance. Self-perpetuating systemic imbalances and challenges have accelerated over the past five years and sorely detract from the country's competitiveness, economic growth and resilience. Despite policy and strategic intent,

implementation inertia and ineffectual interaction between multiple system actors at an industry (or meso level) are evident. System enablement is lacking in South Africa.

A greater collective effort, willingness, coordination, collaboration and cooperation between system actors, with a win-win mindset, are posited as key mechanisms to urgently address macro objectives. The study strives to identify innovative insights for systemic change, turnaround and improvement.

1.4 Research Aim, Objectives and Questions

The description of the research context and the problem statement reflects the researcher's interest in exploring the phenomenon.

1.4.1 Aim

To advance freight intermodalism, as advocated by policy, for outcomes that include competitive and cost effective modal share, national infrastructure renewal, assets utilisation, connected terminals, ports and borders. Imperatives such as innovative intermodal solution development and effective implementation would contribute to sustainability, job creation, economic growth and development.

The study thus aims to determine the systemic imperatives, the hard and soft constructs or mechanisms, the importance of the constructs and the relationships between them that must be collectively developed by government, public and private sector role-players to build a systemic framework that could leverage, advance and enable intermodalism in South Africa's freight transport logistics system.

1.4.2 Objectives

The objectives of the research are:

- i. To evaluate the inter-relationships and inter-dependencies that are imperative for the development and implementation of actions to improve South Africa's intermodal freight performance outcomes.
- ii. To understand the rationale and mindset of actors in building collaborative inter-organisational relationships, and to identify aspects that could impact effective interaction, in an integrated freight system.

- iii. To analyse the interventions that may be practically implemented for the advancement of freight intermodalism, specifically in the South African context.
- iv. To create a systemic framework of constructs that may be collectively applied by the system actors (e.g. freight transporters, intermodal operators, customers and policy makers) to implement practices that spur implementation, transformation and advancement of intermodalism in the country, from a total system perspective.

1.4.3 Research Questions

The primary and secondary research questions to be pursued are:

1.4.3.1 Primary research question

Why has freight intermodalism in South Africa lagged in development and implementation and why a systems thinking approach, if applied collectively by system actors, could develop and transform freight intermodalism in the country towards the attainment of macro level system outcomes?

Secondary-Questions

- i. Why may the pursuit of common or collective (vs individualistic) objectives “unite” the actors and lead to intermodal system optimisation?
- ii. What factors determine with whom system actors will associate, build relationships and co-create to better the performance, functioning and macro-level outcomes in the intermodal system?
- iii. Why it is important to identify the prerequisite hard and soft constructs and system interdependencies that promote (or constrain) cooperation between actors towards the advancement of intermodal solutions and outcomes?
- iv. How the identified constructs for freight intermodalism may be systemically arranged to form a conceptual framework for application in advancing intermodalism?

1.5 Research Philosophy

The research problem is a complex, strategic issue of critical importance to South African national and business outcomes. The problem is approached from a paradigm that the current state of the system requires radical change (not mere fine-tuning) and that innovative approaches are needed (Saunders, Lewis & Thornhill, 2019). to address changes in industry

structure, processes and actor relationships to enable implementation and system improvement. The research is also informed by the researcher's own views:

- i. interest and career experience in strategy, railways, freight logistics and freight intermodalism;
- ii. a deep interest in systems thinking approaches;
- iii. the dynamics of the constructs of cooperation, coordination, collaboration and co-creation;
- iv. the need for solutions to challenges and public inconvenience experienced on roads due to the high degree of heavy road trucks transporting freight on the country's roads; and
- v. the national policy imperative for intermodalism that has failed to evolve to the benefit of the country.

The research philosophy is described in greater detail in Chapter 3. The ontology, epistemology and axiology are briefly addressed in the following sections:

1.5.1 Study Ontology

The researcher's ontology reflects a view of reality that is neither totally objectivist or subjectivist as there are multiple realities in real world business and management contexts (Saunders *et al.*, 2019) and both hard, objective practices and softer, subjective perspectives and experiences of multiple actors in a complicated and complex system, must be considered along with their potential consequences.

1.5.2 Epistemological Perspective

The epistemological approach to this research may be described as pragmatism (Dudovskiy, 2022). In this regard, both facts and opinions in the particular freight industry context are considered valid in building knowledge. Research information was developed from both authoritarian (secondary data forming the literature review and documentary analysis) and interpretation of data (drawn from interviews with Subject Matter Experts (SMEs) and freight intermodal system actor focus groups), being explored to identify themes and explain patterns that could contribute to building knowledge to address the challenges and problems in the system. The pragmatic approach was deemed to be apt in exploring the transdisciplinary nature of the topic for an integrated process of knowledge creation that addresses problems, options and alternatives to transform future practice and outcomes (Saunders *et al.*, 2019).

1.5.3 Axiology

Axiology deals with values, morals and judgements held by the researcher, and those of the research participants. Her own and participants' interests, competencies, behaviours, and management approaches driving business interactions had to be honoured. This required of the researcher to constantly reflect on her values and beliefs while engaging with research participants to collect and analyse data (processes in which she was involved in an integral way). Her personal context required the assurance that research was undertaken, and research decisions made, ethically and transparently to ensure the trustworthiness and potential application of research results (Kivunja & Kuyani, 2017; Saunders *et al.*, 2019).

It is critical that the ethics of the research can be demonstrated because the researcher was intrinsically involved in the research. Steps to ensure ethics address the research aspects of "privacy, accuracy, property and accessibility" (Kivunja & Kuyani, 2017, p. 26). Full ethical clearance was given to proceed with the study in May 2021. (Annexure A: Ethical Clearance Certificate).

1.5.4 Assumptions

The researcher assumes that system actors may hold beliefs and perceptions about the ease and collective value of partnering with the state-owned logistics company, or with other competing supply chain partners, and that such views may impact the extent to which they are prepared to work together. This assumption needed to be tested to determine the views of potential actors, e.g. road haulage companies, the railway, logistics service providers (LSPs), terminal and ports operators, industry associations, information technology and logistics technology service providers.

The study context as well as descriptions of ontological, epistemological and axiological perspectives give rise to certain assumptions on which the research is based. The researcher assumes:

- i. Intermodalism is an appropriate solution to the freight system and modal imbalance challenges in South Africa.
- ii. International examples of intermodalism may be applicable in applying learnings to the South African freight system.

- iii. Varying levels and forms of working together (for example, but not limited to co-operation, collaboration, co-creation, co-opetition) are required to advance and sustain intermodalism.
- iv. Required permissions and authorisations would be readily acquired.
- v. Databases of participants could be readily obtained, and prospective research participants who are prominent actors and SMEs would be willing to participate and share relevant insights.

1.6 Theoretical and Conceptual Frameworks

This research project seeks to build knowledge on the advancement of freight intermodalism in South Africa. The theoretical framework adopted for the research is a systems thinking approach. This theoretical framework, and the data collected, sought to build a conceptual framework that may be collectively applied by system actors.

A review of the literature for the research project has identified conceptual frameworks related to intermodalism, including the economic and logistics cost benefits of greater utilisation of the rail mode, effectively transferring freight between modes linked to nodes, and using two or more transport modes seamlessly to address freight challenges and performance.

Theoretical frameworks that advocate the nature, types, levels and relationships of interactions between parties to achieve intermodalism have been identified. Legislative frameworks indicate policy principles, priorities and phased time horizons for entrenching intermodalism in the freight system. These frameworks all represent valuable insights into the challenge but no single conceptual framework has been identified by the researcher for pragmatically addressing the complex challenge for South Africa with unknown effects of human actors. A systems thinking framework, for example, the DaVinci Institute TIPS™ Managerial Leadership Framework (The Da Vinci Institute, 2019) could contribute to comprehensively analysing and synthesising the research problem to achieve the research aim and objectives of developing a collective and conceptual framework for application to intermodalism progression.

1.7 Research Design and Methodology

The researcher aspires to approach the stated research problem from a research paradigm defined as a radical change perspective (Saunders *et al.*, 2019). This paradigm defines the

attitude to business and management research problems as totally transforming the prevailing situation. “Such research is often visionary, and utopian being concerned with what is possible and the alternatives to the accepted current position (Saunders *et al.*, 2019, p. 139). This approach is apt for the nature of the problem, which has a significant impact on the country’s freight system and logistics costs. The problem has received strategic and policy attention over more than two decades, with little progress evidenced. This unsustainable and untenable situation calls for a drastic change to the status quo and it is for these reasons that the radical change paradigm is appropriate.

The complexity of the research problem requires a multi-faceted or multiple-methods approach (Blumberg, Cooper & Schindler, 2014) that aims to achieve outcomes that add value (McKim, 2017) to the pragmatic paradigm. This research required an in-depth study of academic literature (secondary research data), to determine existing conceptual frameworks and theories relating to the essential aspects required to achieve and implement intermodalism. The freight intermodal system may be viewed as a complicated one as many known modes, nodes and connections have to be designed and managed, with expertise and good practice (Du Plooy-Cilliers, 2022) to assure predictable, reliable and timeous service delivery to customers.

The researcher views the problem as complex (as opposed to complicated) in that the effective management of freight intermodalism, in addition to the multifaceted system parts, a number of human actors is involved in managing the system. The actors all have different beliefs, levels of expertise and values. This means that they also have diverse agendas, goals and notions of system problems or opportunities and how they would respond to them. The human factor thus brings unknown and unpredictable human factors to the fore. The multiplicity and transdisciplinary nature of actor expertise, and the myriad relationships amongst them is likely to impact intermodal system interface performance between modes and nodes, in a random and variable way. Innovative and engaging ways of interacting are required for developing and implementing solutions (Du Plooy-Cilliers, 2022; Gharajedaghi, 2011).

A feature of a systemic approach is that it provides for various elements, human stakeholders, and the links and relationships between them such that they work together for the good of the whole. The research study argues for a systems thinking theoretical framework being used as a foundation for positing the imperative of a *collective viewpoint* of the various actors

directed at optimising the freight intermodal system. This is the research design and methodology by which the study would contribute to the relevant body of knowledge of intermodalism and related systems thinking. The research design and methodology are described in detail in Chapter 3.

1.8 Study scope and delimitations

The scope of the secondary research (the literature review) considered both South African and international knowledge and theories to precisely define constructs and to obtain learnings of innovative or best practices in intermodalism in developed and developing nations. The literature review was augmented by continuous documentary analysis throughout the research period to stay abreast of developments in South Africa's freight sector and to discover global developments that could potentially impact South Africa's intermodal system.

The scope for data collection for the primary research (SME discussion interviews and actor focus groups) concentrated on role-players in the South African freight transport and logistics industry as the research aim was to develop a framework specifically tailored to the South African situation.

The research scope does not intend to analyse the practice, workings or benefits of intermodalism but rather to focus on identifying the determinants of intermodalism partnerships or interactions and the links between these determinants that impact choices and encourage cooperation, collaboration, coordination and co-creation between freight intermodal system actors.

Delimitations to the research study are described (and are addressed more comprehensively in the final chapter):

- i. The study did not attempt to determine or quantify freight intermodal measurements, for example, the extent of the road-to-rail transfers and changes in modal market share or balance of freight that are projected to be realised as a result of greater levels of intermodalism.
- ii. The study does not quantify the demand for freight or intermodal freight on freight corridors in South Africa.

- iii. Findings were derived from the perceptions expressed by interviewed SMEs and freight intermodal system actors that participated in focus groups and may not explicitly apply to all local system actors nor global actors active in the South African system.
- iv. The research did not calculate nor quantify the benefits or the costs of advancing freight intermodalism.

1.9 Significance of the research

The researcher is of the view that the novel contribution of the study is founded in conducting focus groups – as a proxy representation of actors in South Africa’s real freight intermodal system – to illustrate the value of applying systems thinking approaches to the phenomenon of freight intermodalism. The systemic approach provides a place to start in overcoming implementation inertia.

Focus group interaction reflected the willingness of key actors to collaborate, cooperate and coordinate to advance system performance. The uniqueness of the contribution to freight intermodalism lies more specifically in the focus on intermodal system interfaces. The development of relationships to optimise the core interfaces can be used to prioritise and leverage potential interventions and to focus performance measurement.

The study may have relevance for potential application by the freight intermodal industry and system actors, policymakers, academics, lobbyists and interest groups to garner support for intermodalism in the freight and logistics industry, and within the communities that it affects.

1.10 Overview of thesis chapters

The introductory chapter is followed by the literature review which addresses the theoretical framework and intermodal freight constructs.

This is followed by the detailed research design and methodology description, data collection methods and systems thinking tools. A synopsis of the thematic analysis that was conducted is also shared. Chapter 3, furthermore, provides an overview of the structure and sub-system relationships of the system of interest, the intermodal freight system in South Africa, to provide context for subsequent chapters. This structure overview also identifies system actors.

Research findings are comprehensively presented in Chapter 4 through six themes generated from analysis of data collected and augmented by documentary analysis. Systems thinking tools were applied in the analysis of data and are used to present the themes and findings.

Chapter 5 discusses the findings with specific emphasis placed on the extent to which the themes address the research aims, objectives and research questions. This chapter also proposes a pragmatic conceptual framework.

Chapter 6 concludes the thesis by proposing recommendations, including the application of the proposed conceptual framework that could be applied to South Africa's freight intermodal system. Study limitations are indicated, as are suggestions for further research on freight intermodalism in South Africa. Personal reflections on the research journey are shared. The study concludes with a call for action in the interests of the country.

1.11 Conclusion

Research reading shows that business and management discipline has no precise framework on how to install intermodalism in South Africa and other developing countries where key elements are owned and operated by an integrated freight logistics State Owned Company (SOC). Other key parts are owned and operated by large global conglomerates with roles and functions fulfilled by their subsidiaries (e.g. LSPs, shipping and container terminals). Smaller independent organisations are vying for positions in a very competitive industry. Industry associations play a key role in representing and integrating processes and functions. An array of national policies impacts this complex system.

This research project aspires to contribute to this body of knowledge. It was speculated that the development of a framework lies in a systemic thinking approach of finding the synergies and inter-relationships between the parts (Flood, 2000) of intermodalism – the policies, technologies, innovations, perceptions, behaviours and management practices that are held together to form an optimally functioning whole. It is against this pragmatic and systemic background that this study was undertaken.

It is in the interests of the country to advance freight intermodal practices to contribute to increased resilience of supply chains, the economic performance of South Africa, its environment, and its people.

2. CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reflects the review of the literature undertaken to address the research on “Imperatives for the advancement of freight intermodalism in South Africa: A systems thinking approach”. Various literature sources on the phenomenon of freight intermodalism were studied from a systems thinking theoretical perspective, to gather and assess systems thinking theory, methodologies and tools that could aid in defining the constructs required in the building of a conceptual framework for freight intermodalism in South Africa.

The literature review aimed to elicit the concrete or abstract concepts that may be used to determine the imperatives, and ideally the interventions that may be employed, for the development, advancement or improvement of South Africa’s freight intermodal system and to identify what may be done to trigger change in the phenomenon. The researcher’s ontological and epistemological philosophy is to address the research problem through a systems thinking lens as an approach to addressing the system points of leverage, constraints and other systems features that could contribute to an outcome of advancing freight intermodalism, specifically in South Africa.

2.2 Theoretical framework: Systems thinking

The theoretical foundation to this research is systems thinking. This section builds the argument that freight intermodalism is a holistic system and exhibits the characteristics and attributes of a system as espoused by systems thinking theorists. The classification of freight intermodalism as a system is a core tenet of the conceptual and theoretical frameworks of this research and drives the research design and methodology to be used. The ensuing discussion identifies systems characteristics and applies them to the concept of freight intermodalism. A systems thinking approach is useful as the phenomenon of freight intermodalism may be categorised as a complex system (Crainic, Perboli & Rosano, 2017) that exhibits systemic characteristics.

In an inter-country study aimed at optimising European intermodal transport, Flodén used a systems view to consider intermodal transport as a real and dynamic world system constituting components “(abstract or concrete) that work together to reach a common goal” (Flodén, 2009, p. 4). The notion of the system having a common goal is further explored in the conceptual framework of this chapter as this could contribute to improved clarity on the imperatives for success in intermodalism. Flodén furthermore highlights the importance of the systems theory concept of “inter-relationships” between system parts (more than the individual components) clearly distinguishing system attributes from usual “linear cause-and-effect” analysis (Flodén, 2009, p. 4).

In defining the phenomenon of freight intermodalism, it is shown that an intermodal transport system has many linked parts or sub-systems and “many actors with *partly conflicting goals*” (Flodén, 2009, p. 4). The claim regarding partly conflicting goals accords with Meadows’ view through her views on points of leverage and the identification of places to intervene in a system. In a system of multiple actors, “even people within systems don’t often recognise what whole-system goal they are serving!” (Meadows, 2023).

Lindskog (2012) has criticised claims that authors make regarding having taken a systems thinking approach when studying logistics. Lindskog’s (2012) work indicates that many make only vague references to systems thinking and do not properly apply systems theory to logistics management. This suggests that more robust theoretical models and methodologies should be applied when studying freight intermodalism as a system.

In the same vein, Crainic *et al.* (2017) highlight the need for further research and simulation of freight intermodalism due to the complexity of these systems comprising multiple actors making decisions to support their own goals whilst being related to, contributing to and associated with other individuals, groups and systems parts “through many interconnections, interactions, and interdependencies. All actors contribute to processes and tasks that “make intermodal transportation a complex system” (Crainic *et al.*, 2017, p. 4).

The systems thinking theoretical approach may strengthen theories that consider freight intermodalism as a system. This assertion will be considered in greater depth in the development of the conceptual framework. At this stage, one may assert that, at the least,

freight intermodalism does exhibit characteristics or principles of a system and systems theory:

- i. Intermodal freight reflects a complex and real-world problem (Crainic *et al.*, 2017).
- ii. The presence of many parts or sub-systems within the greater freight system (Flodén, 2009).
- iii. Systems reflect characteristics by the “manner in which the parts interact”; and it is these interactions that are important because parts would not reflect the same properties when considered individually or in isolation of each other (Luisi, 2016). The interactive properties thus cannot be analysed nor forecast by considering the workings of the individual parts that make up an intermodal system.
- iv. There are numerous actors and stakeholders representing multiple transport and logistics institutions and organisations, with each striving for their own goals (Crainic *et al.*, 2017; Meadows, 2023).
- v. Relationships, interdependencies and connections between the actors (Crainic *et al.*, 2017) and sub-systems exhibit a collective behaviour (Luisi, 2016).
- vi. The system interacts with and influences its environment and is in turn influenced by that environment (Luisi, 2016).
- vii. The system is dynamic, constantly changing, unpredictable and could even lead to chaos (Mayrhofer, 2004). A system may grow, become distressed and decline (Meadows, 2023).
- viii. The system can self-organise or self-regulate (Luisi, 2016; Meadows, 2023).
- ix. Linear, mechanistic and cause-and-effect rationale does not apply to the complex system (Flodén, 2009).

Given that systems thinking is the overarching theoretical approach to this research project, and that linear, mechanistic and cause-and-effect rationale does not apply to the complex system (Flodén, 2009), it is not appropriate to assign labels such as dependent or independent variables to the concepts to be studied. In this research, the aim is not to determine a cause and effect relationship as in “to understand the causes of phenomena” where “...the presumed cause ... is ... the independent variable and the presumed effect is ... the dependent variable” (Flannelly, Flannelly & Jakowski, 2014, p. 162). Instead, the aim is to discover what the possible imperative constructs are (and the inter-dependencies

between them), that would relate systemically, to contribute to understanding, enabling and improving the system. It is proposed that the building of a conceptual framework would lead to a set of constructs and themes that may be applied in improving the understanding of the freight intermodal system and how it may be advanced in South Africa.

The development of a conceptual framework will reflect a process of “working with data, organising it, breaking it down, synthesising it” into a set of constructs or themes, “searching for patterns, discovering what is important and what is to be learned” (Lawrence & Tar, 2013, p. 29); and determining how the data will be described and interpreted for use in a manner that would enhance the research design, methodology, the findings and their application in the real world of South Africa’s freight industry.

For this research, no *a priori* hypothesis is stated and a pragmatic, transdisciplinary and systemic mindset is adopted, making a systems thinking theoretical approach appropriate in considering such issues as:

- i. Whether or not freight intermodalism in South Africa may be advanced by adopting a systemic view.
- ii. Would collective or common goals or shared objectives be identified to drive innovation, change and improvement of the system.
- iii. Whether consideration of freight intermodalism as a system will aid in the identification of imperatives that could be applied to better understand and drive improvements.
- iv. If collaboration or a coalition of willing actors give rise to greater interaction and cooperation amongst actors, role-players and stakeholders to advance intermodalism.

The contribution to theory will be pursued through the development of a conceptual framework. The research does not attempt to prove or disprove a theory for the working of freight intermodalism as a system, but rather aims to apply systems thinking concepts to build or “discover theory” (Anfara & Mertz, 2015, p. 20) about the imperatives (and even the constraints) for enabling, implementing, innovating and changing this system in South Africa as viewed through the lens of systems thinking (Lawrence & Tar, 2013).

The key concept or phenomenon for this study – freight intermodalism – is defined, and “a set of interrelated constructs” (Anfara & Mertz, 2015, p. 9) is derived through the identification of concepts related to freight intermodalism, to present a view of the phenomena and its constructs, patterns, themes, their interdependencies and interrelationships. It is anticipated that emerging inputs would support the development of theory and may present possible outcomes for practices in the industry or discipline (Mayrhofer, 2004, p. 179).

2.3 Study Context: Freight Intermodalism in South Africa

The premise on which the theoretical framework of this research is based is that freight intermodalism cannot be viewed at a *micro* or single organisation or firm level, where one company strives alone for its efficiencies or to develop innovative solutions for intermodalism. The very definition of freight intermodalism indicates many modes, many consecutive and integrated activities and processes of a chain that are decided upon and carried out by various actors in the system. Freight intermodalism thus must be viewed at least at a *meso*, multi-organisation or industry level with many industry role-players (guided by foundational government policy) contributing and interacting, in a cooperative manner (The Da Vinci Institute, 2020), to the seamless movement of freight.

In the case of South Africa, where the country reflects spatial challenges, modal imbalances and corresponding high logistics costs relative to GDP (Havenga *et al.*, 2016), the concept of freight intermodalism also warrants national or *macro*-level consideration.

The quest for freight intermodalism to move beyond a micro-level approach is illustrated in Figure 1 (reproduced) which reflects the need for the development of solutions amongst industries and that this paradigm could benefit industries and contribute to national or macro-level benefits (Havenga *et al.*, 2012). The goals or outcomes at each level, take on a higher order in the hierarchy from profit maximisation at the firm level, combining welfare and supply chain optimisation at industry and supply chain levels, to welfare maximisation at the macro level. These authors have indicated that the current body of knowledge often tends to address firm-level approaches and is not geared towards solutions for countries such as South Africa that are “sparsely inhabited with long densified corridors” (Havenga *et al.*, 2012, p. 37).

This research proposes that the joint efforts, adopting win-win principles, of South Africa's freight industry participants (at the meso level) can, and should, make a much greater contribution to developing South Africa's economy and pursuing developmental goals (macro level objectives).

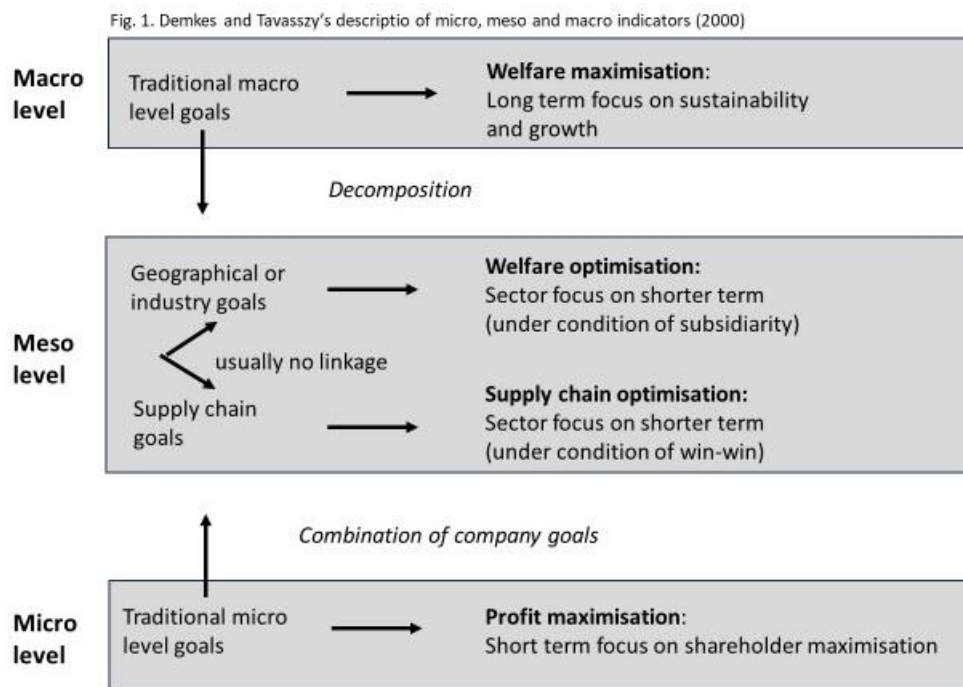


Figure 1: Freight intermodalism micro, meso and macro levels (Source: Havenga *et al.*, 2012)

The macro level view is explained by the significant role that freight transport and logistics systems fulfil in the economic development of nations. A myriad of literature sources cites the role of transportation in national economies, these include “supporting clusters and agglomerations; increasing productivity; enhancing jobs and labour market accessibility; opening new markets for businesses; and enhancing supply chain efficiency” (Dowell, 2017, p. 2). The advancement of freight intermodalism, as a key element of transportation, may thus contribute to progressing macro or national-level objectives.

The freight transportation industry contributes to the country's GDP, enables market connectivity for rural and manufacturing industries in the domestic economy, supports regional trade and promotes export competitiveness (New Zealand Government, 2016; Nistor & Popa, 2014). Investment in transport and logistics infrastructure has the potential to create jobs, develop new businesses around transport infrastructure, attract investment and build technological capacity, capability, and can enhance education and learning.

It is only when these freight transport and logistics systems are efficient and cost-effective that they can fulfil an economic development task in the economy of a country (Rodrigue & Notteboom, 2023). Effective freight transport systems optimise the utilisation of existing infrastructure of all modes and facilities (road, rail, ports, distribution centres, terminals and logistics parks), deploy assets to minimise the impact on the environment and enable business competitiveness by reducing the transport portion of their costs.

Countries that have advanced the development of logistics or intermodalism are also those that have prospered economically and are competitive nations. At the risk of oversimplification, a link can be made between developed and competitive nations as indicated by the Global Competitiveness Report (Schwab, 2019), and the overall logistics performance of countries reflected in the World Bank Logistics Performance Index (Arvis, Ojala, Wiederer & Shepherd, 2018). Developed, competitive economies such as Germany, Sweden, the United Kingdom, Belgium, Singapore and Japan are those that are dominant in supply chain industries and are also at the top of the list in the Logistics Performance Index. At the other extreme are countries at the bottom of both lists, most of them in Africa and other developing countries, that score poorly on economic development, competitiveness and on logistics performance.

In these African countries, which have diverse levels of economic development, transport infrastructure is often under-developed, or has deteriorated and this is reflected in their economic progress. Also, they have made little progress in the development of intermodalism. South Africa is an outlier at number 61 (of 137) on the list of competitive economies and one of the top (number 3) logistics performers of upper-middle-income countries (Arvis *et al.*, 2018).

Whilst South Africa is striving for economic growth, competitiveness and improved logistics performance, the world is changing; our continent is changing, our developing country is changing and within this “current mess” (The Da Vinci Institute, 2022, p. 30), as systems thinking refers to the current state, the freight logistics systems, and the institutions that shape intermodal systems, globally, are changing (Kyshko & Lesinski, 2019). This points to the need for systemic change at individual, organisational, institutional and country levels (The Da Vinci Institute, 2020).

2.4 Development of the Conceptual Framework

The development of a conceptual framework for the study of the phenomenon of Freight Intermodalism (with a particular focus on South Africa) and the search for constructs that would enable advancement of the system, requires a broad approach. A trans-disciplinary stance was thus adopted to embark on the literature review. Research reading and analysis, in search of freight intermodal system constructs and themes, considered systems theory as well as theories from disciplines such as transport, logistics, economics, operations research, management science, cynefin frameworks, innovation, technology, organisational change, human behavioural sciences, social systems theory, community theory, stakeholder theory; transformational and relational theory and particularly how other disciplines may have applied systems thinking to address complex, real world problems.

The application of only one theoretical discipline could result in over-looking key constructs. In their study of literature on freight intermodalism, Mathisen and Hanssen (2014) identified a wide array of topics researched that related to freight intermodalism. The diverse subjects went beyond the disciplines of transport and logistics and extended to assorted topics across disciplines of geography, economics, policy, innovation, technology and others (Mathisen & Hanssen, 2014). This confirms that if the research were to apply, for example, stakeholder theory exclusively, and consider the interactions, cooperation, goals, mechanisms and interests of stakeholders, other major system imperatives (such as the economy, technology or innovation) risk being excluded. An economic stance is seen to be critical to view freight intermodal systems not only at a micro or firm level but also at a meso industry and a macroeconomic level. These constructs will be developed and interpreted in the conceptual framework.

2.5 Clarifying the core concept: Freight intermodalism

Before embarking on a discussion of the conceptual framework constructs regarding freight intermodalism, it is prudent to define the core concept of **freight intermodalism** to clarify the boundaries and scope and how the concept is applied in this research. The advancement of freight intermodalism (the core concept) is interrelated with the “imperatives” (the conceptual constructs) to be discovered and how they systemically impact freight intermodalism in South Africa.

The more comprehensive definition of freight intermodalism (than the basic definition provided in Chapter 1) to be applied in this research in the South African context has been derived from several sources:

Freight intermodalism may be defined as utilising two or more transport modes consecutively to convey freight seamlessly between its source and customer (origin and destination), using nodes, terminals and other interface facilities, where required, to transfer goods between modes in a manner that reduces multiple handling of the actual freight. Freight movement and logistics are enhanced when freight is consolidated or unitised in loading units that make cargo homogenous. Unitisation may be achieved by loading freight in a container, on pallets, car racks, in skiptainers or conveying and handling freight using multimodal technologies such as road-railers, piggybacking, bimodal or swap body units or vehicles such that efficiency, effectiveness and economic performance of the process or system of freight intermodalism are optimised. Intermodal systems require enabling technologies for integration, connectivity, sharing of information and close cooperation amongst different transport mode operators, infrastructure node facility managers, logistics service providers, freight owners and other actors in the freight system.

This research project refers specifically to the South African context where the definition is applied to the way the country's transport and logistics system plans and executes freight movements for the transportation of freight for trade domestically, (within the borders of the country), exports freight to and imports freight from seaports, and interfaces with neighbouring country freight logistics systems for Southern African Regional freight movements.

A review of literature sources has enabled the development of this definition to be applied in the study. A clear definition is imperative for research purposes, as is the case with this research project, where the term *freight intermodalism* is sometimes used interchangeably with such concepts as freight multimodalism, containerisation, freight logistics or intermodal transportation. The concept of freight intermodalism, furthermore is frequently used in the context of the role of intermodalism and logistics in optimising supply chains or value chains.

The inter-relatedness of the concepts is indicated by Jones, Cassady and Bowden (2000, p. 9) who evaluated various definitions and derived the most appropriate as “...Intermodal transportation should be generally defined as the shipment of cargo and the movement of people involving more than one mode of transportation during a single seamless journey” (Jones *et al.*, 2000). This study specifically excludes intermodal passenger transport.

In terms of freight, the growth of intermodality is sometimes seen as a second wave of containerisation (different types of packaging, e.g. boxes and pallets, are commonly referred to more universally as containers (Crainic *et al.*, 2017). The first wave encompassed “technology and innovation” for handling freight whereas the focus in later waves has been on organisational and human-related changes required for integrating transport systems (Van Klink & Van Den Berg, 1998) that elevate the concept beyond multimodalism.

The notion of a *single seamless journey*, as indicated by Jones *et al.* (2000), implies that the movement of the freight is done in a coordinated and efficient manner. These authors, like Crainic *et al.*, (2017), also assert that freight may or may not be *containerised* (in a specialised container) (Jones *et al.*, 2000).

A more detailed definition of the concept is offered by Mathisen and Hanssen (2014) as “Intermodal freight transport is the movement of goods in a *single loading unit or vehicle* that *successively uses two or more modes of transport without handling the goods themselves in changing modes* (UN/ECE, 2001)” (Mathisen & Hanssen, 2014, pp. 611-612).

The main idea behind intermodal transport is to utilise the strengths of different transport modes in one *integrated transport chain*, thereby improving *economic performance* (Flodén, 2009). The definition by Flodén (2009) builds on the Cassady and Bowden (2000) concepts of many modes through the addition of the aspect of economic performance. The concept of *seamless* is also inferred by the indication that the freight is handled in an integrated value chain that reduces handling of the actual freight in the consecutive changing of transport modes. Although the Mathisen and Hanssen (2014) definition does not specify containerisation, it does indicate that the goods themselves are not handled which implies that the freight is unitised in some manner to reduce handling during transfers.

Deeper understanding of the integrated nature of freight transport systems is provided by Rodrigue (2020) who differentiates between intermodal and transmodal connectivity. Intermodal connectivity is referred to as connectivity *between* modes, such between a ship and a road truck or a rail train, at a port container terminal that enables the transfer or transloading of a container. Intermodal maritime transport is further enhanced when an inland rail terminal (e.g. City Deep in Gauteng) is connected to ports terminals (e.g. Durban or Cape Town Container Terminals).

Rodrigue (2020) then refers to transmodal as connectivity *within* a mode, for example:

- i. from a maritime ship to a feeder service ship, as occurs in large transshipment ports in Singapore or Dubai;
- ii. from a large truck at a major distribution centre to smaller trucks for retail deliveries;
- iii. From one rail carrier to another rail carrier. For example, operation of trains between Transnet Freight Rail in South Africa and Caminhos de Ferro de Moçambique (CFM), where services are currently operated for transporting minerals for export.

A definition of freight intermodalism should thus technically include the terminologies for transmodal and intermodal connectivity. These definitions highlight the imperative of connectivity both between and within modes, and also the role of transfer facilities in facilitating these movements.

In their economic analysis of intermodal transportation, Sahin, Yilmaz, Ust, Guneri, Gulsun and Turan (2014) define the concept as “Intermodal transportation comprises two or more different transportation modes linked end-to-end to move cargoes ...from the point of origin to the point of destination”. It is “...the term used to describe the movement of goods in the same loading unit or vehicle which uses successive, various modes of transport” (Sahin *et al.*, 2014, p. 1).

Again, there is consistency with other definitions in that the Sahin *et al.* (2014) definition indicates many successive modes; seamless as in end-to-end; and in the *same loading unit or vehicle*. The reference to the same loading unit or vehicle implies that the freight itself is not handled as it is contained in some form of a single loading unit.

None of the definitions of intermodalism cited previously make any reference to the distance that the freight travels. In the development of an economic analysis for

intermodalism, Sahin *et al.* (2014) do however conclude in their findings that “in the short distance transportation, single transportation modes always tend to be advantageous. As the distance gets longer, intermodal transportation advantages begin to be effective” (Sahin *et al.*, 2014, p. 8). Whilst distance does not specifically define the concept of intermodalism, the issue of distance is an area of importance in the consideration of freight intermodalism in South Africa, the country on which this study focuses.

Havenga *et al.* (2012) in fact, describe South Africa as a spatially challenged country with “demand side” challenges due to very long transport distances between ports and major urban hubs and “supply side” challenges of these corridors being served primarily by road-only means, as opposed to intermodal transport solutions (Havenga *et al.*, 2012, p. 42). Both supply and demand side challenges imply the need for intermodal solutions that optimise costs and improve freight logistics economic performance.

More significantly in the 21st Century, in addition to the physical infrastructure (such as roads, railways, ports, distribution centres, inland and port terminals), are the requirements for information and connectivity aspects between interfaces. These indispensable aspects are emphasised by De Witt and Clinger (2000) who asserted that without market intelligence, business knowledge capabilities, information and connectivity, most definitions refer merely to multimodalism; and not to the more efficient and effective practice of intermodalism.

DeWitt and Clinger (2000) emphasise the essential components of *integration* and information in their views of successful future intermodalism and supply chain management as “An integrated intermodal transport system is a significant and critical factor in the successful execution of supply chains; ...options in the intermodal execution of supply chains are being driven heavily by information and communications systems” (De Witt & Clinger, 2000, p. 2). This highlights the relevance of cybernetics, communication and information technology as disciplines that impact intermodalism.

The concept of freight intermodalism is also often considered in the broader concept of supply chain management in that, “Intermodal transport, as it moves from a focus on infrastructure components to a holistic focus on process or systems, will have more viability and applicability in the world of global supply chain management” (De Witt & Clinger, 2000, p. 2).

In their pioneering work on macro-logistics, Havenga *et al.* (2020) make a deliberate effort to clarify concepts that are frequently used interchangeably. They differentiate between:

- i. materials management or inbound logistics as largely a procurement management function of moving raw material inputs for a production process and
- ii. “physical distribution management or outbound logistics as the flow and storage of finished goods to where they are consumed” (Havenga *et al.*, 2020, p. 4).
- iii. The concept of reverse logistics indicates “returned goods, waste disposal and recycling” thus extending the concepts of logistics to encompass a “circular economy” (Havenga *et al.*, 2020, p. 5).

The three concepts of “inbound, outbound and reverse logistics are collectively known as logistics management” (Havenga *et al.*, 2020, p. 5).

An additional tier is added to this definition by the inclusion of the term supply chain management which indicates “the *integration and management* of the key *business processes* of logistics management, production, and marketing and sales to deliver superior customer *value at less cost* to the business’ supply chain as a whole” (Havenga *et al.*, 2020, p. 5). The final tier is termed the value chain and is described as “the linkage between *multiple firms’* supply chains” and comprises “the set of distinct physical and technological value-adding activities performed by these *economic actors*” (Havenga *et al.*, 2020, p. 5) to create and meet customer demand and requirements.

The Havenga *et al.* (2020) definition of the value chain closely reflects the concept of freight intermodalism, where it may be construed that all actors, across many firms are linked and connected to add value in the quest to satisfy customers. Freight intermodalism thus contributes to the value chain, as a process of moving, storing, transferring and delivering freight seamlessly and optimising the system across many firms.

The power of digital age information technology in building integrated logistics and transport systems of the future is emphasised by pioneering studies of the Physical Internet (PI or π) “an emerging concept that applies the Digital Internet as a design metaphor for the development of sustainable, interoperable and collaborative freight transport...to develop efficient logistics systems” (Stemberg & Norrman, 2017, p. 736). Interest in the concept of PI is cited as being due to “potential positive effects of pooling logistics and

transport resources by creating “The Network of the Logistics Network...” through “...effects of collaboration, cooperation and global supply chain optimization” (Stemberg & Norrman, 2017, p. 742). The concept of PI confirms the integrated nature of logistics and supply chain systems as well as the need for collaboration and cooperation amongst actors; and how these activities and interfaces may be enhanced by evolving information technology.

The concept of a logistics network is similarly highlighted by Crainic *et al.* (2017) who consider several actors (shippers, carriers, facility and facility infrastructure managers, institutional authorities, customers and citizens) with varying objectives and roles interacting with each other in the system (Crainic *et al.*, 2017). These authors also indicate the significance of cooperation amongst stakeholders and the deployment of technologies in a freight intermodal system where new business models, frameworks and “hyperconnected systems” such as “City Logistics, Physical Internet, synchromodality and Logistics 4.0” (Crainic *et al.*, 2017, p. 26), are evolving to optimise and advance freight intermodalism.

The relatively new concept of synchromodality is defined by Acero, Saenz and Luzzini (2021) as a “multimodal transportation planning system, wherein the different agents involved in the supply chain work in an integrated and flexible way that enables them to dynamically adapt the transport mode they use based on real-time information from stakeholders, customers, and the logistic network” (Acero, et al., 2021, p. 51). This implies that transport mode choices are not made in advance, but are selected based on capacity and resource availability, at that time, to optimise service delivery and cost. Such practices are reliant on sharing of information and technological innovation at multiple actor levels.

The increasing enrichment of definitions highlights the many processes required for an efficient system for intermodal freight transport. These ideas are the start of interpreting, deriving and synthesising the constructs for the conceptual framework.

2.6 Conceptual Framework: Freight intermodal advancement imperatives

The aim of this study is not to determine cause and effect relationships between variables but rather to discover the concepts in terms of a conceptual framework of interrelated

themes or constructs that would enable an improved understanding of how freight intermodalism works and why actor interaction is vital. The intent is to determine the aspects that connect and support each other to build increased insights of how they may contribute to advancing intermodal freight systems in the country. This may aid in the contribution to theoretical approaches to the phenomenon (Jabareen, 2009).

The building of the conceptual framework did not aim to provide a list of concepts or critical success factors, but to identify constructs, to build understanding and to evaluate the relationships amongst them in striving for a pragmatic approach to reality. Openness and trans-disciplinarity are displayed when a conceptual framework is “indeterminist” and does not pre-empt the result (Jabareen, 2009, p. 51).

The conceptual framework for this study has evolved several constructs through review and analysis of diverse disciplines in the literature sources. The quality or depth of the analysis is however reliant on the critical interpretation of ideas, concepts and metaphors (Jabareen, 2009). The constructs and disciplines that were derived for discussion, before primary data collection processes began, are summarised in the table below.

Table 1: Constructs and disciplines

No.	Derived Construct	Discipline
1	System Goal, Purpose, Outcome and Benefits	Critical Systems Thinking; Stakeholder Theory, Common Good Theory, Social Science, Patterns and Pattern Language in Systems, System Design Theory
2	Multi-Actor Interrelationships	Systems Thinking, Systems Engineering, Intermodal Planning and Decision-making, Simulation Modelling, Transport Economics, Stakeholder Theory, Transdisciplinarity
3	Systems Customers	Freight Transport Economics, Intermodal Value chains, Macrologistics
4	Policy, Politics and Influence	Institutional Policy, Transport Policy, Regional Development, Investment and Ownership
5	Nodes, Links and Connections	Transport, Logistics, Transport Economics, Environment Management, Systems Thinking, Transdisciplinarity
6	People, Skills and Capabilities	Macro logistics, Human Resources, Education
7	Technologies and Innovation	Information Technology, Business Strategy, Processes and Systems
8	Economy and Environment	Economics, Environmental Management, Transport Economics, Sustainability

Triangulation of data from research literature relative to data obtained from research instruments contributes to determining the appropriateness and correctness of the constructs identified at the literature review stage; and the extent to which such elements can be construed as imperatives for the advancement of South Africa's intermodal system. A discussion of the identified constructs follows.

2.6.1 Construct: System goal, purpose, outcome and benefits

A starting point in identifying imperatives for advancing freight intermodalism is to understand the issues surrounding the perceived goals that actors may have for developing or improving intermodalism in the country. It is not known whether a clear goal exists nor if there are goals that are shared by all actors, or if such a goal would be pursued for the common good of the system or society. Common good implies that goals are shared, or aimed at, in the interests of all, by all members by virtue of them being *members* of the *same* society (Argandona, 2016).

The concept of combined or shared objectives of a dynamically functioning freight intermodal system may be examined in terms of stakeholder theory or the theory of the common good. Each firm in the system would likely have an individual goal, for example, profit or shareholder value maximisation in the interest of, or for the good of, the firm itself. This implies that a shared goal across several firms may not be plausible. However, stakeholder or social responsibility theorists offer that a socially responsible organisation would consider many stakeholders who may have an interest or "stake" in the firm – its shareholders, managers, employees and workers, suppliers, customers, interest groups, unions, competitors ... the local community, ... society in general" (Argandona, 2016, p. 1093). If one accepts a systemic view of the actors in the intermodal system, this assertion indicates that the system actors at least have a responsibility of inclusiveness, even if not sharing the same or collective goal (even with competitors) in contributing to the common good of all.

This responsibility for inclusiveness may be viewed as implying that the goal of the firm would have to be sacrificed or be subservient to those of other stakeholders or to the greater good. No firm would relinquish its ideals unless it could also derive benefit from its inclusivity in the greater system. Argandona succinctly states that "man's duty to

contribute to the good of society derives from his duty to seek good for himself” (Argandona, 2016, p. 1096). Thus, a company (such as one operating in an intermodal environment) would conceivably pursue a shared goal if that company itself could gain from it. This notion supports a systems thinking philosophy of advancing freight intermodalism in that “it is the good of the whole of which individuals...” (or firms or system actors) “...are part of a whole, that is specifically distinct from its parts” (Argandona, 2016, p. 1096). It would seem then that a superior outcome (and possibly emergent system properties) may be arrived at when all actors view the greater benefits to be derived from the systems’ interconnected parts pursuing a shared goal, than would be the case where each part (company or other actor) seeks to enhance their own goal.

Herein lies an anomaly, in that it is uncertain if all actors or stakeholders in a freight intermodal system view themselves as being members of the same society or system striving for a common goal or interest. It is even possible that sub-systems of a greater freight intermodal system (such as an association of road hauliers or a railway or a group of terminal operators) see themselves as actors at the level of their firm, sector or system optimising only their interests.

The concept of own versus greater goals becomes more complex when considering that sub-systems may be unequal with some stronger individuals or groups acting as “dominant islands” with sufficient power and influence to weaken smaller or subservient factions and be dismissive of their new ideas and views without concern for a common good or greater system goal (Finidori, 2016).

Some authors go so far as to claim that the idea of shared goals and outcomes is unrealistic or even farcical and that, in a complex system, other forces at play drive behaviours and outcomes (Finidori, 2016). A social sciences view, for example, is that “all social systems are purposive” (Friedman & Allen, 2014, p. 13). The perspective is that a group merely requires a sense of purpose and “central focus” and that if attempts are made to define goals too specifically, this may limit membership and dilute the shared functioning of the group (Friedman & Allen, 2014, p. 13). Attempting to define or state pre-conceived goals in a complex system could be counter-intuitive and perhaps goals should rather evolve in

a “purpose-seeking manner” (Finidori, 2016, p. 16), rather than attempting, in advance, to specify all aspects for the group.

In a similar vein to the notion of a purposive system, systems design theory proposes that the actors need to deliberately envision “the ultimate goal – the system” (Adams & Mun, 2005, p. 493). The ultimate goal of the system may even be viewed in terms, not of common good or interest but rather striving towards an ultimate goal of system performance improvement to design how each related part of the system could contribute to overall system performance (Adams & Mun, 2005).

Some consideration could thus be given to applying systems, social sciences or stakeholder theory concepts to South Africa’s intermodal freight system. Is a grand system purpose for freight intermodalism possible? Would it be possible to determine how actors in the system view the system's purpose and their roles in contributing to or deriving benefits from that purpose? Would other interventions, such as collaboration efforts, encourage members to ‘satisfice’ or even ‘sacrifice’ some of their own interests to advance system optimisation or to align their views to the purpose that the system seeks? When construed as a system, could the systemic benefits, consequences, impacts and outcomes drive multi-stakeholders and actors toward a higher-order purpose or goal?

The data collection process aimed to investigate the issues of goals, purpose, outcomes and benefits insofar as they may constitute an imperative for advancing the phenomenon of freight intermodalism in South Africa.

2.6.2 Construct: Multi-actor interrelationships

An aspect of the research methodology included the development of a diagrammatic view of South Africa’s intermodal freight transport system that identifies the multiple actors and the multiplicity of the relationships and connectivity between them in the real world of a dynamically functioning system.

These relationships take place not only at the level of inanimate facilities and equipment but at a very human management level. In the application of systems thinking and systems theory to systems engineering, Adams and Mun (2005) indicates that the context, quality, type and nature of these interfaces must of necessity include an element of human activity

as an imperative for advancing “complex systems problem(s)” (Adams & Mun, 2005, p. 499). The nature, contextual formation and quality of the relationships between multiple actors are thus posited as a possible imperative for intermodal system advancement or performance improvement. Relationships and connectivity would impact the nature of various decisions and decision-making about how the intermodal system performs and operates. In studies examining planning and decision-making in intermodal freight transport, Caris, Macharis and Jansens (2008, p. 279) go so far as to say that “intermodal transport, by definition, involves several decision makers who need to work in collaboration for the system to run smoothly”.

The multiplicity and multidimensions evident in logistics or intermodal system relationships would require a mature stance in terms of the outcome of interactions between system actors. Gharajedaghi (2011) offers that multidimensionality involves forming complementary relationships and not merely interacting. The manner in which a diverse group of actors relate could result in:

- i. conflicting “win-lose” outcomes;
- ii. reaching a compromise (not always fully satisfactory to all parties); or
- iii. most ideally the development of complementary “win-win” outcomes.

Collaborative or interactive approaches that adopt an attitude of a “win-win” outcome at a system level could influence the quest for collaboration by the parties involved and potentially improve overall system performance (Gharajedaghi, 2011).

In their work on the simulation of intermodal freight systems, Crainic *et al.* (2017) highlight that even though intermodal actors have their own objectives and decision-making processes, “they are linked ... through many interconnections, interactions, and interdependencies” (Crainic *et al.*, 2017, p. 4). The concept of shared goals becomes more plausible if one accepts the key systems thinking concept of interrelationships between system parts.

The potential for freight intermodalism exists in South Africa and can be considered in terms of the identification of target markets, freight flows and commodities suited for intermodalism. A study by Van Eeden and Havenga (2010) on freight transport flows,

logistics capacity and freight market segmentation in South Africa indicates the *necessity* for collaboration between rail freight transport, logistics players and road transport operators “to commit to a collaborative development of intermodal solutions” (Van Eeden & Havenga, 2010, p. 265). Ittman (2017) considered multimodal collaboration in terms of a Private-Public Partnership (PPP) between Transnet and a major South African LSP. He identified the benefits of a shift of freight from road to rail through multimodal practices but highlighted that, despite intent and apparent keenness, two years after signing the Memorandum of Understanding, there was little sign of multimodal collaboration or actual implementation.

There is also support for the development of collaboration models between partners in supply chains at the industry and supply chain (meso) level, that facilitate intermodalism, because individual organisation (firm or micro level) distinctions “are becoming less important to improve the efficiency and resilience of supply chains” (World Economic Forum, 2017).

National policy documents, reports and academic articles reiterate the *need* for collaboration between actors, yet commitment to development of intermodal solutions is lacking and implementation inertia is evident in South Africa. This study strives to engage actors in data collection to understand the conundrum and to contribute to theory that could foster collaborative approaches. The study also sought to identify areas where interventions could be leveraged to enable implementation and change. Such endeavours may serve as practical applications to narrow the theoretical gap in practice.

The literature shows that there is a strong need for collaboration to achieve the system's purpose. Adams' systems theory approach proposes that “an interdisciplinary collaborative approach” (Adams & Mun, 2005, p. 496) between actors is needed to develop ways to meet the needs and acceptance of both customers and the public. A high degree of collaboration and coordination is vital given that those multiple actors are required to make decisions at multiple levels, not only at an operational level for freight movements; but also at tactical and strategic levels to plan and determine appropriate capacity allocations and investment in future intermodal infrastructure developments (Caris *et al.*, 2008).

Caris *et al.*, (2008) have reviewed decision-making at various levels by multiple actors in the freight intermodal system and indicate that few studies consider “multiple decision makers”, even though greater levels of coordination and integration are critical for improving intermodal freight transport and addressing “planning problems at different decision levels” (Caris *et al.*, 2008, p. 298). Integrated decision-making is also a feature of systems theory.

In the context of multi-actor interaction, the terms collaboration, coordination and cooperation are sometimes used synonymously, even in academic journals. For example, in assessments of “decision objects” in intermodal simulation models, Crainic *et al.*, (2017) p. 7) describe collaboration and cooperation as various forms of interaction as “Cooperation: is concerned with the evaluation of the strengths and synergies arising from collaborations, cooperation, and coalitions among carriers, among shippers, or between shippers and carriers, with or without participation from institutional authorities”.

Other authors go to great lengths to distinguish between the concepts, of cooperation, coordination or collaboration (as well as integration and synergies) and their views are briefly discussed as they relate to intermodalism or meso inter-organisational interactions (industry level); as opposed to interactions within an organisation operating in its business environment.

In their paper on integrated business processes for supply chain management (SCM) (management of a supply chain often considers intermodal choices), Moharana, Murti, Senaparti and Khuntia (2010) indicate the need for supplier coordination, collaboration and integration for decision-making in managing order oscillations, inventory levels, management of lead times to replenish stocks, reconciliation of transport costs, and so forth, in the delivery of customer requirements. They consider various definitions and indicate that:

- i. cooperation is reflected in terms of shared information and policies;
- ii. coordination is expressed in terms of greater degrees of influence in joint decision-making;

- iii. some view collaboration as merely working together for a defined purpose and others express collaboration in stronger terms of teamwork, interactive processes and joint effort in decision-making and implementation.

Kotzab, Darkow, Bäumlér and Georgi (2019) also differentiate between actor interactions for integration in a supply chain context and the need to develop a strategy for a complete chain. The authors describe cooperation as actors working together in pursuance of a common goal. More interaction is evident in their definition of coordination where actors' harmonisation or synchronisation of interdependent activities is a goal-oriented process. Such a definition supports descriptions of integrated and seamless intermodal processes that require great levels of coordination between parts and particularly at process interfaces.

Kotzab *et al.* (2019) then afford high value to collaborative interactions where shared responsibility and management of SCM measurements are characteristic. They indicate that in collaborative relationships the organisations even appear to act as “one single entity” (Kotzab *et al.*, 2019) to develop a strategy that enables them to jointly perform better on a measure (for example, greater throughput or modal transfer) than an individual firm could achieve on its own.

McNamara (2012) explored inter-organisational interactions, also differentiating between cooperation, coordination and collaboration in tackling complex problems, building innovation and allocating resources. She places the three concepts on a continuum with cooperation at one end and collaboration at the other. She stresses that one form of interaction is not superior to another, but rather that the nature of the inter-organisational interaction is dependent on the setting, context and intention. The interactions and interfaces required between different actor organisations in freight intermodalism were explored in the data collection processes.

McNamara (2012) describes cooperation in terms of actor choice to work together (with others who have the capabilities) to achieve individual goals in the accomplishment of organisational goals. Cooperation thus *results in all achieving their goals*. Coordination is viewed as constructively mobilising and formalising linkages because parts need assistance from others in achieving organisational goals. In her view, collaboration emphasises

collective responsibility and shared interests to address complex goals, particularly where tasks are interconnected and thus cannot be achieved individually. The concept of interconnectedness of activities is particularly relevant for freight intermodalism given that it is an integrated process requiring efficient interfaces. No individual actor can fulfil this process alone, making strong forms of interaction imperative in an intermodal system. Collaboration differs from cooperation and coordination in that it “require[s] much closer relationships, connections, and resources and even a blurring of the boundaries between organisations” (McNamara, 2012, p. 391).

Finally, the Da Vinci TIPS™ model (The Da Vinci Institute, 2020) addresses the three concepts of interaction in terms of workplace realities that emerge depending on levels of interaction and agreement between parties. This model also emphasises that no reality is superior to another and that the purpose and nature of the interactions are context dependent. Interactions are also not static, they evolve as required by the interaction agenda purpose, actors and their relationships.

The TIPS™ model describes tasks that need to be coordinated to meet a deadline (for example, loading times to meet a departure schedule). This type of interaction results from an interface between technology and innovation to promote agility. An expert in a leadership position would drive the effort. This type of interaction could, for example, be interpreted as a foreman directing a team of crane drivers to load a container ship at a time that aligns with vessel sailing time (operational coordination). Such task direction would likely have been driven by tactical-level decisions on coordination of interfacing weekly or monthly schedules. Resource allocations and freight reservation systems for container train or container truck arrivals at the port for unloading containers to stack or loading containers to meet the vessel sailing window.

Where challenges or solutions are more complex and require collaboration for creativity in exploring alternatives or improved ways of doing things, then engagement between actors (blending people and innovation) is beneficial. Interactions in such a collaborative environment (or reality) could occur at strategic, tactical or operational levels. Collaboration could conceivably take place laterally, e.g. between crane and truck drivers’ foremen, to improve task interfaces. It is also likely, that various actors in positions of higher authority or influence, may decide to collaborate at an intermodal or value chain

level in the interests of developing integrated and seamless process interfaces across an entire intermodal chain for higher order or macro level outcomes. Such strategic decisions would have to be effectively communicated and cascaded to tactical and operational levels to give effect to the strategic intent of the collaboration.

The DaVinci TIPS™ model describes an aligned workplace reality characterised by the fusion of technology and people. A key feature of this reality is that actors themselves choose to cooperate, engage and share ideas, knowledge and information in a manner that all possibilities and potential synergies may be raised, shared, explored and co-created. Cooperative behaviours may be seen as a way of transcending “the boundaries of what is thought to be possible” (The Da Vinci Institute, 2020, p. 17). This type of cooperative behaviour, attitude and competence is ideally what is needed to promote a more functional intermodal system in South Africa.

It seems obvious that collaboration amongst actors is an important element for an improved intermodal system, and this begs many questions regarding collaboration in South Africa’s system. Do actors collaborate and which actors collaborate with whom? What is the nature of the collaboration? Do conflict and other determining factors override collaboration efforts? Do multiple actors perceive a need to change the system or to change beliefs and paradigms about the system and other system actors? There are likely to be many factors at play.

One of the age-old notions may be that past knowledge and experience may hinder the need for innovation and change. It has been proposed that in a system, the actors need to “forget” or “unlearn” past knowledge and conflicts about individuals, organisations or environments such that paradigms are modified to bring about redesign or transformation (Grisold, Kaiser & Hafner, 2017; Meadows, 2023). In the systems thinking and patterns for change studies by Finidori (2016), it is asserted that actors have imprinted patterns of experience in their individual and “collective minds” (Finidori, 2016, p. 13). This notion implies that many actors could have entrenched views that could hinder or constrain the development of relationships and new ideas and solutions for intermodalism improvement.

When addressing the topic of collaboration, one must also consider the aspects of ethics, morals and values, and even the extent to which deep collaboration may be construed as anti-competitive. A premise of stakeholder theory is that “stakeholders are basically moral” (Harrison, Freeman & Sa de Abreu, 2015, p. 865). Actors may be judged on their morality in terms of how the value that is created is distributed and who benefits from such value creation. Such issues may become increasingly complex in systems where a goal or purpose is not shared or where one lacks clarity on whose interests are served in a system where diverse actors collaborate.

Harrison *et al.* (2015) claim that it is virtually impossible to consider stakeholder theory at a level as broad as a society (or a large system) because there are so many role-players who have varying and conflicting goals and interests. He asserts that much greater consideration needs to be applied to collective and “both combined and divergent interests, and how they influence stakeholder relationships” (Harrison *et al.*, 2015, p. 866). This issue is similarly raised by Crainic *et al.* (2017) who (in studies on intermodal freight simulation) highlight the notion of considering the behaviour of actors from a system point of view and that we lack “a global, system-wide vision of the problem setting, including the decision-makers, the actors involved and the issues they want to address” (Crainic *et al.*, 2017, p. 2).

It holds then, that collaboration amongst freight intermodal system actors regarding goal sharing, problem-solving, distribution of costs and benefits, planning at various levels and mechanisms for conflict or issue resolution may all be imperatives for system optimisation.

2.6.3 Construct: The system customer

The discussion has considered the goals and purpose of an intermodal freight system and why the system actors are required to develop relationships and interact with each other to optimise the performance of the system. As has been indicated in section 2.4 of this chapter, Havenga *et al.* (2020) described the value chain as the outcome of the collective and integrated efforts, processes and activities of actors and their system parts to add value to satisfy customers.

In a pluralist case study approach used to develop intermodal freight transport models, that incorporate rail transport as part of the solution, for transporting low-density, high-

value, perishable or time-sensitive goods, Islam and Zunder (2018) found that it was imperative to consult extensively with customers to fully understand their specific requirements. The development of innovative solutions to address attributes (such as cost, reliability, flexibility, time constraints and continuous cold chains) required a change in mindset not only of railway management but also in some cases, of the customers themselves.

An interesting recommendation in one of the cases was the concept of “bundling” of freight loads. This required that to make up a full train load (and thus optimise costs), the solution required that multiple customers collaborate (individually or through an intermediary). This views system collaboration from the angle of customer beneficiaries to derive service benefits, as opposed to collaboration between the system actors delivering the service (Islam & Zunder, 2018). This again emphasises the complex inter-connectedness or systemic nature of intermodalism.

Studies on sustainable (or “Green”) logistics supply chains by Brodin, Sweeney and Evangelista (2020) have, however, found that whilst many LSPs strive for environmental innovation, many customers (shippers) state that they are environmentally compliant, but when making procurement choices for transport and logistics services, the customers reflect less concern for “green” issues (Brodin *et al.*, 2020).

From a systems perspective, it may be more apt to view customers in a stakeholder theory sense, where a higher order of system customers such as the community, suppliers, a geographic region, the environment or society itself may ultimately be viewed as the customer to be satisfied.

2.6.4. Construct: Policy, politics and influence

As has been the case in Europe and the USA, the South African government and transport ministry (over at least the past 20 years and as recently as the past three years) have developed various policy papers that aim to promote freight intermodalism. Such policies are typically put forward to promote a better road-rail modal balance, reduce environmental impacts and traffic congestion (Mathisen & Hanssen, 2014) as well as to grow freight systems for competitiveness and economic benefits. It would appear, however, that policy development alone is insufficient to truly advance intermodalism.

Governments are also instrumental in facilitating planning at various levels (national, regional, provincial and local levels), directing implementation in areas that require development, for example, to stimulate the economy of a specific area or region for peripheral effects such as increased trade and job creation arising from investment in transport and intermodal infrastructure in an area. It is also imperative that government institutions have the capacity, skills, experience and institutional governance and regulatory oversight to plan for coordinating transport and economic development policy, facilitate funding and ownership models and avoid conflicts that constrain development where different intent or outcomes may be envisaged at national versus regional level (Monios, 2016, p. 365).

The quantitative study of data and qualitative case studies done by Monios (2016) investigate the regional or provincial development of Italian freight villages or *interporti* which are described as “large logistics parks with attached intermodal terminals” (Monios, 2016, p. 367), which in turn are connected to ports to stimulate regional trade. This work sought to identify both industrial and institutional factors, and the interactions between the various stakeholders, that constrain or aid the development, ownership, funding, operation and management of freight villages in various Italian regions. Findings suggest that the success (or lack thereof) of freight village development, although promoted by national policy and dedicated funding, is often plagued with adversarial relationships between stakeholders (regional and national government, operators and other role-players).

Business and investment models that place control and influence either with national institutions (such as the railway, port authority or roads agency) or with a terminal or logistics park owner sometimes thwart the original objective of the development (Monios, 2016). The (integrated or fragmented) structure of the freight sector as well as factors such as density of traffic and port connectivity also play a role in the way that a freight village develops.

Similarly, in a study undertaken in Sweden, to determine the factors that impact the development process and pace to select an appropriate location and develop regional road-rail terminals (primarily operated by firms other than the national railway operator and infrastructure provider), it was found that “profitability, combined with an enthusiastic

and committed political entrepreneur is the most vital factor” for success (Bergqvist, Falkermark & Woxenius, 2010, p. 286). This again indicates the role of politics or policy in advancing intermodalism. In this case, it was the active role fulfilled by a political individual, rather than the existence of policy and funding that promoted developments.

Bergqvist *et al.* (2010) also raised the issue of interaction between private stakeholders (such as intermodal terminal operators and public parties (e.g., ports and rail infrastructure and operating companies) and the need for mechanisms to resolve problems and conflicts posed by the actions of collectives with differing goals (commercial, socio-economic, etc.). The researchers in this instance found value in the role fulfilled by a “political entrepreneur” (Bergqvist *et al.*, 2010, p. 300) – a prominent and influential individual who has an incentive or political aspiration for the development of the local or regional authority.

Policy and appropriate political intervention are imperative in the workings of the system and are required to facilitate relationships, direct investment and resolve conflict. The geography of the region, the correct location and management of facilities and transport nodes are the manifestation of policy implementation.

2.6.5. Construct: Nodes, links and connections

An effective freight intermodal system must comprise equipment such as infrastructure, rail and road rolling stock, loading equipment, shipping lines as well as terminals, dry ports, distribution centres and other facilities where the seamless transfer of goods takes place (Hanaoka & Regmi, 2011).

Many refer to freight intermodalism in terms of the movement of freight utilising many modes of transport in a seamless process. In their study on the promotion of freight intermodalism in Asia from an environmental perspective, Hanaoka and Regmi (2011) emphasised three attributes:

- i. transport links, the road and rail networks and navigable waterways where these exist (as they do not in South Africa);
- ii. transport nodes and their location, such as terminals and dry port facilities that provide opportunities for the transfer of goods and for optimising modal balance between road and rail; and

- iii. the provision of efficient services, in particular the reliability, quality and punctuality of connecting rail services.

Extensive logistics and transport economics research on domestic intermodalism in South Africa by Havenga *et al.* (2012) indicates that an improved intermodal system would consider types of commodities and the geographical routes and concentrated corridors over which they flow as well as the optimal locations for connectivity provided by terminals, ports (or dedicated gateway ports connected to hinterland freight villages or intermodal nodes as is the case in Europe (Monios, 2016)). Havenga *et al.* (2012), emphasise the need for the development of a business case centred on freight market segmentation as a basis for reducing logistics costs and improving South Africa's competitiveness.

The implementation of the recommendations and business case made by Havenga *et al.* (2012), along with the political will and collaboration amongst role-players, are deemed critical to the advancement of intermodalism in South Africa. The market segmentation, demand forecasting and optimisation of individual physical elements, whilst critical, are beyond the scope of this study. It is suggested that these are perhaps not the primary *determining* aspects of intermodal advancement in South Africa, rather the focus of this research is the systems approach to how these factors are viewed and optimised as nodes, links, interactions and connections to deliver improved intermodal services and to develop specific regions of the country (Van Klink & Van Den Berg, 1998).

These attributes indicate the imperative of physical infrastructure not only as a mode of transport or storage facility but rather as a means of transfer and connectivity as specific interface elements that are requisite, for a seamless intermodal process, to enable the transshipment and distribution of goods (Hanaoka & Regmi, 2011). The notion of links and nodes for connectivity and interfaces emphasises the need for coordinated planning and collaboration amongst role players in the development and operations of links and nodes to achieve the benefits of intermodalism (Hanaoka & Regmi, 2011). Ownership of terminals (nodes) is critical in that it is "risky to invest in terminals without controlling the operations on the links" (Bergqvist *et al.*, 2010, p. 290) that the freight transport is derived from. The transport links drive freight to the nodes.

It may be accepted that each operator or link in the system is striving to optimise their individual system part, their own port, terminal, trucking company or railway, however the

sum of optimised parts would not necessarily advance and improve the entire system (Bergqvist *et al.*, 2010). It is by this reasoning that the researcher deems the *connectivity* attribute of links, nodes and interrelatedness as a possible system advancement imperative.

2.6.6. Construct: People Skills and Capabilities

The achievement of collaboration, coordination and connectedness can only be made possible by the skills, capabilities and mindsets of people; and a consideration for how others may benefit.

South Africa's logistics performance (as measured by the World Bank Logistics Performance Index) (Arvis *et al.*, 2018) had been the best of BRICS nations for the decade of measurement. Whereas most BRICS countries improved in this time frame, their improvements were better than South Africa's performance, which declined in some years. In the Barloworld survey (Barloworld Logistics, 2012) it was found that of the top ten logistics challenges that executives experienced in South Africa, skills are the issues that are afforded the least effective responses.

Whilst many countries globally, experience challenges in finding the right skills and talent for available jobs, South Africa's case is made critical by the skills shortage. This is also true for the logistics or supply chain sector which, for success in the industry, requires myriad skills ranging from information technology (IT) to engineering and finance, in addition to logistics and transport skills and experience.

Heyns and Luke (2012) have indicated that not only are formal academic qualifications in short supply, but also critical skill sets such as logistics analytical, interpersonal, creative big picture thinking and problem-solving, cross-functional coordination, communication, customer service and teamwork skills are vital for effective global, complex supply chain working. More specifically, in South Africa, is a need to develop skill sets in business ethics (Heyns & Luke, 2012). Globally, the transport and intermodal sector workforce of the future "will need higher skill levels in fields such as information technology (IT), as well as diverse disciplinary perspectives, to address increasingly complex social and environmental issues" (National Academies of Sciences, 2018, p. 25).

These views highlight that skills development may be imperative for the advancement of intermodalism in South Africa. As socially responsible businesses, it is the role of freight intermodal companies to support government efforts in developing and retaining these skills that contribute to the competitiveness of the sector and the economic development of the country.

Globally, population trends such as rising individual choice, growing connectivity, increased urbanisation and the growth of mega-cities (Atkinson, 2016) will also change the way that freight and goods are in demand and how this freight flows efficiently. In the current era, the need for effective intermodal systems is more pressing than ever to address the challenges and opportunities of South Africa's developmental state. South Africa's current state reflects several economic, social and political mega-challenges, *inter alia* high unemployment, low growth, unethical business practices, extreme inequality, low levels of education (particularly science, technology and mathematics), and a less than optimal freight intermodal system as indicated by the Logistics Barometer, and when compared to the Logistics Performance Index scores of developed countries) (Arvis *et al.*, 2018).

The development of skills, capabilities and education are imperative for advancing intermodalism such that the people and the country benefit from improved delivery and that their changing demands are met.

2.6.7. Construct: Technology and innovation

In the age of the fourth industrial revolution, intermodal systems increasingly rely on technology and innovation (and associated skills) to achieve desired outcomes. Rail services for time-sensitive cargo such as those conveyed intermodally, will have to develop and embrace novel technologies to improve competitive positioning in intermodal markets (Islam & Zunder, 2018).

To survive and prosper, African countries (PWC South Africa, 2013) are compelled to embrace and respond to the opportunities and challenges of the fourth industrial revolution, the digital age and how technologies apply to and enable freight transportation systems in Sub-Saharan Africa and rural areas' access to markets (Ayentimi & Burgess, 2018). The technologies of previous industrial revolutions all altered industries, business models and production processes, but what we often neglect to acknowledge is the

transformations that these technological revolutions drive in society, human behaviours and their impact on the planet (Ayentimi & Burgess, 2018).

There has been only limited business model innovation from within the rail transport sector, which appears to be constrained by a significant degree of inertia. The incumbent rail companies, despite efforts and intent, often seem too big and lack the resources required, to bring about the organisational and cultural transformations that are necessary to exploit the potential of digital business (Meyer, Horvat, Hitzler & Doll, 2018). Examples of digital technology deployment in the road freight sector abound (e.g. platooning, autonomous driving, freight tracking) and freight intermodalism could potentially be advanced by using technologies that enable better connectivity and integration of road and rail modes with each other, with nodes and with other intermodal actors. Meyer claims that innovative business models could revolutionise and revitalise the rail sector which is integrated into the larger transport sector (Meyer *et al.*, 2018). These authors suggest that railways should look outside of rail for innovation and propose that new digital models that improve processes, analytics and platforms should be considered.

A review of literature on the simulation of intermodal freight systems and decision-making (Crainic *et al.*, 2017; Delbart, Molenbruch, Braekers & Caris, 2021) has revealed the concept of synchromodality, described as the evolution of multimodal and intermodal transport concepts where stakeholders in the transport chain interact within a cooperative network to flexibly plan transport processes in a manner that enables real-time switching between transport modes tailored to available capacity resources (Crainic *et al.*, 2017; Delbart *et al.*, 2021).

The concept of synchromodality emphasises the imperative for a meso-level approach as defined by cooperation amongst a network of transport stakeholders and the essential technology and information required for a network to function effectively, where the logistics service provider has control over planning, allocating or switching freight in real time depending on available resources (Alons-Hoen, Van Duin & Somers, 2019). Such sophisticated processes require new business models, technology, innovation, skills and inter-relationships between role-players.

It would be impossible to achieve synchromodality by adopting a micro, singular firm or organisation-level approach. While the developing world is grappling with optimising

freight transportation and intermodalism, the developed world is already using digital technologies and new relationships to pilot synchromodality.

The maturity of such innovative processes would also depend on the maturity of data exchange systems between companies and the willingness and level of trust required to share critical information. Data sharing and joint operational execution of intermodal freight loads would also ultimately lead to serious decisions such as acceptance of “integral pricing” (Alons-Hoen *et al.*, 2019, p. 130), an aspect that may have far-reaching implications for ethics and fair competition.

Collaboration is increasing across networks and companies would have to balance the benefits and opportunities to be derived from system innovation with the costs and ability to adopt, especially in a complex and uncertain world. Bunn, Azini and Puentas (2009) suggested that viewing the sector as a system is innovative in itself although the gains can vary from new to incremental to radical.

Research on advancing freight intermodalism must thus consider both the hard and soft human, infrastructure, technological and environmental aspects. It would be interesting to assess the extent to which actors in the freight intermodal sector are willing and able to embrace and invest in technologies and innovation, not only for own business gain but to benefit the entire system and whether this aspect is viewed as an imperative for advancement in South Africa.

2.6.8. Construct: Economy and environment

The research is based on the premise that, to address macro level goals and contribute to national objectives, the concept of freight intermodalism must be tackled at a meso or industry-wide level encompassing all modes, facilities and role-players. More specifically, from a theoretical framework point of view, it is posited that freight intermodal is a system and the challenge is to research the concept as a holistic system with systemic attributes.

The role of logistics at a macro level is further accentuated by Havenga *et al.* (2020), who stress that the discipline of logistics should evolve to macrologistics in the manner that economics evolved to macroeconomics. These authors assert that “On a macro level, society is the customer of logistics; inventory needs to be positioned optimally through the value chains of the total economy to serve society” (Havenga *et al.*, 2020, p. 111). This

macro approach forces logisticians to consider the system (and the possible trade-offs in optimising systems), in terms of the challenges of greater macro issues such as resilience, global warming, migration and poverty alleviation. Sustainability, and the impact of externality costs of freight transportation and logistics, are likely to become an increasing imperative in the effectiveness of freight intermodalism and logistics.

In addition, the type and nature of freight, that future logistics systems will be required to transport, is changing. Climate change and global warming are driving the development of alternative energies and reducing the demand for South Africa's export of coal and other mineral commodities that the country is reliant upon for export competitiveness and income (Ayentimi & Burgess, 2018). There is a drive to stimulate the manufacturing sector, to grow the agricultural sector for food security and to create jobs. These trends are likely to change demand and flows and influence the need for intermodal solutions.

Beyond the macroeconomic benefits, sustainability objectives should also drive the development of transport and intermodal solutions. Energy efficiency and the impact on costs also need to be balanced in the context of road-only versus intermodal costs and the costs of externalities such as congestion, noise and pollution (Havenga *et al.*, 2020; Mathisen & Hanssen, 2014) in making decisions and choices.

2.7. Interventions and points of leverage

The stated aim of the study is to determine the key constructs, the relative importance of the constructs and the relationships between the constructs that must be collectively developed by the industry role-players to build a systemic framework that contributes to the advancement of intermodalism in South Africa's freight transport and logistics system.

Lindskog (2012) explores the use of systems thinking and systems theory in researching logistics management and concludes that appropriate interpretive methodologies should be sought to gain increased insight into systems thinking and the way that it is applied to logistics management (Lindskog, 2012).

The ideal would be to determine ways to intervene to bring about change in the system to meet desired outcomes. In a system, which theoretically does not exhibit linear cause-and-effect relationships nor events occurring in a specific and predetermined order, alternative ways would need to be discovered to stimulate systemic change as conventional

approaches may not be enough (Rajagopalan & Midgley, 2015). An ecosystemic perspective, for example, proposes that it may be possible to facilitate systemic change by identifying the strengths of the system (Friedman & Allen, 2014).

Whereas the literature review has identified several constructs that are deemed to be imperative for addressing some of the challenges in South Africa's freight logistics system, it is unknown if these are the real imperatives or whether addressing these aspects would bring about significant and meaningful change. According to systems theory, it would be essential to determine possible points of leverage in the system, typically the smallest aspects that would be most likely to bring about the greatest change (Meadows, 2023). Leverage points may thus be viewed as points of power and that may be strong enough to bring about change exhibiting unintended (positive or negative) consequences and effects. Through her life-long endeavours in applying systems thinking, Meadows developed a hierarchy of "places to intervene in a system" (Meadows, 2023) reproduced below.

"Places to intervene in a system (in increasing order of effectiveness:

- 12 Constants, parameters, numbers (such as subsidies, taxes, standards).
- 11 The sizes of buffers and other stabilizing stocks, relative to their flows.
- 10 The structure of material stocks and flows (such as transport networks, population age structures).
- 9 The lengths of delays, relative to the rate of system change.
- 8 The strength of negative feedback loops, relative to the impacts they are trying to correct against.
- 7 The gain around driving positive feedback loops.
- 6 The structure of information flows (who does and does not have access to information).
- 5 The rules of the system (such as incentives, punishments, constraints).
- 4 The power to add, change, evolve, or self-organize system structure.
- 3 The goals of the system.
- 2 The mindset or paradigm out of which the system — its goals, structure, rules, delays, parameters — arises.
- 1 The power to transcend paradigms"

This hierarchy of points of leverage accords to some degree with the constructs identified in the study of the literature and further reveals an unexpected element of the importance

of the “softer” points of leverage such as mindsets, goals and paradigms as opposed to the “hard” aspects such as data regarding freight flows or the configuration of transport networks.

The complex and challenging intermodal freight system of South Africa may well require that interventions focus on multiple actors across many disciplines and institutions. Organisational change theory indicates the need to pursue change and transformation through processes for paradigm shifts at a “collective level” (Grisold *et al.*, 2017). The transformation would require original systemic approaches and forms of inquiry to understand the current state and to determine and imagine a future and what may be implemented for change (Finidori, 2016; Rajagopalan & Midgley, 2015).

2.8. Conclusion

The evidence of the advancement of freight intermodalism in developing nations (Arvis *et al.*, 2018) and the less mature development of freight intermodalism systems in South Africa (despite policy intent) and Southern Africa, suggest that system change and evolution are imperative. South Africa requires economic transformation to change society and the lives of people in the country. Freight intermodalism can contribute to driving this change.

The premise of the research project, and the problem that it addresses therefore, is that South Africa’s freight intermodal system is not optimised and that it needs to be enabled to better fulfil the role of contributing to the country's growth and competitiveness, and in so doing, play a role in advancing economic transformation, environmental sustainability and human development.

This research project adopts a systems thinking theoretical framework to explore the research problem. Freight intermodalism is a complex system and will require a systems approach to contribute to the transformation of South Africa’s current situation and optimisation for the good of the country.

The country’s intermodal system is a complex one. Multiple actors wield different powers and decision-making influence, and many interdependencies, links, nodes and interrelationships are evident. The systems approach must consider hard transport and logistics infrastructure and soft infrastructure, the behaviours of the actors in the system,

their public images and reputations, and their willingness to collaborate, cooperate and co-create with a variety of other actors in the system.

This study is not about merely identifying a set of critical success factors for advancing intermodalism, instead the research is directed at detecting, surfacing and evaluating the points of leverage or interventions that may bring about systemic change and transformation, not only of the freight intermodalism system but also placing pressure on driving economic transformation in South Africa.

The study aims to identify the small (and least costly) interventions that have the potential to bring about a transformation of the system and the environment within which it exists and functions. The study may be required to address intangible human behaviours such as the willingness of actors to transform, fair and competitive collaboration (not collusion), trade-offs and the sacrifice of individual objectives for the good of collective system ideals, and ultimately balance the goals of profit, people and the planet.

The research study argues for a systems thinking theoretical framework being used as a foundation for positing *the imperative of a collective viewpoint and shared or common objectives* of the various actors directed at optimising the freight intermodal system.

The justification for qualitative research lies in the researcher's aim to unveil the perceptions and beliefs of actor participants in a real-life context of the freight intermodal business. The researcher sought to engage with experts and with prominent system actors to obtain a holistic, transdisciplinary and integrated view of the actions of the role-players and the interactions between them in an integrated system. Eliciting collective views of actors could not be achieved by quantitative methods such as surveys with statistical analysis. (Gray, 2018, pp. 163, 164). The complexity of the research problem and the interactive, pragmatic mode of inquiry requires a qualitative, phenomenological research design and methodology that aims to add value to the radical change research paradigm.

Chapter 3 describes the research design and methodology followed and the building of the research instruments for studying freight intermodalism as a system in South Africa.

3. CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The research design and rationale for the qualitative, pragmatist study of the freight intermodal system in South Africa, explored through a systems thinking theoretical framework, are described in this chapter. A qualitative study was deemed to be appropriate for engaging with participants to determine their perceptions and beliefs about freight intermodalism, individually in the case of SMEs and collectively, in the case of actors managing the system. Details of the research philosophy, sampling strategy, data collection instruments and thematic analysis are covered. Assurance of ethical considerations and trustworthiness are also addressed. The chapter includes diagrams of the system of interest, the South African freight intermodal system, to provide context for subsequent chapters.

3.2 Research Philosophy

The research philosophy is entrenched in a systems thinking theoretical framework (as discussed in Chapters 1 and 2) and in the researcher's ontological and epistemological views.

The research problem is a complex, strategic issue of critical importance to South African national and business outcomes. The problem is approached from a paradigm that the current state of the system requires radical change (not mere fine-tuning) and that innovative approaches are needed (Saunders, Lewis & Thornhill, 2019). to address changes in industry structure, processes and actor relationships to enable implementation and system improvement.

The literature review has also highlighted the emphasis on collaborative and cooperative approaches to addressing complex (or wicked) system problems. Transdisciplinary interactions between multiple system actors allow for the exchange of diverse perspectives by drawing on many disciplines, and in so doing, find a common "language" to evolve ideas and co-create ideals and futures collectively (Neely, 2019). The pragmatic research philosophy is strongly influenced by the view that it would be of significant value to determine the collective standpoint of the various stakeholders working together as a group to achieve a goal

as espoused by “collaborative systems thinking” (Behl & Ferreira, 2014, p. 105), and to consider the consequences of actor actions and interactions.

In South Africa, collaborative and cooperative approaches have become increasingly prevalent with calls for government, the private business sector, SOCs and civil society to work together to address national economic and social issues. In fact, at the time of completing the research project (April - June 2023), business experts from key economic export sectors had met with the President (in April 2023), with calls for intervention in resolving logistics challenges in the country. The meeting culminated in a commitment by the President to establish a logistics crisis committee (Steyn, 2023). This was followed by a larger dialogue session (08 June 2023) between business and government where presidential oversight structures and partnerships were set up to address the energy crisis, the logistics emergency and the fight against crime and corruption (Gore, 2023).

3.2.1 Ontology

The researcher’s ontology reflects a view of reality that is neither totally objectivist or subjectivist as there are multiple realities in real world business and management contexts (Saunders *et al.*, 2019) and both hard, objective practices and softer, subjective perspectives and experiences of multiple actors in a complicated and complex system, must be considered along with their potential consequences.

Ontology is defined as “researcher’s assumptions about the nature of the world and reality” (Saunders *et al.*, 2019, p. 159) and as “...the study of being. Ontology can also be considered as the nature of being and our ways of being in the world” (Babin, Carr, Griffin & Zikmund, 2015, p. 57). The ontology thus informs how the researcher views her “nature of existence or reality” (Kivunja & Kuyani, 2017, p. 27) for application in the disciplines of business and management.

An objective and systemic approach needs to be taken when considering intermodalism, policy and the intermodal system actors (or alliance parties), whilst the imprecise concepts of cooperation, collaboration and co-creation, require a more subjective type of research consideration.

The researcher’s ontology or view of reality does not tend to favour either a pro-rail or pro-road bias but rather proposes a practical view that a greater degree of interaction between

nodal, modal and other industry role-players, would benefit South Africa's freight system and economy. The researcher's view is that greater degrees of interaction between industry role-players, with the will to advance intermodalism, would lead to consequences for improved efficiencies, lowering of the nation's logistics costs, better utilisation of available road, rail, port and terminal infrastructure and resources and ultimately improvement in national competitiveness and logistics performance.

The phenomenon of intermodalism for logistics competitiveness (and rail growth) have long been extolled as business challenges to the South African railway and relevant government departments. Various company strategies put forth by the state-owned railway, and its Group holding company Transnet SOC (which also includes the ports authority, inland terminals and port terminals), over the past decade have specified the strategic intent to develop partnerships between Transnet and the private sector to further the goals of rail growth, general freight corridor growth and value-added logistics solutions. Such partnerships have unfortunately floundered or are taking years to come to fruition.

3.2.2 Epistemological perspective

The epistemological approach to this research may be described as pragmatism (Dudovskiy, 2022). In this regard, both facts and opinions in the particular freight industry context are considered valid in building knowledge. Research information was developed from both authoritarian (secondary data forming the literature review and documentary analysis) and interpretation of data (drawn from interviews with Subject Matter Experts (SMEs) and freight intermodal system actor focus groups), being explored to identify themes and explain patterns that could contribute to building knowledge to address the challenges and problems in the system. The pragmatic approach was deemed to be apt in exploring the transdisciplinary nature of the topic for an integrated process of knowledge creation that addresses problems, options and alternatives to transform future practice and outcomes (Saunders *et al.*, 2019). Epistemology is concerned with a researcher's assumptions, the nature and sources of knowledge that together encompass what is known to be true and valid (Kivunja & Kuyani, 2017). The epistemology addresses the philosophy and researcher decisions regarding the process, type and manner of sourcing and producing knowledge such that it constitutes trustworthy research information (Babin *et al.*, 2015) and data that is consistent to contribute to theory development (Dudovskiy, 2022; Saunders *et al.*, 2019). According to Saunders *et al.*

(2019), the trans-disciplinary and complex nature of business and management research means that a wide range of data is considered legitimate.

The building of knowledge regarding intermodalism and the nature of interactions, relationships or links required between the many system actors is complex. The ontological and epistemological perspectives of this research project are influenced by a collection of researcher mindsets and perceptions:

- i. National policy statements as well as the views of academia in South Africa and abroad advocate the value of efficient intermodal and logistics solutions for a country. In South Africa, the ubiquitous publication of academic journals, articles and sponsored research (for example, State of Logistics reports) led by Professor Jan Havenga of the University of Stellenbosch have influenced and contributed to the researcher's interest in and passion for the development and advancement of intermodalism in South Africa's freight system.
- ii. The researcher holds the view that, at a micro level, it is natural that all firms or organisations in the system are all *individually* aspiring for performance improvement, which would not necessarily amount to total intermodal system performance. The researcher has a greater interest in the collective, macro or systemic approach to the advancement of freight intermodalism in the country.
- iii. The researcher is concerned about the slow pace of the advancement of intermodalism, despite strategic and policy intent. The freight sector can, and should, make a much greater contribution to developing and supporting South Africa's economy.
- iv. The researcher has an interest not only in hard infrastructure and operational model requirements but also in the "soft" constructs of cooperation, information and risk sharing, reputations and perceptions, collaboration for co-creation, collective and shared goals and that freight intermodalism does not seem to be viewed and treated as a greater system.
- v. The researcher is also curious about the dynamics between the actors in the system, and the factors and technologies that are imperative for the advancement of intermodalism.

These are the aspects that the researcher believes are critical for furthering intermodalism and this industry and which inform the research design and methodology.

The researcher assumes that system actors may hold beliefs and perceptions about the ease and collective value of partnering with the state-owned logistics company, or with other competing value chain partners and that such views may impact the extent to which they are prepared to work together. This epistemological assumption would need to be tested to determine the views of potential partners, e.g. road haulage companies, the railway, LSPs, information technology and logistics technology service providers.

The literature review; a consideration of the application of the concepts for intermodalism in other countries; and conducting interviews and focus group discussions to elicit the views of stakeholders in the South African context; will contribute to the development of knowledge on these phenomena. The aspiration is to contribute to the development of knowledge by way of a conceptual framework for enabling and advancing intermodalism in South Africa. This has become increasingly critical at this stage of the country's developmental ambitions, many of which have been jeopardised by State Capture, failing SOCs, low economic growth, high unemployment, social unrest and crime, all exacerbated by the outbreak of the Covid-19 pandemic in the country in March 2020.

3.2.3 Axiology

Axiology deals with values, morals and judgements held by the researcher, and those of the research participants. Her own and participants' interests, competencies, behaviours, and management approaches driving business interactions had to be honoured. This required of the researcher to constantly reflect on her values and beliefs while engaging with research participants to collect and analyse data (processes in which she was involved in an integral way). Her personal context required the assurance that research was undertaken, and research decisions made, ethically and transparently to ensure the trustworthiness and potential application of research results (Kivunja & Kuyani, 2017; Saunders *et al.*, 2019).

The research does not aim to arrive at a position that is beneficial to the railway only, but rather to determine the greater benefits of intermodalism to the country through improved interaction between all system partners. Steps were taken in the research design and methodology to ensure this neutrality in conducting data collection, analysis and interpretation of findings.

It is critical that the ethics of the research can be demonstrated because the researcher was intrinsically involved (by virtue of her past employment position) in the research idea. Steps were taken to ensure ethics addressed the research aspects of “privacy, accuracy, property and accessibility” (Kivunja & Kuyani, 2017, p. 28). Full ethical clearance for the study was granted (in May 2021) for the research to proceed (See Annexure A: Ethical Clearance Certificate).

3.3 Research Design and Rationale

Research is a process or cycle of learning, experience and building knowledge (McLeod, 2023). The research design aims to address the research problem by determining the most appropriate plan for the research design (Blumberg *et al.*, 2014) and methodology that are apt to the researcher’s background and experience and the research philosophy.

The key concepts forming the conceptual framework of this study are informed by the research aim, idea and objective (Babin *et al.*, 2015). The key concepts of this research study are:

- i. Freight Intermodalism;
- ii. Intermodal system parts, processes and functions;
- iii. Interactions between actors, stakeholders and decision-makers;
- iv. Perceptions and behaviours of the actors and the relationships between them;
- v. Implementation enablers, barriers and consequences;
- vi. Complex systems and
- vii. Systems thinking.

The research design strives to develop a framework by determining how these concepts may be arranged to develop innovative solutions for implementation, that contribute to positive changes in the intermodalism status quo in South Africa.

Research into the simulation of intermodal freight transport systems, suggests a practical knowledge gap in “a global, *system-wide* vision of the problem-setting, *including the decision-makers, the actors* involved, and the issues they want to address” (Crainic *et al.*, 2017, p. 2)

indicating the need for research that adopts a systemic approach as a possible means for applying theory to real-world practice.

Not only is the systems approach imperative, but also a pragmatic one that considers the positions, perspectives or standpoints of the multiple actors (Behl & Ferreira, 2014) and the potentially manifold and varying objectives that each of the actors (or stakeholders) have, concerning the intermodal system effectiveness, constraints and opportunities. In terms of systems thinking Behl and Ferreira (2014) stress that it is essential to understand, not only individual parts of the system; but also, vital to grasp the interactions, interdependencies and interconnections between the parts. The researcher is of the view that a novel contribution may be made by considering the interrelationships (between actors and between parts) for the significant role that they play in South Africa's freight intermodal system performance.

In response to this paradigm, the research design and methodology reflect the researcher's approach to addressing the research aim, objectives and questions by eliciting the viewpoints of stakeholders through SME interviews and staging focus group discussions with proxy groups of system actors to elicit multiple and collective objectives and standpoints.

Systems thinking conveys the concept of viewing the organisation, phenomenon or institution as a whole and not merely viewing its parts in isolation, but also the connectivity, complexity and relatedness of the parts, in the quest to optimise the total system (Pourdehnad, Wexler & Wilson, 2011). Systems thinking is therefore selected as the fundamental theoretical framework guiding this research design. An extended branch of systems thinking is found in the discipline of systemic design that is "concerned with higher-order socially organised systems that encompass multiple subsystems in policy, organizational or product-service contexts..." and through amalgamation with systems thinking approaches, such design techniques "...bring human-centred design to complex, multi-stakeholder service systems as those found in industrial networks *and* transportation" (Jones, 2014, p. 1). Systems thinking is therefore an appropriate theoretical framework for a research design that explores the dynamics of the concept of intermodalism.

Intermodal structures are not inanimate mechanistic forms but are dynamic systems designed, planned, operated and influenced by interacting human managers (Gray, 2018). The research was therefore designed to explore the perceptions of, relationships between, and the feedback behaviours (Behl & Ferreira, 2014) amongst humans who make the decisions

that drive the functioning, dynamics and ultimately, the optimal (or sub-optimal) performance of the system (Pourdehnad *et al.*, 2011). The relatively well-researched concept of intermodal freight logistics was used to generate deductions and practices about the lesser-researched notion that collective and systemic solutions lead to improved performance of the intermodal system being considered (Saunders *et al.*, 2019).

The research design to address the research aim and objectives may be described as pursuing an exploratory study (Gray, 2018), to understand and evaluate the system and its elements, determine how it works in reality, and consider and interpret questions about the system performance derived from the perspectives, views and experiences of actors in the system. Whilst intermodalism is an objective real-world phenomenon with structures and processes that drive its function, the quest to understand the perceptions of the players, why they behave as they do and their views of the system performance requires gaining insights and interpretation (Saunders *et al.*, 2019).

The research questions presupposed that a systemic approach requires a collective view for the optimisation of the systemic whole. The application of systems thinking theory, frameworks and models, to the qualitative data collected from interviews and focus groups, requires that the researcher apply an abductive approach, of inductively and deductively working between theory and data, (Saunders *et al.*, 2019) to contribute to the body of knowledge in this real world, management context.

Research methodologies that are typically employed to conduct such an exploratory study include the literature review (authoritarian or secondary data) (Saunders *et al.*, 2019); deriving insights from conversations with experts in the field (Gray, 2018, p. 36) and conducting focus group discussions with the stakeholders or actors in the system. The diverse viewpoints gleaned from interviews and focus group discussions required interpretation and thus constituted qualitative research techniques. These approaches guided the choice of research methodology used to conduct this study.

To understand the South African freight intermodalism phenomenon systematically, required the researcher to map or plot the South African intermodal system to diagrammatically depict all the actor groupings that perform functions in the process of delivering intermodal services, their role in the system and the interactions and relationships between and among them (Crainic *et al.*, 2017).

The exploratory considerations also aimed to identify factors such as policy and regulatory requirements, technology deployment, facilities and equipment that could contribute to optimising the system. Decisions regarding intermodal systems enhancements are made by the stakeholders, acting individually or collectively, to impact the system (Crainic *et al.*, 2017). Each of these actors (or stakeholders) in the system has their own viewpoints on what is best for the system, how they believe they need to behave and conduct themselves to fulfil their roles in the system, the gains each actor individually strives to achieve in fulfilling these roles, the stake of individual actors and what they believe other actors could and should do to improve the system. The standpoints of individual actors do not necessarily add up to a collective optimisation of the total complex system (Pourdehnad *et al.*, 2011). These human factors that drive the system and determine its effectiveness required a pragmatic and qualitative research design (Babin *et al.*, 2015).

The development (through the study of literature, Subject Matter Expert (SME) interviews and focus group discussions) and adoption of apt systems thinking frameworks were imperative to addressing the research question to build a foundation for exploring intermodalism as a complex system. Furthermore, a feature of a systemic approach is that it provides for various elements, human stakeholders, and the links and relationships between them such that they work together for the good of the whole. The research study argues for systems thinking theoretical framework being used as a foundation for positing the imperative of a collective viewpoint of the various actors directed at optimising a purposeful freight intermodal system.

The complexity of the research problem and the interactive (Babin *et al.*, 2015) mode of inquiry required a qualitative, phenomenological (The Da Vinci Institute, 2020) research design and methodology that aimed to add value (McKim, 2017) to the pragmatic paradigm that could potentially lead to change as a key outcome. The described research design and methodology were used in striving to contribute to the relevant body of knowledge of intermodalism in South Africa and related systems thinking.

3.4 Research Methodology

The research methodology for conducting the phenomenological and pragmatic research design is summarised in Figure 2 (depicted overleaf) and highlights the steps that were followed in the methodological approach based on the systems thinking theoretical framework.

The research is defined as phenomenological in that it explores and interprets the “lived experience” (Babin *et al.*, 2015, p. 128) of actors in the system. The study is interactive in that the researcher interacted through conversations with system stakeholders such as experts and actors in the field. Furthermore, the research was designed to discern interactions between system actors in a facilitated focus group structured to “elicit information about their views...by generating interactions and discussions” (Gray, 2018, p. 460) and to qualitatively interpret those views towards recommending the imperatives for system advancement; and to support the development of a conceptual framework for optimising the intermodal system.

The first step in the research methodology was to develop a good understanding of the system of interest being studied, the South African freight intermodal system. The interviews and focus group discussions were preceded by the in-depth literature review as well as documentary analysis which sought to determine the most appropriate and effective approach, or combination of approaches to represent the South African freight intermodal system, boundaries, actors and links, using diagrams (and other systems thinking tools).

The review of literature sources, as well as documentary analysis, aided in identifying the main actor or stakeholder groups in the country’s intermodal system; the connections between elements, relationships between actors, key system issues and to postulate the viewpoints that advance or constrain system performance. The literature review also served as a guide to justifying methods, research methodology and approaches for triangulating data to assure rigour and trustworthiness of findings.

Methodology for Qualitative Research Design

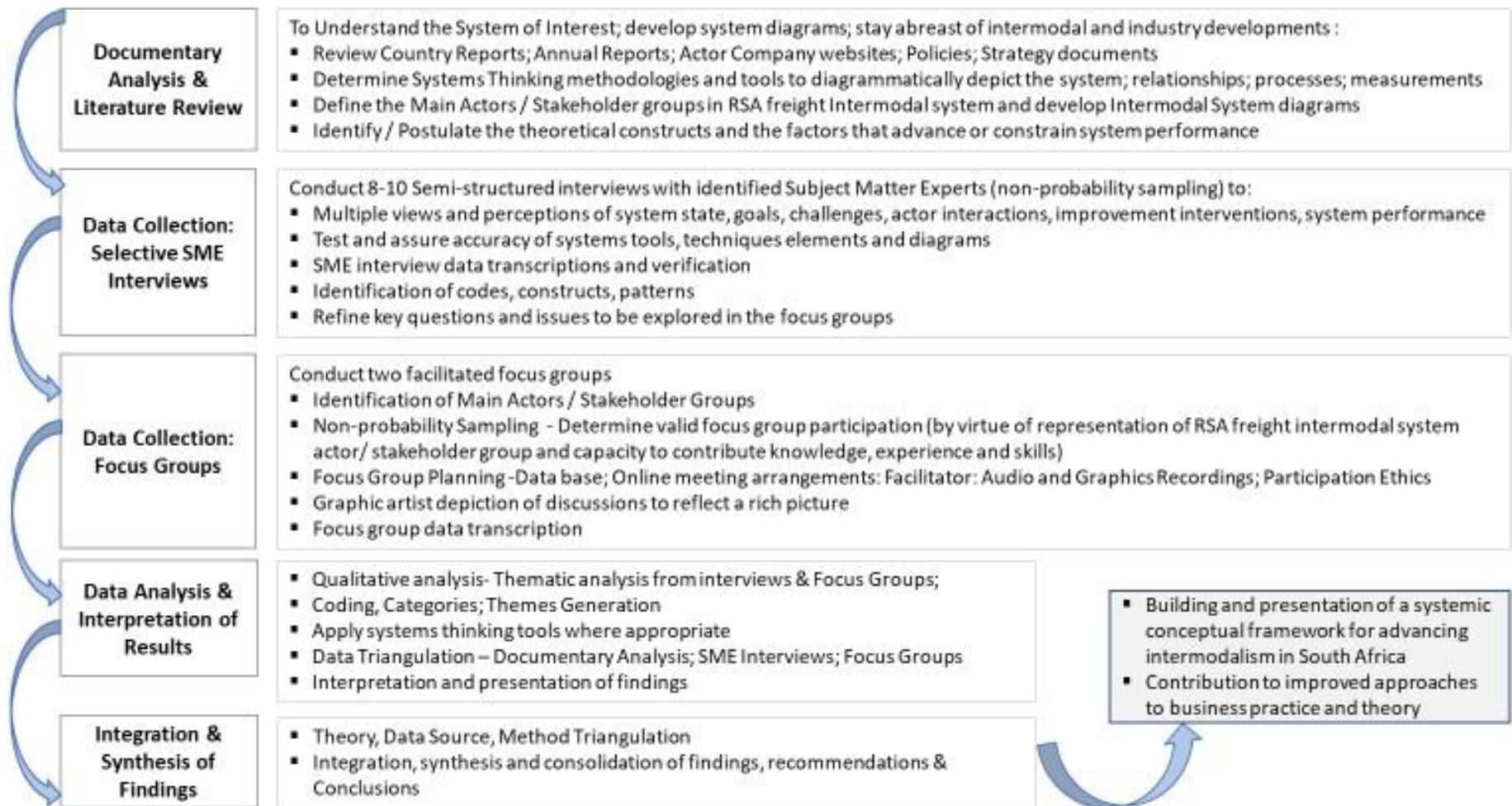


Figure 2: Research Methodology Overview (Researcher Construction)

The researcher explored and studied myriad systems thinking approaches and methodologies to discover tools that would be useful in understanding and representing the complex intermodal system. Different tools were applied during data collection and analysis to extract, analyse, map and present viewpoints of individuals and collective groups who were engaged during the research process. The selection and utilisation of tools is reflected in chapter 4 which presents the findings elicited from the data collection. Examples of tools and methodologies, and their purpose, that were applied are reflected in Table 2 below:

Table 2: Systems thinking tools and purpose

Purpose	Tools	Referenced by:
To understand, analyse and conceptualise the system and systemic nature of the problem at various thinking levels including mental models and mindsets about the system	Iceberg model	(Kim, 2000); (Maani, 2013) (Betley, Sterling, Akabas, Paxton & Frost, 2021)
To understand the characteristics; structure; states and dynamics of the freight intermodal system and its environment	Formulating the Mess; Three States of a System	(The Da Vinci Institute, 2019); (Gharajedaghi, 2011); (Crainic <i>et al.</i> , 2017).
To understand the nature, complexity and extent of the problem and responses to the issues	Cynefin frameworks	(Betley <i>et al.</i> , 2021); (Neely, 2019); (Du Plooy-Cilliers, 2022)
Express a problem through pictures and graphics to align understanding	Rich Pictures	(Conte & Davidson, 2020) (Maani, 2013);
To assess the links, relationships and interdependencies between key concepts and their impact on an issue	Cognitive mapping	(Gharajedaghi, 2011); (Maani, 2013)
To identify and evaluate synergies, causal relationships and circular causality amongst freight intermodal parts and their balancing or reinforcing effects	Causal Loop Diagrams and Feedback loops	(Kim, 2000); (Maani, 2013) (Betley <i>et al.</i> , 2021); (Meadows, 2023); (The Da Vinci Institute, 2019)
To evaluate the most optimal places to apply interventions for optimal effects	Points of Leverage	(Meadows, 2023); (Betley <i>et al.</i> , 2021); (Maani, 2013)
To consider various outcomes and their possible intended or unintended consequences	Scenario Planning	(Betley <i>et al.</i> , 2021); (Maani, 2013)
To identify freight intermodal measurements; patterns and trends over time	Behaviour over time	(Kim, 2000); (Maani, 2013)
To recognise typical behaviours and effects	System Archetypes	(Kim, 2000); (The Da Vinci Institute, 2019);

Purpose	Tools	Referenced by:
The systemic interaction of people, technology and innovation in building collaborative, coordinated and cooperative behaviours and competencies	TIPS™ framework	(The Da Vinci Institute, 2020)

Preliminary versions of intermodal system diagrams, (mostly depicting connections between parts and the consequences of a legacy system), were to be shared with SMEs as part of the interview discussion. In fact, the preliminary diagrams were found to be somewhat superficial when the first four SME discussions confirmed systemic issues, but indicated the need for the development of more purposeful diagrams that reflect system structure, boundaries, actor functions, goals, outcomes and mindsets. More specific system diagrams were later developed once data had been collected and analysed.

3.5 Research Sampling

The research methodology indicates that data, information and insights needed to be sourced from subject matter experts (SMEs) in diverse disciplines such as transportation, intermodalism, logistics, transport economics, industrial engineering, accounting and systems thinking, to describe and define the system, characteristics, boundaries, the challenges and effects of relationships. A specific (and different sampling strategy) was required to select participants for participation in focus groups, as discussed in this section.

3.5.1 Subject Matter Experts

The purposive selection of interview participants for the interview phase in the methodology is non-probability sampling, through the identification of individuals with appropriate knowledge, skills and expertise who were available and willing to be engaged in conversations to advance the country's intermodal objectives. "Interviews are used when the researcher can identify key respondents in relation to the phenomenon...and can engage those respondents..." (Babin *et al.*, 2015, p. 244).

The researcher aimed to engage in semi-structured interviews with eight to ten individual Subject Matter Experts (SMEs) identified by the researcher as having appropriate knowledge, expertise and insights. The researcher initiated the interview sampling process by building a database of contacts known to the researcher. Additional SMEs were identified by seeking

journals or other articles published by South African academics, attending industry forums and perusing specialist media articles or published opinion pieces relating to freight intermodalism.

Where contact details of prospective interviewees were not known, the researcher made contact via LinkedIn (a professional social media application) and requested contact details for setting up an academic research interview. In most cases, the response to this approach was very favourable. This process resulted in a database of 16 SMEs.

For selection, SMEs had to satisfy at least three of the following criteria to be validated as credible, knowledgeable, skilled, capable and experienced experts (Lavin, Dreyfus, Slepiski & Kasper, 2007). SMEs were identified by virtue of their research publications and / or positions that they hold in business, academia, consulting or research institutions. SMEs were asked to give an overview of credentials and background as an introduction to the interviews (also refer to Table 4 of SME credentials). The inclusion criteria used were:

- i. Have first-hand experience in the disciplines or industry of freight transport, intermodal transport, transport economics, logistics, systems thinking and systems engineering;
- ii. Have experience and technical expertise by being active in these disciplines or the industry for five to ten years;
- iii. Have obtained a recognised qualification in the disciplines of freight transport, logistics, systems thinking, systems engineering;
- iv. Are currently active or involved in these fields of interest;
- v. Are recognised or recommended by peers in the industry or discipline;
- vi. Hold a position of authority such as Senior Lecturer or Professor in academia, management, leadership, consultant or advisory position in a related industry association, institution or organisation. They may also be sought-after speakers at intermodal, logistics or freight-related conferences.

3.5.2 Focus Groups

Focus group participants were selected through non-probability, purposive sampling based on the role that they fulfil in the freight Intermodal industry (thus context specific participants had to be selected) (Gray, 2018). They are the actual actors who have the ability and know-

how to describe the system's functioning and performance, build assumptions, highlight critical interactions, define relationships, make decisions and influence the development of system improvements. Focus group participants were approached to participate based on the categories or actor groupings that they represent in the freight intermodal system (for example, shipper, railway, terminal operator). The sampling method and appropriate selection of participants to focus groups was imperative to ensure specific representation of actor groupings across the system.

Focus groups are appropriate where those that are invited to participate are familiar with or are experts in the field being studied (Babin *et al.*, 2015) and the “sample” in this case was designed to be a group of 12 to 15 participants. Two focus groups were planned to observe the dynamics between participants and to derive perceptions of the lived experience of the actors. The rationale for holding two separate focus groups was to assure the participation of a mix of actor grouping attendance according to the sampling strategy and to improve rigour, trustworthiness and transferability of findings.

In this research study, focus groups were chosen to serve as a research instrument to uncover the extent to which the group, as representatives of the freight intermodal system, engages towards the development of common viewpoints, goals and objectives, which is a key tenet of the study. Crainic *et al.* (2017) identified the actors or stakeholder groups in an intermodal system as indicated in Table 3, which was slightly refined by the researcher to be representative of the key actors in the South African system. Participants were invited to participate in a manner that a “sample” of at least 12 participants from the intermodal industry were represented in each group.

Table 3: Focus Group Representation

Main Actors / Stakeholders	Role in Intermodal System	Ideal Number of Participants per group
Shippers, Cargo Owners or Cargo specific industry association	Generate freight transportation demand	2
Carriers (Road hauliers; Railways; Shipping Lines)	Perform the transport for the shippers	2 Road; 1 Rail; 1 Shipping Line
Freight Logistics Providers (FLPs) or Logistics Service Providers (LSPs)	Third-party logistics service providers that undertake various logistics tasks and provide value-added logistics	2 – 3 LSPs

Main Actors / Stakeholders	Role in Intermodal System	Ideal Number of Participants per group
	services in the intermodal system	
3PLs (sometimes appear as Carriers) or Freight Forwarders	Secure timely transportation capacity	1 3PL or Freight Forwarder
Facility and Infrastructure Managers	Public or Private entities provide and manage physical networks and infrastructure (roads, railways, terminals, port terminals. Ports and dry ports) and technology	2 Facility Managers
Institutional Authorities (Government departments, public administrations, agencies)	Set policies, Regulate, Tax or incentivise	1 Government representative
Freight Intermodal system	Intermodal solutions	Total Group of 12 – 15 participants

It must be noted that it was not the intention to include the same participants in both the interviews and the focus groups. In fact, this was deliberately avoided. The distinction made between “Experts” (SMEs) and “Actors” is supported by Müller *et al.*, (2012) in studies on terminology for collaborative research often used in systems thinking approaches. These researchers differentiate between actors and experts and describe actors as “individuals or collective entities in the real world” who carry out activities in that system. Experts are defined as “individuals capable of representing the perspective of an actor ... in addition to their individual perspectives” (Müller, Groesser & Ulli-Beer, 2012, p. 500).

The appropriate selection of participants to the focus groups was imperative to ensure a proper, transferable and repeatable representation of key actor groupings in the system. A focus group does not aim to generalise opinions from the sample to the greater population, as is the case with national randomly representative surveys, rather it is more important to ensure that identified actor groups are represented, or that they approximate (Gray, 2018) the actors in the freight intermodal system population (Crainic *et al.*, 2017). In order to obtain a group representative of the actor groupings in Table 3 above, the number of participants to be invited was slightly larger than an ideal focus group size suggested as between six and twelve participants in a one to two hour session (Gray, 2018, p. 465).

A database of prospective focus group participants was built by developing diagrams of the freight intermodal industry structure and identifying organisations in South Africa (by organisation name) that fulfil those functions. In some cases, the names of actors representing organisations were known to the researcher through her career network in the industry. Where names (and/or contact details) were unknown, the researcher conducted online searches of organisation websites and annual reports to identify the names of executive-level participants. Potential participants were contacted by e-mail where contact details were visible, or via LinkedIn and were requested to share contact details for participation in a focus group for academic research on South Africa's freight intermodal system.

These approaches enabled the researcher to build a database of approximately 40 system actors. Participant lists were divided to form two proxy groups to optimise the spread of actor groupings, as close to the ideal research design representation in each focus group.

3.6 Data Collection

Focus groups and interviews are appropriate methodologies deployed for research based on a pragmatic philosophy or one that seeks to understand a group or "social construct", in this case, the group is made up of the intermodal role-players (Babin *et al.*, 2015). The research is a qualitative study using multi-methods that were conducted sequentially. The data collection methods comprised documentary analysis, subject matter expert interviews and focus group discussions. To ensure that the methods were credible, trustworthy and available for analysis, specific steps were adhered to for the collection of information in each of the sequential steps (Babin *et al.*, 2015; Gray, 2018). Data triangulation methods (theory, method and data source triangulation) of the collected data were also conducted to assure the dependability, trustworthiness and credibility of findings required for qualitative research (Moon, 2019). Data triangulation is discussed in Chapter 5.

3.6.1 Documentary Analysis

The first data collection step was to source and analyse various documentary resources related to the topic. This has been a continuous endeavour throughout the study and has allowed for ongoing awareness and insights into the phenomenon of freight intermodalism, particularly during what has become a time of global supply chain challenges, in large part

instigated by the Covid-19 pandemic and other challenges unique to the South African situation.

Documentary analysis was conducted to explore the South African freight intermodal system to understand the structure, processes and core functions fulfilled by the actors in a purposeful system. In other words, to get the “beat of the system” (Meadows, 2023) before even beginning to determine imperatives or the need to develop interventions that could advance the system.

Documentary analysis was primarily used to develop an understanding (and diagrammatic representations) of the system in South Africa, its sub-systems, actors, boundaries and interrelationships between system elements and actors. Documentary analysis was performed throughout the research period to track developments in an evolving real-world freight system. Criteria used in determining the sources that would be valuable to explore in the documentary analysis are indicated:

- i. Company Annual Reports and websites to confirm the key actors and actor organisations in the South African freight intermodal system. This was necessary to enable the building of a “map” of the system structure; its boundaries, the roles of system actors; system processes and functions and system purpose (often reflected by actor organisations as value propositions or logistics service offerings). This also assisted in developing a database of potential actors for focus group participation.
- ii. Country Reports to determine system performance and measurement criteria that relate to the performance of South Africa’s freight intermodal system.
- iii. Websites to identify and clarify roles of industry associations in the system, for example, representing, integrating and lobbying for actor causes.
- iv. Forums, conferences and webinars were attended to identify and build a database of industry experts and actors that could potentially be approached for an interview or focus group participation and to determine topical industry issues, terminologies and the lens through which actors see and phrase their opinions and views of the system.
- v. News and specialist press articles regarding industry developments and announcements that enabled insights into policy developments, structure, process and function of the freight intermodal system in the country. These sources often elicited information

regarding the formation of strategic alliances among actor organisations, core challenges and highlights of system performance.

The study could be repeated by other researchers using these criteria to select sources for documentary analysis. The presentation of findings (Chapter 4) includes key aspects of the documentary analysis) where appropriate.

3.6.2 SME Interviews

One-to-one interviews comprised specific semi-structured, open-ended questions relating to system characteristics and working (Babin *et al.*, 2015) and a preliminary system diagram was to be tested. The interviews were conducted with SMEs who have appropriate credentials and who could add insights into systemic aspects of the phenomenon. Interview participants, as thinking human managers and business decision-makers, conceivably have both objective and subjective views and perceptions to share (Saunders *et al.*, 2019). This step constituted qualitative research designed to enable the interpretation and understanding of perceptions of experts, about the research constructs, before embarking on focus group discussions.

The researcher had originally planned to conduct interviews with eight to ten Subject Matter Experts (SMEs). The interview questions and the rationale for posing these questions are contained in Annexure B. A total of sixteen SMEs were approached (to make provision for negative or non-responses) and invited to participate in one hour-long online discussion interviews. Several positive responses were received and ten SME interviews were ultimately conducted over approximately four weeks (10 February – 14 March 2022) due to the timing of responses received and interviewee availability. Consent forms were signed by interviewees.

The credentials of SME interviewees are summarised in Table 4 below to reflect the appropriateness of their selection as participants as indicated in section 3.4.1. The interviewed SMEs reflected a broad range of expertise across several disciplines which enabled the collection of diverse perspectives. To preserve anonymity and confidentiality, SMEs were each assigned a “Code Name” which was used when saving transcripts for coding and when quoting their perspectives in the presentation of findings.

Table 4: SME code names and credentials

Subject Matter Expert	Credentials
Container M	Transport; Logistics; Containerisation; Strategy; Project Management; General Management; 25+ years' experience
Logistics I	Chartered Accountant, Rail Transport; Road Transport; Logistics; Consultant; 35+ years' experience
Academia J	Macro Logistics; Supply Chain; Transport Analytics; Professor Emeritus and Consultant; 40+ years' experience
SysIntervene I	Information Systems; Systemic Interventions; Research in Transport; Veterinarian; Principal Researcher; 25+ years' experience
Intermodal L	Sales and Marketing; Business; Rail and Logistics Transport; Consultant 35+ years' experience
SystemsAca N	Systems Engineering; Transport Research; Senior Lecturer 20+ years' experience
SC Consult G	Engineer; Logistics; Supply Chain Management; Consultant; Managing Director 35+ years' experience
Analyst D	Business Management; Freight Forwarding; Global Logistics Trade; Investment Banking; Pricing; Senior Analyst 15+ years' experience
Custodian H	IT Systems; Transport Communication; Owner; 40+ years' experience
TruckTech P	Civil Engineer; Rail infrastructure; Road transport design innovation; Transport Research; Road Transport Consulting 40+ years' experience

Recorded and transcribed interviews resulted in a significant amount of primary qualitative data being collected for analysis.

3.6.3 Focus Group Discussions

The one-on-one interviews were followed by holding two focus groups with identified actors who are active in the system. The preceding research steps (documentary analysis, the development of preliminary system diagrams and the interviews with SMEs) helped to define the context and specific issues to be addressed in the focus group discussions (Babin *et al.*, 2015). It was envisaged that the focus group discussions would uncover group dynamics (such as the manner and willingness to interact), discover themes and patterns, strive to identify the tangible and intangible factors that are required and determine the constructs that advance (or that constrain), the required interaction between actors for effective intermodal functioning.

The plan was to hold facilitated, interactive and robust discussions amongst a proxy group of 12 – 15 freight intermodal system actors per group as per the sampling strategy described. As planned, two focus groups were conducted. Focus groups were held on 25 and 28 July 2022 respectively. Once again, an overwhelming response was received from actor representatives active in the country's freight Intermodal system. The focus group

discussions were conducted online via MS Teams. Online meetings, training workshops and conferencing had become the norm in the country during Covid-19 lockdown impositions, and the convenience of this practice has continued to current times. Online discussions also facilitate participation of actors, who are located in various cities around the country (without incurring travel and accommodation costs). The focus groups were extremely well attended online with good representation by system actors, most of whom hold executive level positions at the organisations that they represent. Actual focus group participation and representation are reflected in Table 5 with 19 and 16 participants in attendance in Focus Groups 1 and 2 respectively, which reflects mostly planned representation of system actors (relative to the research design and sampling) allowing for a good view of actual experiences and views of system actors.

Table 5: Focus Group Representation

System Actor Groups	Role in Intermodal System	Participants: Design	Participants FG 1	Participants FG 2
Shippers / Cargo Owners	Generate freight transportation demand	2	5	4
Carriers (Road hauliers; Railways; Shipping Lines)	Perform the transport for the shippers	2 Road; 1 Rail; 1 Shipping Line	2 Rail; 1 Road; 1 Shipping	2 Rail; 1 Road
Freight Logistics Providers (FLPs) or Logistics Service Providers (LSPs) 3PLs (sometimes appear as Carriers)	Third-party logistics service providers that undertake various logistics tasks and provide value-added logistics services in the intermodal system Secure timely transportation capacity	2	4	2
Facility and Infrastructure Managers	Public or Private entities provide and manage physical networks and infrastructure (roads, railways, terminals ports) and technology	2	2 Terminals; 2 Rail	2 Rail; 2 Terminals; 2 Port Terminals
Institutional Authorities (Government departments, public administrations, agencies)	Set policies, Regulate, Tax or incentivise,	1	2	1

System Actor Groups	Role in Intermodal System	Participants: Design	Participants FG 1	Participants FG 2
Intermodal system	Intermodal solutions	Total Group of 12 – 15 participants	19	16

A larger number of participants had been invited to make provision for a typically high degree of no-shows (Gray, 2018). Almost all invitees dialled in at the appointed time and the willingness of high level individuals to participate was gratifying and did not detract from the robustness of the discussion (where some participants also made use of the MS Teams Chat function to express their views). The focus group discussions intended to determine how system actors converse regarding freight intermodal issues as they might in a similar grouping of real-world system actors. For purposes of quoting actors, their anonymity was preserved by indicating the focus group attended (FG1 or FG2) and the type of actor, (e.g. Rail Actor, Road Actor; Shipping Actor; Customer Actor) to contextualise their statements and views.

The discussion centred around a description of the system “As it should be” and the nature of interventions to be designed to address the gaps between the “Current or As Is” and “As it will be” states to move closer to a description of the system “As it should be”. This approach is based on the Da Vinci method (The Da Vinci Institute, 2019) depicted in Figure 3 below. The two focus groups elicited a wealth of data for analysis.

System States

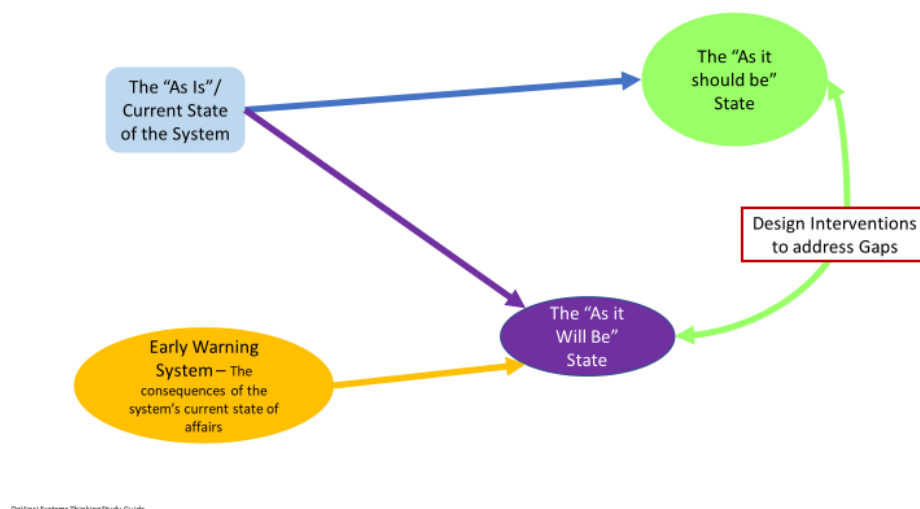


Figure 3: Three states of a system (Source: The Da Vinci Institute, 2019)

In preparation for the focus groups (and for the facilitator briefing), the researcher prepared slides on highlights of SME perceptions and freight measurements. These briefing notes are contained in Annexure C. Slides used by the researcher to introduce the focus group discussion topic are reflected in Annexure D. In addition to the facilitator, an independent observer was in attendance to take notes and observe group dynamics during each focus group. (Non-disclosure forms were signed by the observer and the facilitator). To add interest and appeal to the discussion and its output (building a rich picture perceived by participants), the researcher obtained the services of a graphics artist who is skilled in observing focus group events and visually recording the discussion points, in real-time, for presentation to participants in the last few minutes of the discussion. These graphics may be viewed as primary data and provide the perceptions of a neutral observer about the discussion and issues raised. The graphic “recordings” are contained in Annexure E.

All focus group participants were requested to sign and return consent forms prior to participation. Not all returned the signed forms. The facilitator did however remind both groups that the discussions would be recorded on MST functionality and requested permission to begin recording. There were no objections.

The data collected from these sequential steps were analysed, interpreted and synthesised to address the research questions (Babin *et al.*, 2015).

3.7 Data analysis

The data collected is qualitative and, as such, the analysis is prone to scrutiny. Rigorous and logical methods must therefore be applied to ensure and show evidence of trustworthiness and consistency of all sequences of the research methods (Gray, 2018).

Both the interview and focus group data were analysed through a review of the audio recordings, transcripts and graphics diagrams to identify specific concepts, ideas and themes (O'Connor & Gibson, 2003). The language, jargon and words used by the participants were assessed by thematic analysis and “disaggregated ...to smaller parts” (Gray, 2018, p. 684) to identify themes or recurring patterns of thought which were arranged into codes and categories that were consistently voiced by interviewees and participants. The original transcripts and audio recordings have been retained for scrutiny to assure that the coding and categorisation are not construed to be subjective or biased in interpretation.

Gray describes a logical process for coding qualitative data that may be summarised as multiple readings and reflecting on the transcribed data, exploring and “playing” to emerge with themes, coding the themes and seeking ways of connecting them (axial coding), reviewing, reflecting and refining to build the findings and arguments (Gray, 2018, pp. 686-7; 697).

Transcripts were coded manually, and software was not used. This manual method was preferred as it required increasing familiarity with the data through numerous iterations of reading, coding and re-arranging of data.

Data from a focus group can be analysed similarly to the methods applied to individual interview data, some distinctions are imperative, namely, there are “three units: individual, group and interaction” (Gray, 2018, p. 475). For this research, the analysis of the interactions was important as the aim was to determine the *collective view* of the role-players as they generated thoughts, ideas and improvements that could benefit the system as a whole. Analysis of the focus group typically begins immediately at the conclusion of the first focus group discussion and “data collection and analysis are concurrent” (Gray, 2018, p. 475) and simultaneous.

The Braun and Clarke six-phase approach to thematic analysis (Braun & Clarke, 2012) was followed rigorously and systematically to code the data and generate research themes. The method followed is described to give credence and trustworthiness to the outcomes that seek to address the research problem and “answer” the research questions.

i. Data familiarisation

Interviews and focus group discussions had been audio-recorded and auto-transcribed (using Microsoft Teams functionality) and the first step in data familiarisation began by reading transcriptions and listening to recordings to assure the accuracy of transcriptions. Transcriptions were edited by the researcher to exclude introductory chatting not relevant to the research, gross errors in auto transcriptions, removal of disfluencies (e.g. um, ah, you know, I mean) and significant grammatical lapses. A neutral assistant also listened to recordings and verified the correctness of the transcripts.

Reading and re-reading then commenced to understand the data. This process was followed immediately after each interview and focus group was concluded. All printed

transcripts were reviewed again as a complete set of data before continuing to the coding phase.

The same coding approach was used for both interviews and focus group transcripts as the intention of both data collection methods was to obtain multiple viewpoints of reality to develop concepts that would address the research problem. The data triangulation discussion (Chapter 5) indicates the similarities and differences or areas of convergence or divergence between the different data collection methods.

ii. Initial Coding

Codes by which to sort the data collected (from the ten interviews and two focus group discussion transcripts), were initially derived in a top-down or deductive manner. Codes were selected based on constructs identified in the literature review, concepts relating to freight intermodal principles, systems thinking concepts, ideas stemming from the documentary analysis and the researcher's knowledge of the freight system (Saunders *et al.*, 2019). This resulted in a set of eight initial codes. Codes were highlighted on printed versions along with researcher notes and thoughts. As the reading and re-reading progressed, additional codes were induced and added. At times a relevant extract contained more than one code, and all were noted. Annexure F reflects the broad set of codes that resulted. Codes and the definitions, thoughts, ideas and concepts associated with each code are also reflected in Annexure F. Data extracts, with their codes, were then transferred to a master spreadsheet with a worksheet per code.

iii. Searching for themes

The next step in the process was to group the codes into broader categories of meaning where patterns, similarities and divergent views had started to become visible through iterations of searching. This categorisation was used to organise, rearrange and regroup the large amount of data to be used in generating themes that would address the research aims, objectives and questions.

All coded text extracts were transferred to spreadsheets by grouping coded data and constructing them into a master file with a spreadsheet per category. The use of Excel spreadsheets enabled the researcher to sort data, regroup and search for specific

keywords during analysis phases. Broad categories of codes were ultimately “collapsed” into seven preliminary groups or themes and sorted into a revised spreadsheet.

Data extracts per research participant were identifiable in a spreadsheet column using the SME code names and indicating the type of actor and focus group (1 or 2) that they participated in. This enabled the researcher to return to a specific original transcript to verify the context of statements where required and to prepare the data for triangulation.

iv. Reviewing potential themes

The arrangement of codes into categories resulted in more manageable sets of data that enabled further review of text to rearrange phrases to search for, generate and construct themes. At this stage, patterns and relationships between constructs were sought with the specific intention of identifying and analysing those extracts that more specifically addressed the research questions. This also required the identification of text or data extracts that evidence and support the researcher's findings, interpretation and claims. During the process of searching for themes, the researcher used conceptual mind maps, causal loop diagrams and notes to discern relationships between data in and between themes. The themes slowly took shape and grouping, and re-arranging extracts allowed the researcher to identify sub-themes within the preliminary theme groupings and considered them within the context of the research questions. The seven preliminary themes were ultimately reduced to six discrete themes.

v. Defining and naming the themes

Continuous review resulted in some extracts being prioritised for inclusion in the presentation of findings as they were deemed to be valuable in building the “storyline”. All extracts were retained in the spreadsheets for later verification and re-consideration for inclusion in the presentation of findings. A mind map was then developed reflecting the relationships between themes and how they build on each other. This provided an overall view of how the findings would be presented to address the research questions and aims.

vi. Producing the report

In developing the final report for presentation of findings, themes were given more descriptive and creative names to assist readers in building a coherent view of the research findings. The six themes are presented in Chapter 4 of the thesis.

Documentary analysis was also considered in the development of themes and is incorporated (where applicable) within the findings to support or present alternate views to those expressed by the research participants.

Triangulation of data analysis and findings (Saunders *et al.*, 2019) was employed (discussed in Chapter 5) to synthesise and validate the findings obtained from the three different research collection methods (O'Connor & Gibson, 2003), the theory (and documentary analysis of the intermodal system and system characteristics), the expert interviews and the focus group discussions. The triangulation of data findings serves to verify the trustworthiness of findings (or to refute them) and present alternative findings or directions for further research (O'Connor & Gibson, 2003). This analysis was used to contribute to the body of knowledge about the value of a systems approach to intermodal freight systems and the contribution of collective common objectives and multi-party means for enhancing intermodal system performance.

3.8 Data Integrity Processes

Every effort was made to assure the trustworthiness of the research. Methods were used to ensure the integrity of participants, the data, its management and its analysis (Babin *et al.*, 2015). According to Gray (2018) the trustworthiness of qualitative research is addressed by considering the data collected and its analysis in terms of credibility, transferability, dependability, confirmability and authenticity (Gray, 2018). The research conducted is discussed in terms of these attributes:

i. Transferability

The sampling strategies that were described in this chapter clarify the manner in which research participants were identified and selected. Pursuit of the same sampling strategy and applying criteria specified for SME selection and the purposive sampling to approximate focus group actor representation are indicators of transferability. By using the same sampling strategy and methodology, the study could conceivably be repeated

by other researchers to test for similarities or differences used in the descriptions that were voiced by participants in this study.

In addition, a neutral facilitator mediated the focus groups to avoid researcher bias or subjectivity that could steer the group discussion in a pre-determined manner (Babin *et al.*, 2015). An independent observer was present in each focus group and provided notes on her observations of group dynamics. The graphics artist's drawings of her interpretation of the discussion provide a further independent view to the researcher's interpretation.

The group dynamics of focus groups were observed (as far as possible via the audio process) and noted by the researcher and an independent observer. To improve data integrity, "a rapporteur may be used to make observations and produce notes of these" (Gray, 2018, pp. 481-482).

ii. Dependability

All recordings of interviews and focus groups (audio recordings, MST auto-transcriptions, MST chat notes and graphics) were retained and stored safely, as were notes, diagrams and other material aids such that they may be used as evidence and for verification at a later stage (Gray, 2018). Annexure F contains a summary of the codes that were applied across the data. This reflects descriptions of the ideas that codes encompassed to reflect consistency and dependability of coding and interpretation of data by the researcher.

iii. Confirmability

An audit trail can be shown in the file retained by the researcher which reflects the thinking, re-arrangement, categorisation and eventual themes generation. Each time that data was analysed and adjusted, the spreadsheet was dated and saved and indicates the progression of the analysis over a period of more than six months. An independent researcher could thus access and listen to audio recordings or read transcripts and view analysis files to confirm the researcher's interpretation. Verbatim extracts and conceptual mind maps contained in the presentation of findings (Chapter 4) also reflect the way the researcher interpreted the data through the steps followed in the thematic analysis.

iv. Credibility

An important test of credibility is reflected in the comprehensive discussion of data triangulation presented in Chapter 5 of the thesis. In this regard, data sources, methods, and theory were triangulated to determine convergence or divergence of interpretation as well as other key differences or similarities. Transcripts were shared with SME participants to allow them to confirm the correctness of the discussions. In cases where SMEs or a specific focus group actor had made intriguing statements, the researcher followed up with that individual to clarify. Responses were received by email or WhatsApp to provide clarity to the interpretation.

v. Authenticity

The authenticity of statements made by research participants may be gleaned from the verbatim extracts used to present findings as well as in the detailed extracts shared in annexures used to build the outcomes chain and the actor inter-relationship analysis. Descriptive and detailed responses voiced by participants attest to the authenticity of their knowledge and perceptions about the freight system.

3.9 Ethical Considerations

The researcher has stated that the project will not be approached with a pro-rail bias (despite her past career as a railway strategist employed by the national railway). Her particular situation required the assurance that research is undertaken, and research decisions are made, on a very ethical and transparent basis to ensure the trustworthiness and application of research results (Kivunja & Kuyani, 2017; Saunders *et al.*, 2019). The research does not aim to arrive at a position that is specifically beneficial to the railway only, but rather to determine the greater benefits of intermodalism to the country through improved interaction between all system partners.

No interviews or focus groups were conducted until after an ethical clearance letter had been received by the researcher (Annexure A).

In addition to the data integrity aspects described in the preceding section, steps to ensure ethics address the research aspects of “privacy, accuracy, property and accessibility” (Kivunja & Kuyani, 2017, p. 28). Considerations to assure ethics were:

- i. Privacy – Declarations made in letters of consent to assure anonymity of responses. Permission was obtained for recording of interviews and focus groups. The methods used to develop databases have been described in sampling and participant contact methods (including the use of LinkedIn to make initial contact). The study information letters and letters of consent explicitly indicated that the study aimed to obtain participants' perceptions of the system and that no one would need to divulge personal nor secret, classified or commercially sensitive organisational information. The letters also gave participants the right to withdraw from the study at any point.
- ii. Accuracy – Statistical packages were not used for the analysis of data. A rigorous manual process is described and all recordings and transcripts have been retained should verification be required. The researcher exercised responsibility and objectivity in the data interpretation processes.
- iii. Property – Intellectual property ownership has been verified to be following the rules and procedures of the DaVinci Institute.
- iv. Accessibility – Declaration of safe storage of response information with the university period for which information will be stored for academic and research purposes. Participants of interviews and focus groups were advised at the start of engagements (through letters of research information and consent to participate) that they have a right to access the results of the study via the university protocols and publication of the findings in the final report or other publications.

3.10 System Structure and Boundaries

Before the presentation of findings, it is prudent to provide a map of the defined system of interest, the freight intermodal system in South Africa. As indicated, the researcher primarily utilised the documentary analysis, supported by her knowledge of the system, to construct a view of the system structure, boundaries and context (Figure 4) to which the research relates. The defined system of interest enhances understanding of the interview and focus group discussion issues and aspects. The diagram of the system reflects several attributes of South Africa's freight intermodal system:

- i. The external environment boundaries (rules of the game) (Havenga *et al.*, 2020) and comprises sub-systems such as government departments, agencies and regulators;

financial institutions; suppliers of enabling equipment and technology; industry associations; interest groups; organised labour; the media and academic institutions.

- ii. The market environment system is where the main role players compete for the business of moving freight for customers and cargo owners. Sub-systems include freight carriers and transport modes (shipping lines; road; rail and air transport carriers and logistics services providers); and transport and logistics infrastructure owners (rail and road network infrastructure owners; nodes such as container terminal and dry port owners/operators; Port Authority and port terminal operators; warehouses and distribution centres).
- iii. There are strong connectivity relationships between role players in the market environment sub-systems to deliver intermodal solutions, for example between terminal operators and trucking companies; or logistics services providers who also own or operate distribution centres.
- iv. Figure 4 also reflects the perceived degree of control and power (or influence) exerted on the freight intermodal system by bodies in the external environment.

System of Interest : RSA Freight Intermodal System Environment & Boundaries

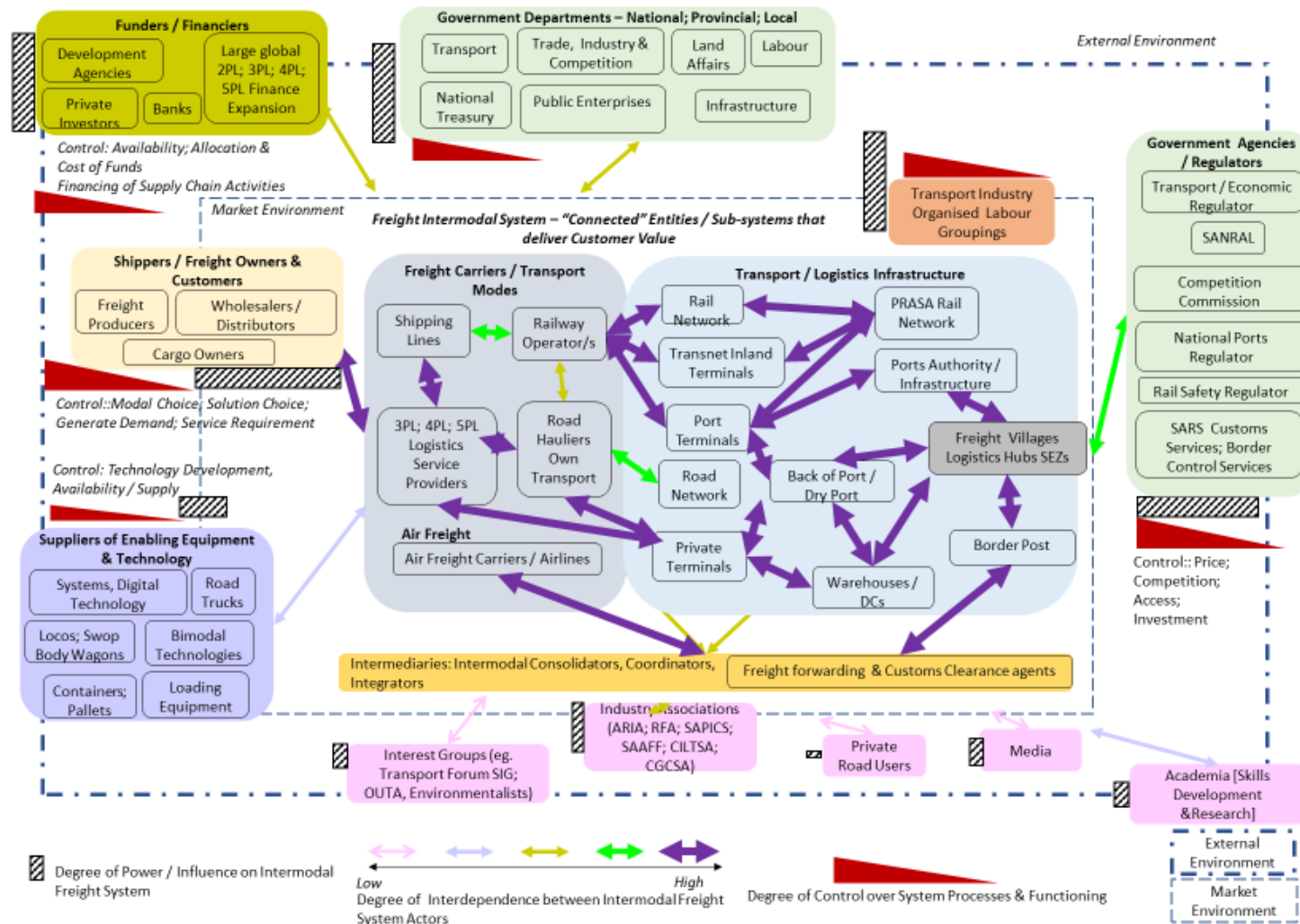


Figure 4: Freight Intermodal System Environment and Boundaries (Researcher construction)

Figure 5 (constructed by the researcher) reflects the relationships between system actors and summarises the processes and functions performed by actor groups to deliver system results.

There are several powerful players in the system. Transnet SOC exerts significant power as the owner-operator of national transport assets and as such should fulfil many roles in developing and optimising intermodal freight in the country. Furthermore, as a State-Owned Company (SOC), Transnet plays multiple roles of being required to implement objectives in the National interest and simultaneously cooperate and collaborate with its competitors in the market, while striving to remain commercially viable.

Private sector road freight transporters and Logistics Services Providers (LSPs) are powerful players and are backed by a strong Road Freight Association (RFA) and the South African Association of Freight Forwarders (SAAFF), who exert influence in lobbying for issues in the interests of members. Freight forwarders and customs clearance agents fulfil integration, consolidation and coordination functions for many actors in the system.

The road transporters and LSPs active in intermodal freight, are often large and dominant companies (often international or global players) that are vertically integrated and control processes either through partnerships, strategic alliances or ownership of assets (e.g. shipping line ownership of container ships, container terminals and air freight carriers, as well as interests in financial institutions). These structures enable the provision of an array of transport and logistics services in the supply chain.

The South African Association of Ship Operators and Agents (SAASOA) is also an active player in the industry and represents ship operators and vessel agents. Its members are also members of various international shipping and ship's agency organisations.

Freight Intermodal System of Interest : Structure & Function to deliver Customer Value

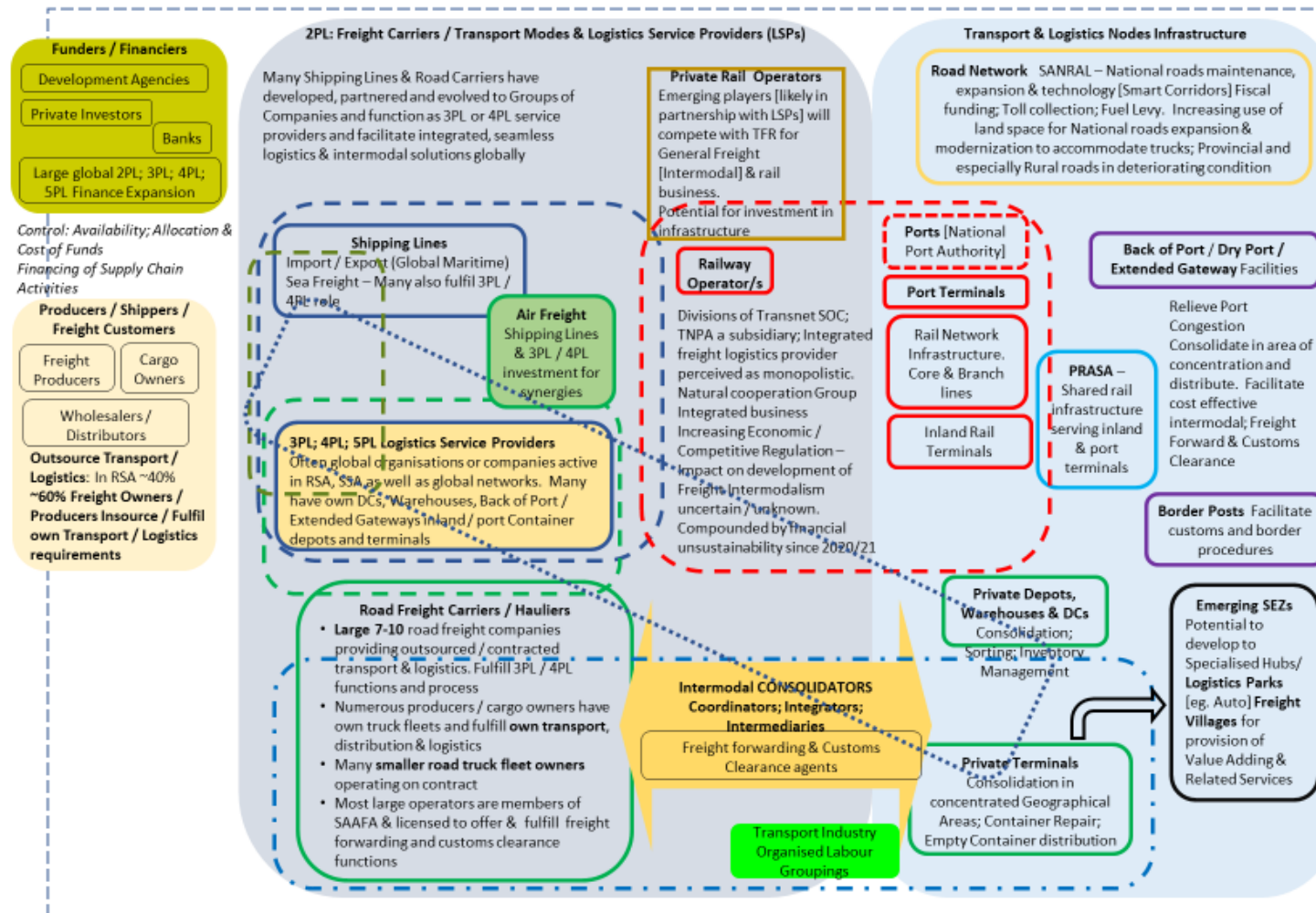


Figure 5: System Structure and Functions (Researcher construction)

3.11 Conclusion

This chapter describes the research design and rationale and the methodology conducted to address the research aim, questions and objectives. The research reflects a pragmatist philosophy where “humans are different from physical phenomena” (Saunders *et al.*, 2019, p. 160) to explore the phenomenological concept of freight intermodalism and its real-world systemic functioning. The phenomena are studied from a systems thinking theoretical framework as a foundation for addressing and testing the research idea of developing holistic and collective system solutions through common system-wide objectives and viewpoints to unlock value.

The research methodology identified as suited to a study of this conceptual and theoretical framework (Babin *et al.*, 2015) is a multi-method qualitative methodological approach (Saunders *et al.*, 2019):

- i. Systems tools and documentary analysis for actor identification, system understanding, interdependencies, inter-relationships and diagrammatic framework development;
- ii. SME interviews to refine the framework and elicit characteristics and issues for improvement; and
- iii. focus group discussions to derive collective viewpoints about the research constructs and desired outcomes.

This chapter also incorporates system diagrams of the system of interest to provide context for the presentation and discussion of findings in subsequent chapters.

A pragmatic epistemological approach may be derived if the solutions generated by the research could lead to action, (Saunders *et al.*, 2019) where action would be the ultimate desired outcome.

Data were sequentially collected from multiple interviews (approximately six weeks) and two focus groups (one week) over a time horizon of approximately six months. Thematic analysis of collected data was conducted using coding, categorisation and generating themes to identify and uncover patterns and links that address the research questions.

The approach to theory development may be asserted as abductive in that the researcher had to “move back and forth between data and theory” (Saunders *et al.*, 2019, p. 148) to elicit observations and new ideas as plausible theory arises from an examination of the data and

findings. Data triangulation is comprehensively addressed in Chapter 5: Discussion of Findings.

Data integrity and ethical considerations provide assurance of the trustworthiness of the research and analysis.

The rationale for the research design and methodology supports the researcher's own ontological, epistemological and axiological philosophies and that the methodology to be deployed is appropriate for a business and management research problem that is both complex and transdisciplinary (Saunders *et al.*, 2019; The Da Vinci Institute, 2020) as seeks to enable change as an outcome. Chapter 4 presents the findings by way of the six themes generated by pursuing the research methodology and sampling as designed.

4. CHAPTER 4

FINDINGS

4.1 Introduction

This chapter presents and describes the findings derived from the collection of data in the multi-method qualitative research conducted in pursuing the primary and secondary research questions.

The theoretical framework of the research is for the freight intermodal system in South Africa to be explored through a systems thinking lens. This theoretical framework requires that, in addition to the presentation of findings through thematic analysis, systems thinking tools are also used, where appropriate, to present findings from the data collected by the primary data collection methods.

Thematic analysis (as described in Chapter 3) was selected as the appropriate method for analysis across a large set of qualitative data, collected through transcriptions of ten recorded interviews and two focus group discussions (multi-methods), to understand and interpret the views and perceptions of research participants. This method of analysis was selected to elicit the key aspects relevant to addressing the research questions from a systems thinking theoretical framework lens.

4.2 Themes

The six themes and their respective sub-themes that were generated from the data to address the research topic and questions are presented as a map of themes in Figure 7. The themes are distinct, but interlinked, as is the system reality of the issues and potential interventions and approaches that could be applied by system actors and other stakeholders.

The map of themes reflects the current state of the system by the theme **“So much at stake”** which also describes early warnings and possible outcomes of the system “as it will be” if left unchecked. To advance the system requires the building of institutional capacity and capability and a national vision that builds consensus around a vision for the future (Themes **“Capacity and capability”** and **“A National roadmap”**). The theme **“All seeking solutions”** presents research participants’ proposals for improving the freight intermodal system in South Africa – ideally improvements would be driven by a clear national view. Improvement proposals would require significant interaction between system actors as described by the

theme “**A CCC network**” that discusses cooperation, coordination and collaboration, all of which would depend on the quality of the institutional capacity and capability; and the clarity of the national road map. The final theme leading to the advancement of the freight intermodal system is “**A better system**” where participants emphasised the need to see the bigger picture to encapsulate the beauty of a system that works. The findings of each of the six themes are then presented in the sections that follow.

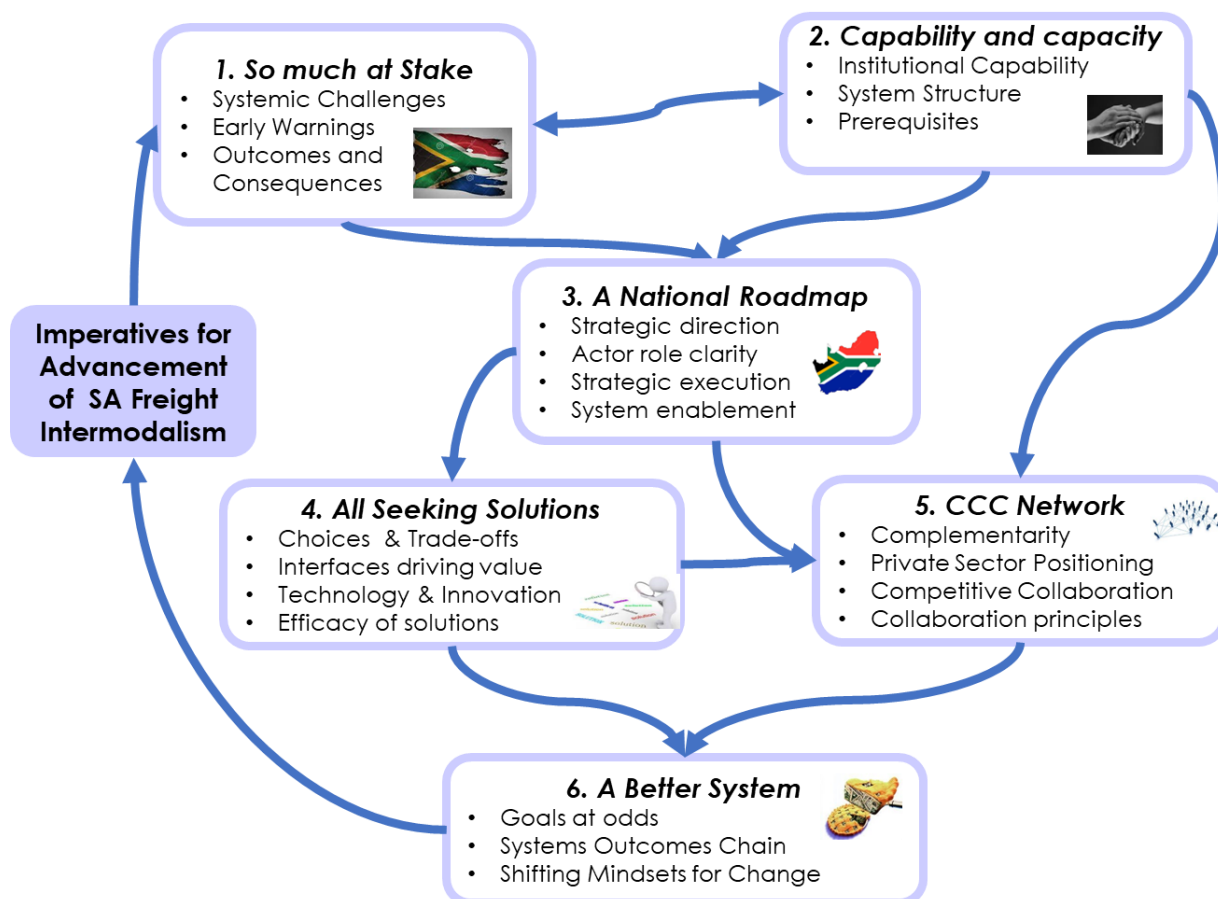


Figure 6: Map of Themes

4.2.1 So Much at Stake

The theme “So much at stake” reflects the current state of the system. At this vulnerable time of South Africa’s history, the freight intermodal system (and indeed the country’s overall freight system) is in a very challenging position, as is the case with many South African systems and institutions on which the economy relies. South Africans express hope and evidence of resilience and patriotism in the face of adversity but also share frustration and despair at the state of critical systems. Many research participants indicated the urgency and timeliness of the research study and were supportive of, and adamant that, improvement solutions be found in the interests of the country, its economy, and its people.

Any attempt at developing solutions must be founded on an understanding of the system challenges, interactions, relationships, structures, processes, functions and consequences. For these reasons, the challenges are explored in terms of sub-themes describing the systemic nature of freight intermodalism; early warning system and consequences or outcomes, in other words, the system “as it will be” if left unchecked.

4.2.1.1 Systemic Challenges

The nature and extent of South Africa’s freight transport challenges can best be described as systemic. The goals of the freight intermodal system are explained in terms of efficiency and cost-effectiveness, but challenges result in significant inefficiencies, sub-optimal interventions and high costs of transport to the country, which could be addressed through improved intermodal systems.

The feedback loop diagram in Figure 7 overleaf summarises the “current mess” of systemic challenges. The diagram was constructed by the researcher by drawing from statements made by SMEs and by participants in focus group discussions. The system may be described as a self-reinforcing one (issues denoted by the letter ‘s’ where the same force or effect is evident) with current challenges (many derived from legacy issues) reinforcing or perpetuating existing imbalances, bottlenecks and shortfalls. The forces at play do not bode well for the development of more sophisticated freight transport and logistics practices such as intermodalism.

This situation is not sustainable for the actors, the economy or the development of the country. Some go so far as to say the system is in a death spiral (particularly insofar as the rail mode is concerned), or overall, at a tipping point. While rail is a contributor to the current state (and prey to various external forces), other parts of the system are also under-performing, subject to external forces, not interfacing appropriately, and thus are also contributors to systemic challenges and their perpetuation.

“But unless we can fix our rail, we won't have an Intermodal system of consequence. And I think that's really the absolute priority; and it's so critical that we move as much as we can But my point is that our system is broken, it is literally broken” FG1 Customer Association Actor

“There are far too many trucks on the road and we cannot sustain this. The XXX [association name deleted in the interest of actor anonymity] has been pushing for rail to play its part and to grow” Road Freight Actor FG2

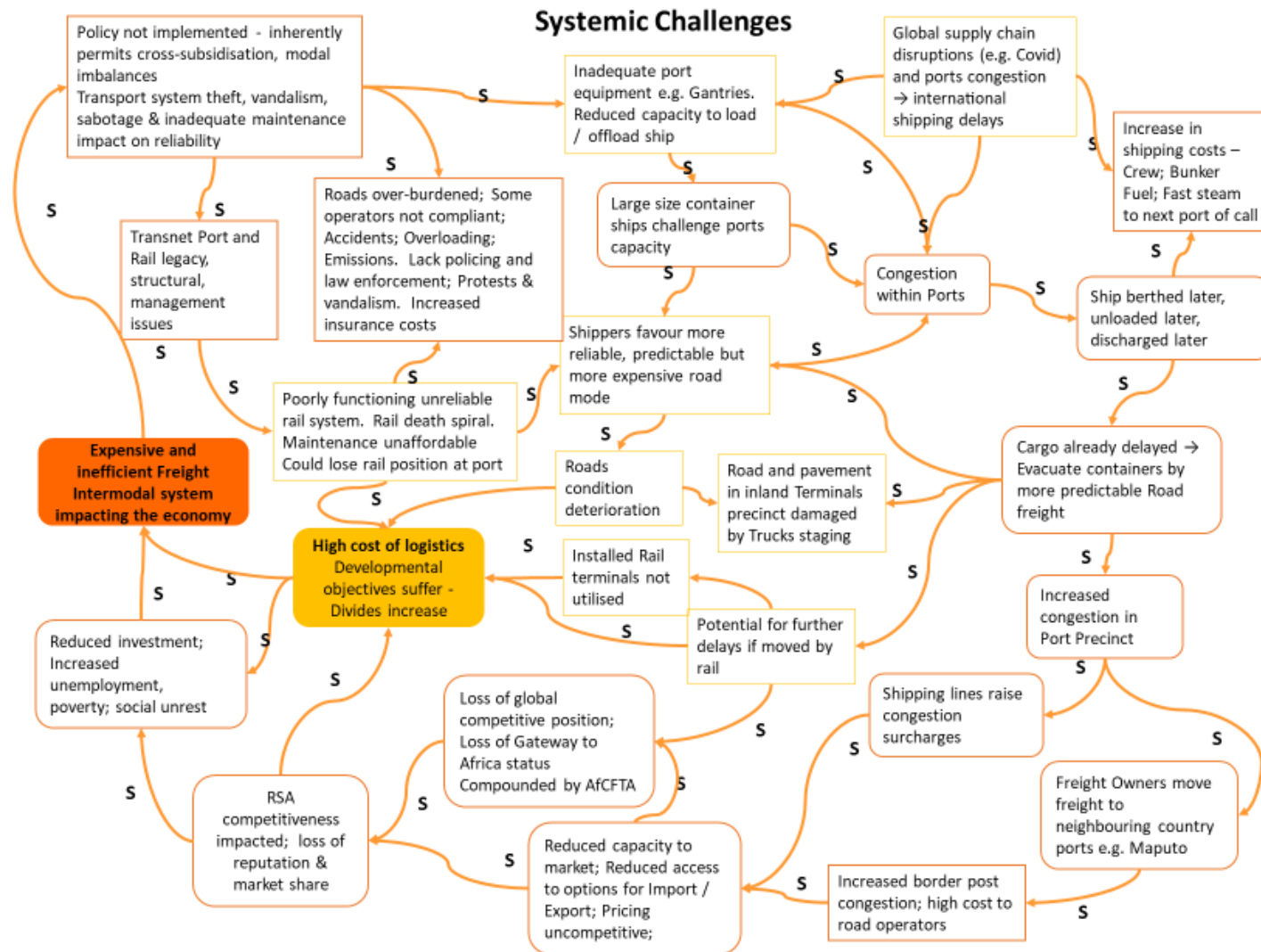


Figure 7: Systemic Challenges

The current state of the freight intermodal system is characterised by a host of system inefficiencies and imbalances that threaten both current performance and longer-term prospects for growth and sustainability, as described by research participants.

The land freight market was deregulated in the late 1980s and legacy challenges have evolved since then. The highly competitive road freight industry is self-regulated through voluntary compliance to a Road Traffic Management System (RTMS). The rail industry must comply with the Rail Safety Regulator (RSR) and economic regulation of rail is imminent. SME participants indicate that truck vehicles are subsidised by private road users (taxpayers). These factors have all led to modal imbalances resulting in over-burdened roads and under-utilised railways with congested ports and border posts, under-utilised rail container terminals assets and over-investment in warehouses.

There are advantages to using rail as it is inherently cheaper and more environmentally sustainable. As rail performance has deteriorated, the lack of service reliability and predictability has disadvantaged the rail competitive position, (and the propensity to include the rail mode in intermodal solutions), more than the slower speed and longer journey times have. Road freight haulage has become the preferred modal choice due to the ability to offer a more reliable and predictable service even though prices are higher.

“Freight intermodal is non-existent because road guys have gobbled up nearly everything and have also been able to deal with the fact that, (although they are more expensive traditionally than rail) the customer doesn’t care anymore. For the very simple fact that he’s not getting a service on rail. So, if you look at the two primary modes on the land side – Road and rail and clearly road is winning hands down at the moment and there’s been no need for a transfer at any point. Once it starts on road at the origin, 99% of the time it will end on road at the destination”. Logistics I

“It’s impossible [for rail] to leverage advantages of cost and safety against the significant disadvantage of the poor performance, poor service, the lack of reliability, predictability and the potential of damage to the cargo...you’re not going to find those in the complexity of embarking on intermodal solutions”. Logistics I

“Supply chains compete. Not commodities, not products, not modes” SC Consult G

Customers are prepared to incur increased road transport costs rather than the costs of the perceived complexity of intermodal options that include rail. These include cargo not reaching the port in time for vessel sailing or the cost of running out of stock. Such “forced” modal choices lead to consequences such as roads congestion, bottlenecks and delays at ports and border posts and add to the costs of transport which the consumer ultimately pays for.

The exclusion of the rail mode from land freight solutions eliminates the notion of freight intermodalism, with its potential benefits. Using only the road mode also means that there is no need for freight to be transferred from one mode to another and the necessity of optimising the exchange, interface or transfer points (nodes) between modes is not given attention.

The structure of South Africa's economy, with a reliance on mineral mining exports, has also meant that the Johannesburg-Durban corridor (Road N3) or rail Natal Corridor (NatCor), a "designated" intermodal corridor suited to moving consumer goods to the economic hub in Gauteng, has become flooded with heavy road trucks, inconveniencing private road users and contributing to severe and fatal road accidents.

"But at the end of the day, we need long haul so that we can get this huge number of vehicles off the road. Though, ...it's not containers and freight from containers, the biggest problem is bulk cargo on the N3, on the so-called container corridor, which has become a bulk corridor at the moment" FG1 Customer Association Actor

Furthermore, South Africa imports more finished goods in large forty-foot equivalent (FEU) containers, and exports few beneficiated or manufactured goods in FEUs and mostly exports agricultural goods in smaller twenty-foot equivalent (TEU) containers. This results in empty FEU containers stacking up at inland terminals and eventually incurring high costs when having to be returned empty to ports. Imbalances in flows of freight also create bottlenecks or capacity constraints at nodal points in the system.

"the 40-20 foot imbalance is a problem here. It's been a problem for years and it's getting worse... We import everything in 40 foot boxes and we don't export much in 20s. We do exports invariably in 20s and we don't export much in 40s. So, the end result is that those boxes have to come back empty. And ... just today ... got the message ... Maersk, for the next three weeks, are no longer accepting 40 or 20 foot empties in Johannesburg. Just not accepting them there for three weeks because of their capacity problems there. Returning an empty container costs around about R6000 a box by road" FG1 Industry Association Actor

Large numbers of empty containers could easily be returned to port terminals by rail at a lower cost. Rail infrastructure deterioration severely impacts rail service reliability and constraints lead to rail-suitable freight being conveyed on roads. The condition of highways and other roads is deteriorating and is adding to operator costs of wear and tear on-road trucks. The high volume of trucks (instead of a percentage being transported by rail and making use of inland rail container terminals) moving in the precinct of the port to deliver or evacuate containerised freight (or empty containers), creates congestion at ports and causes further damage to road and pavement infrastructure in the port precinct and at inland terminals.

“Should be very little reason to be moving cargo via road freight down into Durban port. And that could also help alleviate some of the port congestion. The number of trucks operating in and around the port, in the entrance, and Bayhead often gets congested.” Analyst D

“So, your road infrastructure, regardless if the road infrastructure is good - where trucks park on the side of the road, damaging all the stormwater inlets. So, Road is a huge issue in the port precinct and at City Deep - trucks staging on that mine ground and in wet weather is atrocious.” SC Consult G

Imbalances and infrastructure deterioration lead to bottlenecks and cargo delays, cumulatively manifesting as capacity constraints. Congestion at ports leads to ships being delayed. Shipping lines ultimately raise surcharges to cover the increased operating costs of congestion delays. In extreme cases, ships merely bypass the South African port (e.g. Durban) and dock at a neighbouring country port (increasingly Maputo in Mozambique). South African road trucks are then required to travel over-border to deliver and collect freight or containers at Maputo, and in so doing incur further costs. There are also the social costs of drivers being away from home longer than they should be. The modal choices and mode utilisation thus also impact the capacity and efficiency of border posts and ports.

“Komatipoort queues! 19 kilometres! Almost back to Malelane... you've got 5, 10, 15 kilometres of trucks standing there just about every day. There's queues there all the time! And yet despite that, to get product onto ships even from trucks, a lot of operators are now using Maputo. Trucks are sitting there for days to get through. The cost of that equipment, the truck, the trailers and the commodity, it's millions. Every truck is worth a good few million. That is sitting there idle. It's costing them money”. TruckTech P

An additional consequence is that, with the majority of traffic moving by road, there is simply no longer a need for a transition between road and rail modes and rail terminals are bypassed and so have become under-utilised. Instead, several warehouses and distribution centres have mushroomed in various locations to create the capacity to store, sort and distribute freight. This reduces terminals' density and cost benefits of scale economies. This issue raises the need to explore solutions for the correct type (e.g. dry port, terminal or warehouse) and locations of interfaces between ships, ports and landside modes.

“Critical for Back of Port facilities to support quick, mass evacuation of TEUs. Warehouses start mushrooming closer to the port e.g. Durban area, whereas historically, would have found an Intermodal solution where these boxes would have gone to be stuffed in the hinterland. Now that changes the cost of doing business and at the same time, it favours certain modes” FG1 Rail Intermodal Actor

Inefficiencies are indicated across the system in rail and road transport, at core interface points like ports and terminals. Bottlenecks at borders and weaknesses in corridors

connecting African countries, also challenge intra-regional trade and are likely to be compounded as the African Continental Free Trade Area (AfCFTA) agreement implementation gains momentum:

“There are so many systemic challenges that we have. What's going to happen once we fall into this African Economic Free Trade Area? It's actually going to swamp us because all of our systems are just not - even road - there are just issues. We're not going to be able to do this. One of our biggest challenges is this N3, and this North-South corridor” FG2 Road Actor.

At various stages in the movement or transfer of cargo there are patterns of service that cause constraints and bottlenecks. Congestion and backlogs build up and add to lead times and accumulate, causing poor service performance that adds costs to each stage:

“..have to plan for longer lead times, having to increase inventory holdings; means cash flows being tied up; means longer working capital days” Analyst D.

Things are becoming more expensive because of inefficiencies and ultimately the total cost of logistics to the country is rising. This also hinders national competitiveness and reduces investment attractiveness.

4.2.1.2 Early Warning System

The signs of a system at a crisis point of decay are already evident. The early warning systems have been increasingly visible to many actors for at least a decade. Early warning signs are visible to private individual road users, long haul trucking companies and the various authorities in the form of increased congestion, dangerous road conditions, declining rail volumes, violent and destructive protest action, theft, vandalism and sabotage. The Covid-19 pandemic, incidences of political and social unrest, destruction of infrastructure and service disruptions due to extreme flooding, have heightened the impact of system weaknesses. All these signals are palpable, while operator costs rise and consumers are impacted by resultant inflationary cost pressures.

“From a road perspective, our challenge in the port or the terminals on both sides also depends on accessibility to the precinct. Can have a slick operating wet terminal for offloading vessels, but if you cannot get the trucks into the port precinct to evacuate the containers or to deliver the containers, then that port will suffer and that's the reason why the ports, are suffering. Not so much the quay side or back of quay, but it's back of port precinct issues. That's where road infrastructure comes in.” SCConsult G

The agricultural industry, particularly fruit growers and exporters, is reliant on a “cold chain” with produce being kept at consistent refrigeration temperatures to ensure the quality and standards of fruit being exported to European and Asian markets. For some years, this

industry has been extremely vocal about the impact of delays and inefficiencies on farmers (and their workers) and the loss of foreign revenue when spoiled fruit is rejected and must be discarded. There are so many ripple effects of an inefficient system. The pleas are not heard or not acted upon with the level of urgency required.

“Reefer cargo, Citrus went away. Citrus that should have gone to export markets at premium prices ended up being sold locally to a juicing house - lost profitability. Not acceptable and hurts their bottom line. Farmer producing, everyone involved in getting product to market, loses out. Loss of market share to e.g. Spain. We do damage to industries when we are inefficient, they rely on an efficiently operating port system”
Analyst D

“...for the Citrus industry, that is the Intermodal capability that we are trying to drive so we can try and get more product off our roads. Get onto the rail. Have it more efficient and effective, optimise links to the ports for our growers.” FG2: Customer Association Actor

“There are far too many trucks on the road and we cannot sustain this.” FG2 Road Actor

“Seen with a number of our members and some of their clients. Some of the freight has left South Africa and it's not coming back”. FG2 Road Actor

Documentary Analysis

The extract below reflects the need for efficient port facilities for the citrus industry and that this requirement is being met through the establishment of facilities at ports outside South Africa. This also reflects that global logistics conglomerates are investing in Southern Africa.

“Port of Maputo gains new cold storage facilities: The Port of Maputo has gained new fresh produce cargo handling capacity with the opening of two new cold storage facilities that are ready to service customers during the 2023 citrus export season.

The latest developments come after the port restarted the flow of South African citrus via the DP World Maputo terminal for export globally to the Middle East and India and the Far East in 2022.

According to FreshPlaza, the first cold storage in the Matola Cargo Terminal, an investment by TLG, will be opened on 16 May, just in time for the start of the citrus season. All the citrus exported via the Maputo fruit terminal originates in South Africa; there is a special arrangement for perishable products transported through the Komati border post into Mozambique” (Comins, 2023).

The real tragedy for the country is that despite the visible early warning signs, actors are powerless or unwilling or unable to arrest the decline and implement interventions to turn the tide.

Events and patterns were visible as early warnings and are illustrated in Figure 8. The conceptual map or causal loop diagram also highlights the relationship between the choices

made concerning transport solutions for competitive supply chains, relative to the outcome of the increased cost of logistics to the country. This conceptual map of early warnings also serves to illustrate core system relationships between freight consolidation, congestion, capacity, costs and investment; and how they are affected by the interfaces between intermodal parts or constructs, i.e. road, rail and ports infrastructure, port and inland terminals and shipping and port operating assets.

The continued functioning of the freight industry must be due to the efforts of actors at the firm or community (micro) level (for example development of distribution centres served by road), or even through coordination between some actors at a supply chain level (meso level). Cracks, however, are becoming increasingly visible by the high cost of logistics to the country and the overall under-performance at a developmental, economic and national (macro) level.

“...well-known link between economic growth and supply chain health. And if we don't fix that supply chain health...that's just where we're going to end up”. Container M

“If we don't sort out our logistics competitive position, globally, regionally, we are not the gateway into Africa. In the World Bank study of the competitiveness of ports, we ranked the last three ports.” SC Consult G

“Cost of logistics is insane. We always talk about the cost of logistics versus GDP, and we always looked at the cheap one, which is an overall function of the GDP. But when we look at our economy as a services economy, its transportable GDP, they're not cost effective, it is ridiculous.” FG2 Logistics Actor

The real question then, is what will it take to trigger enough awareness to instigate action to improve the freight system? And more so, what can be done to raise the realisation that the implementation of intermodal freight solutions could improve freight performance, and in a manner that also contributes to cost-effectiveness and efficiency for imported and exported freight, intra-regional freight, as well as freight being transported domestically within the borders of the country.

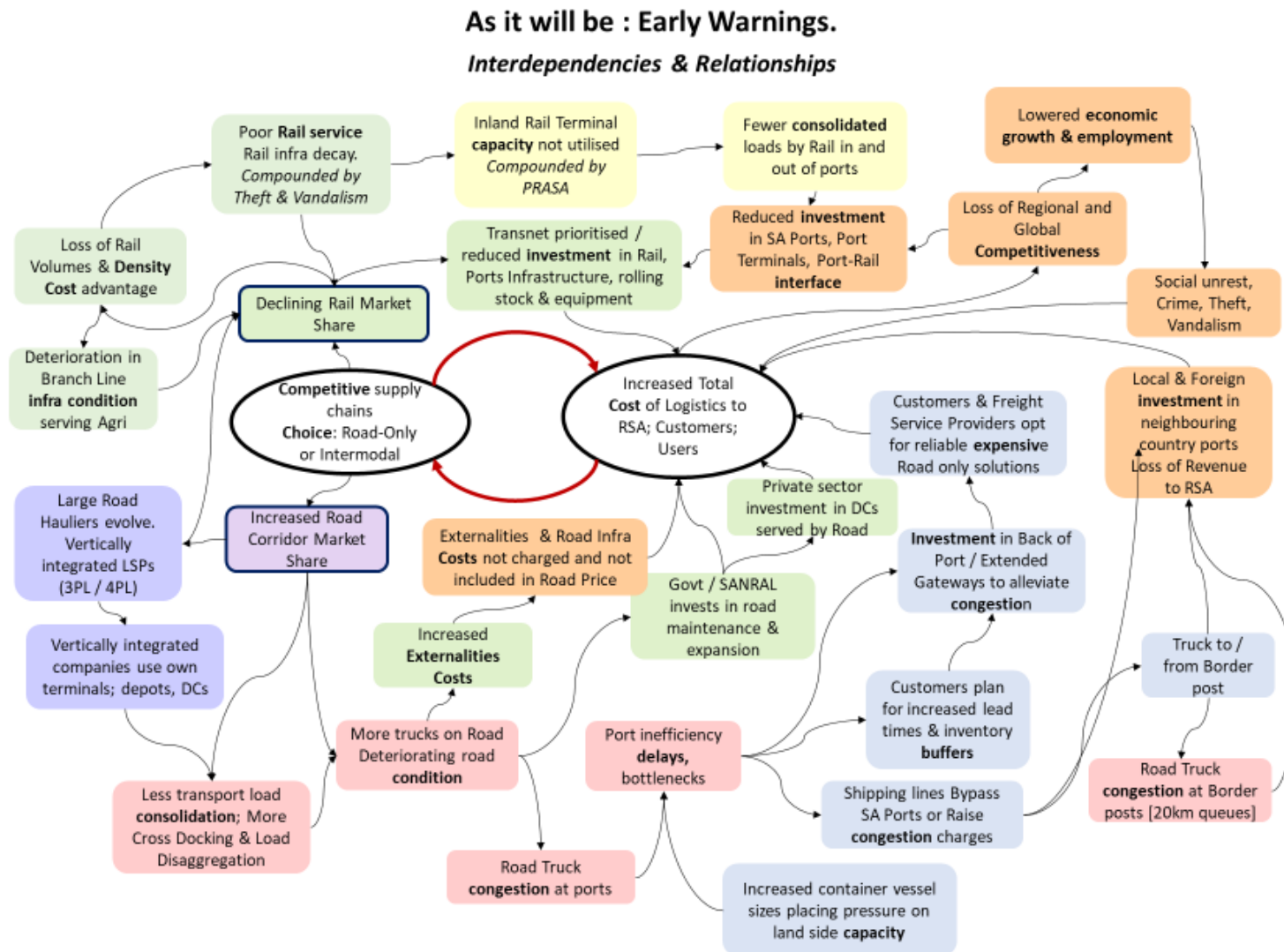


Figure 8: Early Warnings (Researcher Construction)

4.2.1.3 Possible Scenario Outcomes

Conversations with experts and freight intermodal actors alike indicate that the system is in dire straits, and if left unchecked will continue to deteriorate, with severely negative consequences for the country, that cannot be allowed to continue. The past three decades have shown that there is no inherent “balancing loop” that adjusts or corrects the system (negative feedback loop) to a more optimal level of functioning, it is instead reinforcing and strengthening the current state of affairs with accelerating negative impacts and consequences. The system is unlikely to right itself and requires that decisive actions are taken for change.

Findings reflect few possible scenarios for the future (“as it will be”), and these are dependent on the mental models, beliefs and assumptions of actors in terms of inherent attitudes of realism, pessimism or optimism. Three possible futures are illustrated (Figures 9,10, and 11) in the following pages (researcher construction of scenario causal loop diagrams derived from data collection methods).

Figure 9 reflects a pessimistic, but somewhat realistic, view of the future based on the current state. This indicates that the current state will be perpetuated (self-reinforced) with extreme consequences for South Africa in terms of economic decline where less is produced, less freight is transported, and less is consumed. South Africa’s status as the “Gateway to Africa” is challenged as trade moves to neighbouring country ports and investors increase their footprint outside of South Africa.

In this scenario, smaller businesses and the poor will be most severely impacted in terms of social costs of unemployment, quality of life and poverty with increased crime and unrest. Once again, the scenario emphasises the systemic nature of challenges as well as some of the root causes and relationships between parts.

As it will be Scenarios: Do Nothing & Collapse

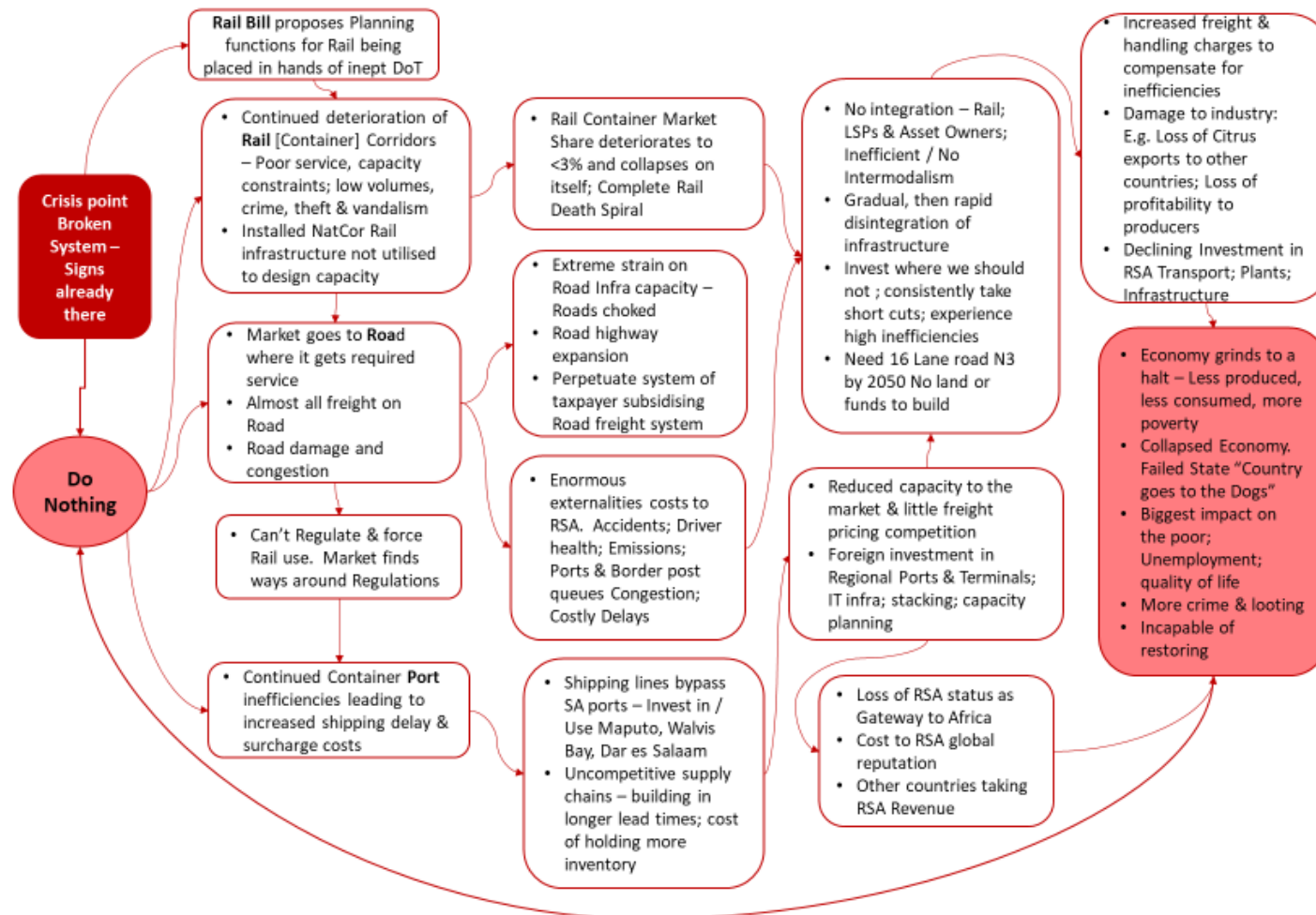


Figure 9: As it will be - Do nothing and collapse (Researcher construction)

As it will be Scenarios: Improvement but not sustainable

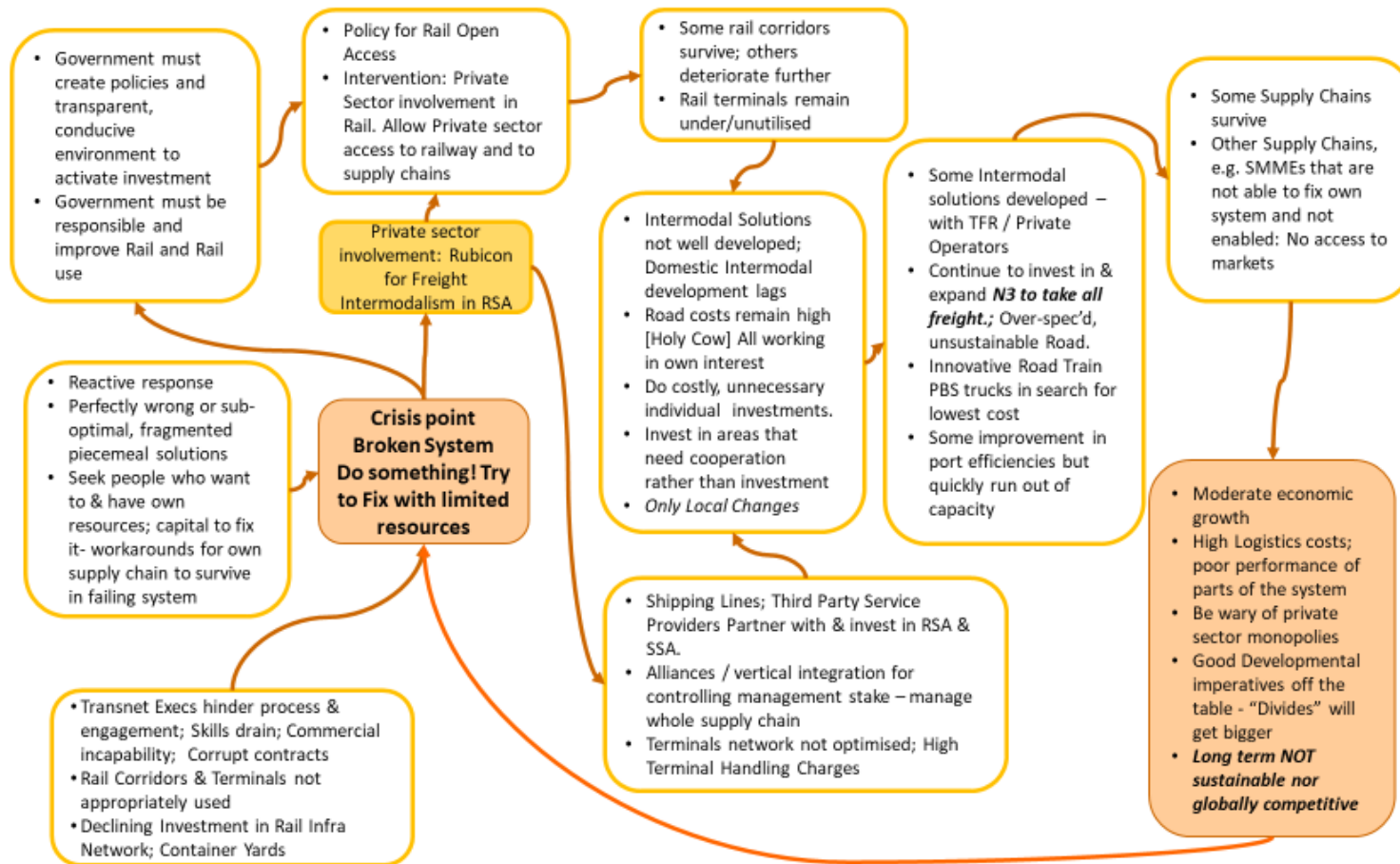


Figure 10: As it will be - Improvement but not a sustainable systemic solution (Researcher construction)

As it will be Scenarios: Urgency and Turnaround

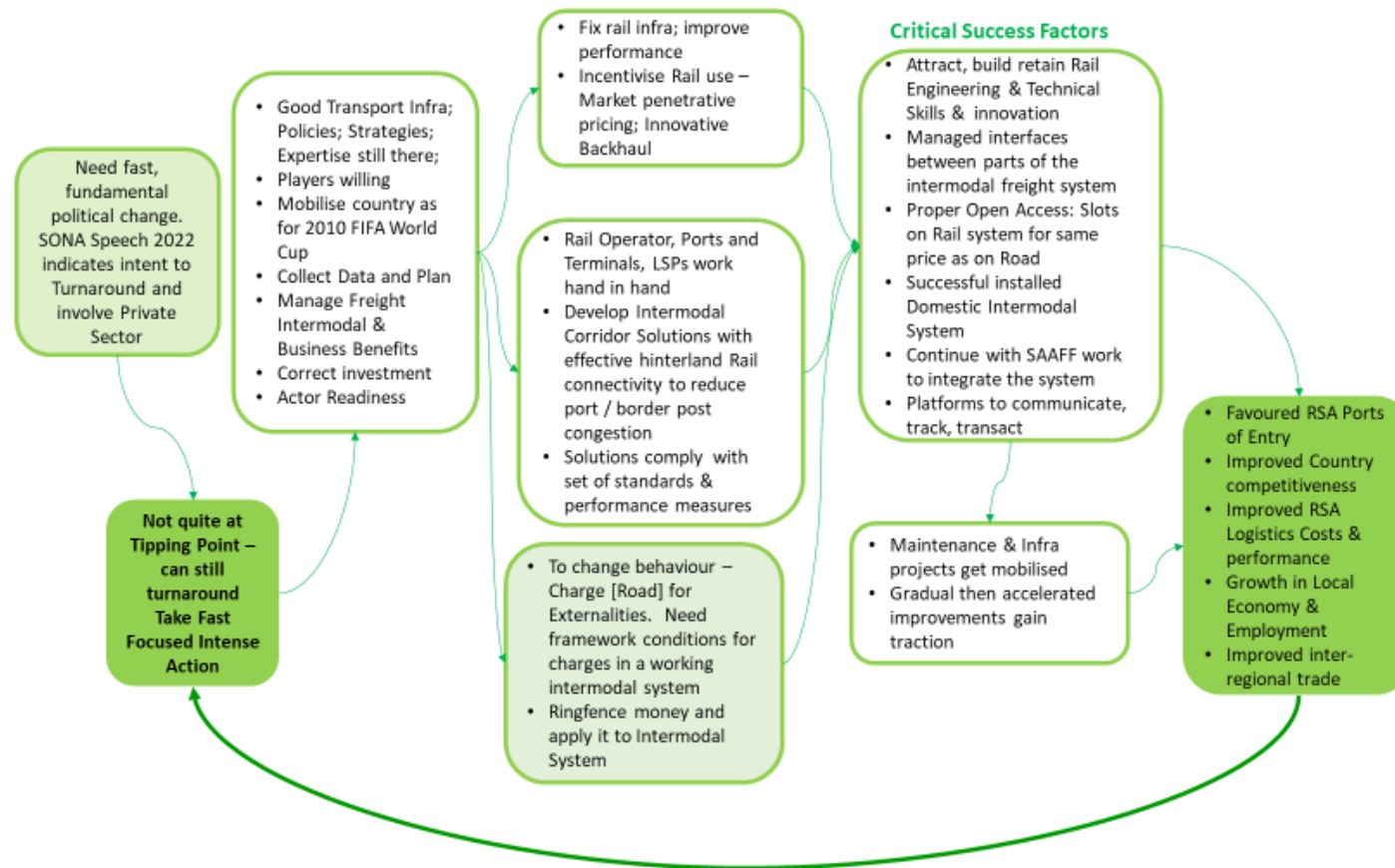


Figure 11: As it will be scenarios - Urgency and turnaround (Researcher construction)

A middle-of-the-road scenario is illustrated in Figure 10. This scenario suggests a greater role being played by the private sector in operating rail systems, partnerships between actors and the deployment of limited resources to parts of the system. This could result in improvements in certain areas and some innovation being introduced to enable intermodal solutions, but may not necessarily lead to the most optimal or more sustainable systemic solution.

A more optimistic scenario – and also a potentially realistic outcome, depending on the speed of actions taken – is presented in Figure 11. This outcome scenario indicates that a sense of urgency and mobilisation of currently available resources, assets and skills could achieve a turnaround. Such a turnaround would result in many positive outcomes for freight growth, intermodal development and the economy and developmental ideals.

Documentary Analysis Findings

The dire state of the South African freight system, as described by research participants under the theme “so much at stake”, was (unfortunately) officially confirmed by statements made by the National Treasury in the Budget Review report of February 2023, which repeatedly highlights the impact of rail and port infrastructure deterioration on the economy and its performance; the damage caused by the decade of state capture; and the need for institutional and sector reforms to address these significant challenges (Treasury, 2023). Statements by the government confirming the state of the freight system confirm the extent of the systemic challenges, the urgency of the issue, and the concern that system actors reflect regarding the current state of affairs.

In this regard, the Economic Reconstruction and Recovery Plan (ERRP) (2020) addresses the need for the revitalisation of South Africa’s rail and port infrastructure and structures. The ERRP prioritises the road-to-rail strategy as an aspect that will stimulate growth in the economy and enable investment and employment creation (Government of South Africa, 2020). Structural reforms at Transnet SOC (a significant actor in the system) aim to reduce the investment backlog that contributes to systemic challenges. The ERRP also supports supply chain and integrated modal approaches through industry collaboration as indicated by the statement that “a broader shift away from a divisional, modal service offering to a more strategic collaborative approach. It will enable Transnet to participate in integrated commodity value chains” (Government of South Africa, 2020, p. 97). The ERRP further indicates that Transnet had invited the private sector to respond to “a request for quotations for private-sector participation on its container corridor between Johannesburg and Durban” (Government of South Africa, 2020, p. 97). These developments are a positive indication of a drive for structural reforms that could drive intermodal development and its contribution to the economy. These issues were also raised by research participants.

The current structure of the freight intermodal system is the result of legacy, institutional, regulatory and market forces that have defined its evolution over the past 35 years. The freight transport (and intermodal) structures include Transnet which is perceived as a monopoly with control over a railway that is vertically integrated but under-performing, allows for cross-subsidisation, for example, of general freight by export lines and the railway by the ports business. While Transnet (and specifically, its largest division the railway) achieved record freight tonnages (226 million tons in 2018) as recently as five years ago, the decline in recent years has been deeply concerning (173 million tons in 2022) (Transnet, 2022).

The road freight industry is partially cross-subsidised by private road users and taxpayers. Neither the rail nor the road sector is subject to adequate economic regulation. Transnet operates many port terminals and, via Transnet Freight Rail, owns and operates inland container and automotive terminals. This structure confirms the role that Transnet should, but does not, play in advancing intermodalism.

Container vessels that dock at South African ports are primarily owned by vast global shipping lines, many of which own and operate port and inland terminals globally, and in South Africa. Many actors fulfilling roles in the system are thus global private sector players. Transnet is State-owned and falls under the jurisdiction of the Departments of Transport and Public Enterprises and is compelled to operate within the bounds of SOC requirements set by the National Treasury (for example, the Public Finance Management Act (PFMA) and various preferential procurement practices).

There are several interacting and interdependent variables at play, for example, choices that are made, implementation of appropriate policy, the behaviour of actors, the nature and extent of required interventions (and the cost thereof), engagement between actors and the need to address systemic challenges with systemic level solutions.

Discussion points raised by participants indicate that modal choices (and imbalances) and system capacity (availability, utilisation or constrained by congestion and poor maintenance) are interdependent elements. The need for, or utilisation of, nodal transfer points is also dependent on the modal choices that are made. The efficiency of the system is dependent on levels of investment made. Investment improves condition and utilisation, leading to viability which may spur further investment.

The challenges described in the findings, the response to early warnings and the possible scenario outcomes give rise to other key themes generated and discussed. Action must be taken to arrest the decline, avert a collapse of the system and bring about change in the interests of South Africa.

4.2.2 Need Capability and Capacity

The theme labelled “Need capability and capacity” encompasses such concepts as care, stewardship, accountability, ability, will and capability required by system actors to drive, manage and implement processes to improve intermodal freight practices in South Africa. Research participants highlight that the current lack of institutional capability and capacity are reflected in blurred lines of accountability and low understanding of the issues at stake. These issues require that change in the freight intermodal system structure is required, and is imminent. The essence of the findings of this theme is presented through a discussion of three related sub-themes, i.e. the institutional capability of the key actors, system structure, and the prerequisites for role fulfilment.

4.2.2.1 Institutional Capability of the Key Actors

The preceding theme “So much at stake” indicates the dismal state of the freight logistics system in the country and the significant challenges to be overcome. Research participants indicate that key actor groupings such as the Government and specific government departments, (the Departments of Public Enterprises and Transport (DPE and DoT)), lack strong institutional capacity and skills to drive processes that could advance intermodalism. The approaches, behaviours, so-called political will and lack of understanding of system issues of this grouping are perceived to have contributed to the current state of affairs.

“We have a completely failed Department of Transport”. Academia J

“Somebody spoke about political will, that's a workshop on its own. That doesn't get the system to get better” (Logistics Actor FG2) and

“We always talk about political will and access to funding... those are precursors or hygiene factors that need to be there... are we enabling people to engage with that system?” SysIntervene I.

Transnet is positioned as an integrated freight services provider promoting South Africa's economic growth. The organisation is entrusted with national assets to achieve the country's goals but does not appear to reflect the will and care to fulfil this vision at the pace required. Transnet, the State Owned Company (SOC) is a major factor in the freight intermodal system and should be fulfilling a crucial role in driving intermodalism, particularly concerning the development of the railway such that, in cooperation with other industry actors, the rail mode is incorporated into intermodal service offerings.

Participants shed doubt (or even scorn) on the ability of Transnet (and its rail and port operating divisions) to deliver. SME participants, in particular, express frustration at the lack of management appetite and grasp of the need for the development of intermodalism, at worst they are failing in the delivery of basic transportation roles.

“No real traction taking place because of leadership within Transnet, and hidden agendas and corrupt contracts, etc.” Analyst D

“Transnet is its own worst enemy, the whole process just falls flat because of Transnet”
Intermodal L

Recent media announcements and the publication of the reports on State Capture regarding the prevalence of malfeasance in State Owned Companies (SOCs) have also compounded the perceptions expressed by research participants. This does not bode well for improved collaborative relationships, nor the advancement of more sophisticated processes and strategies that intermodalism requires.

The incorporation of rail services in intermodal solutions is imperative for reducing the cost of a total intermodal solution. This would require a departure from traditional rail operating models (that, in recent years, have mostly focussed on the export of minerals and ores from mines to ports), to the development of new models for conveying palletised and containerised consumer goods between ports or from domestic production sites to terminals and distribution centres within the country’s borders.

New operating models and processes would require close operating relationships with road freight operators and logistics services providers (LSPs) who could bring the product by road to rail terminals to fill “wholesale trains” destined for onward distribution and final consumption. Experts indicate that the driving force behind intermodal solution development of this nature, will not be led by rail management, despite the belief that LSPs would support Transnet and participate in such solutions to serve specific market demands.

“[Transnet] management and operations is not of a sufficient level to optimise the use of intermodalism. Strategies are still old. Trying to still do what was working in the 80s... No dynamic thinking. Capabilities are not there. Rail and Port services are poorly run.”
Intermodal L

“So, ... it just doesn't seem that anybody cares.” Logistics I

The capabilities, priorities, accountability, will and implementation urgency of Transnet and Government are inextricably linked (with Government being the sole shareholder of Transnet under the custodianship of DPE and with DoT being accountable for transport policy development). There are complex relationships between Transnet and Government

departments, and between DoT and DPE specifically, which are perceived to compound and hinder the capability of Transnet to transform the system and foster intermodal development. This has the potential for misalignment, and even conflict, which leaves Transnet in a difficult position and could jeopardise the implementation of certain interventions.

“DoT competing with DPE. Got two political personalities fighting with each other, those two ministers don't sit around the same fire...Never mind, the policy for the new white paper that comes out of the DoT. What do people in Transnet do? ... it's a natural reaction from them and we're not going to implement it” FG2 - Logistics Actor

Furthermore, the development of intermodal solutions requires specific project management, technical skills and commercial acumen (for developing the relationships and contracts with road and LSP actors to monetise the solutions), which research participants feel Transnet no longer has.

“Biggest challenge is going to be: Do you have the right people? And the right leaders within government and Transnet to drive the process and keep momentum going. Allow the private sector to engage in a way that they need to. Be able to decide what's the best way forward in infrastructure, rail networks, container yards, etc. But a big, skills drainage from Transnet. But government need to give more control over to the private sector. But first need to find out, who are the right stakeholders within the private sector to take this forward, then let them run with the management of ports and rail networks. They'll be able to commercialise it properly.” Analyst D

Building and retaining skills for the future would reflect greater stewardship, care and accountability for the country's economy.

4.2.2.2 System Structure

Participants indicate that there is an increasing need for the private sector to intervene in the system in the interests of South Africa and the future of the industry. If the private sector enters the system to fulfil roles traditionally performed by Transnet, some gaps in system institutional capability could potentially be addressed. There appears to be much confidence in the ability of the private sector to perform better than Transnet, in its current financially and reputationally weakened state. This lack of confidence in Transnet to demonstrate it can deliver and show tangible results, may be a catalyst for change in the structure of the system.

“Transnet's efforts in trying to re-establish intermodal...it requires passion for intermodalism and an absolute requirement for it in the various market segments. They have just failed horribly” Logistics I

“Big private players will do things a million times better than any state-owned entity would ever do. They are driven by profit, which is 100%. And ultimately, they will shift the way that freight is going to be moved in this country” Container M

Changes in actor roles could alter the future structure of the system, bring about change and alter the rules of the game, or the way the system pursues goals and purpose. Such structure changes would require a change in mindset by Transnet, particularly in terms of allowing the private sector to take greater ownership and control, for example, with private parties being allowed to operate trains on the network (third party or open access) and to operate port and inland container terminals. Such processes are guided by recent legislative developments for ports and rail, that have already been initiated and pave the way for various models of private-public partnerships to be implemented.

“At least there's now recognition that those partnerships will be allowed on national assets so to speak” SysIntervene I

“The private sector has enough skills to commercialise their system. Railways have enough skills to provide the long-distance freight. But, once again, it's just the will to do it.” Academia J

The roles of organised labour groupings (and their communities) would also need to be addressed as they have the power and influence to disrupt major changes (as has been evidenced in recent (2022) strike actions at Transnet and frequent road industry protests by drivers). Any discussions and interventions that bring about change in system structure for the future (for example changing ownership) must incorporate organised labour as a core system actor and partner. Government commitment is also required to promote the acceptance and buy-in of organised labour, and communities, to enforce respect for, and protection of, the country's assets.

“..hope the separation of TFR and concessions works. And that trade unions don't get in the way, will lead us to a point where, this thing will go forward” Intermodal L

“How do you do that without creating all kinds of panic... for example, contingencies like organised labour around what this means for the future of freight traffic delivery” FG2 Logistics Actor

“Government is key to it all. Are they willing to open up or change policy? Willing to give up control of a state-owned entity? Labour unions...you need that buy-in too. We know what disruptions they cause. And you need commitments from government on that side.” Analyst D

The view is that the private sector actors are better equipped, in terms of access to investment and funding, operational expertise and commercial and business acumen to improve and accelerate implementation of solutions. Government and Transnet are currently resource-constrained and the perception is that the private sector will provide financial injections, as is proving to be the case with the development (led by the Gauteng Provincial Government) of a high-capacity rail corridor to meet growing demand for automotive exports. The right

private stakeholders do, however, need to be selected, accompanied by sound contracts that truly improve freight transport and intermodalism in the country.

“Doesn't help taking it from a from a government sector monopoly to a private sector monopoly or even worse, a politically aligned grouping of people monopoly. Because then it wouldn't get the solution. Because they won't. They're not there for the market. They're there for something else.” Intermodal L

Institutional capability and capacity are required across the system, by authorities with the powers vested in them, by various private and public sector management structures and actors, as well as by organised labour and interest groups influencing the system.

4.2.2.3 Role Fulfilment Prerequisites

The development of intermodalism requires, and will be stimulated by, investment. The expectation is that private sector parties will readily partner with Transnet and seize opportunities to invest in the system, but do require support, strong (corporate) governance, trust, transparency and commitment from Government if investment and partners are to be enabled and facilitated. In addition to the need for trust and transparency, Government must foster a business environment, with appropriate policy (and policy certainty), that is conducive to partnering and investment, and at an urgent pace that will suit actors and evidence tangible results.

“Government needs to rethink its role in terms of how they enable those partnerships to happen. That should become the focus of government” SysIntervene I

“If government steps back, private sector will pick up and they will run it. If the private sector is allowed to have access on the primary lines and have access to the supply chains and so on, then they will develop it.” Custodian H

“Our roads will come to a complete grind, so we have to find a solution. One of our biggest weaknesses is the government itself. They think the solution lies with them. They have to let go of it. They are not providing the policy clarity that is necessary”. Intermodal L

An enabled private sector could well enhance system institutional capability, harness opportunities, improve intermodal best practices and accelerate the development of freight intermodalism for the betterment of the country. The extent to which private sector actors would promote stewardship in the form of care and accountability for assets, over which they have partial ownership and control through partnerships with Transnet, is not known. There are both soft and hard constructs that could affect the outcomes.

Soft constructs include the perceptions around reputation, trust, commitment and transparency as a basis for forging collaborative relationships and partnerships between

actors. Hard constructs in the form of accepted national plans, legislation, regulation (where required) and policies that define and clarify future structures, roles and mechanisms for actors, need to be refined to make changes a reality. New relationships will also be founded in new business and partnering models and solid contracts that assure implementation.

Ultimately, a true sense of stewardship needs to prevail in the freight system, and amongst South African society at large.

Documentary Analysis Findings

Transnet positioning and mandate is stated in terms of mission, vision and values (Transnet, 2022, p. 20):

“Our vision: Fuelling Africa’s growth and development as the leading provider of innovative supply chain solutions

Our mission: what we need to do: Linking economies; connecting people; growing Africa!

Our mandate: To assist in lowering the cost of doing business in South Africa, facilitating economic growth, and ensuring the security of supply by providing appropriate port, rail and pipeline infrastructure cost-effectively and efficiently, while remaining within acceptable benchmarks. The mission and goals of Transnet, as well as our Shareholders’ Statement of Strategic Intent, are congruent with national objectives. “

Recent failures in many South African systems (education, electricity, water, health care, etc.) lead many to voice cynicism about the ability of the country’s government to recover from failures and move towards development and growth. This paradigm is intensified by those that look to failed States in Africa to validate their pessimism. On the other hand, one may look at examples on the African continent where noteworthy developments have been achieved.

Another perspective on South Africa’s institutional capacity and capability may also be provided through consideration of the Just Energy Transition Investment Plan (JET-IP) that was launched before the 2022 international COP 27 Climate Change Conference (Presidency, 2022).

The plan serves to attract investment to support the country’s decarbonisation efforts. The JET-IP is comprehensive in that it addresses, not only investment and funding mechanisms but also the need to develop skills and create employment; cultivate private-public partnerships; engage stakeholders and social partners; catalyse green industrial development; mitigate risks; and build capacity to assure implementation (Presidency, 2022).

This well-developed plan (that is a reflection of institutional capability and expertise in the country), is also relevant in terms of the role of transport in contributing to a lower carbon economy, energy security and a more resilient climate. This is reflected In the need to address

freight sector challenges such as the “low use of rail for the transport of freight; and ageing infrastructure with a high maintenance backlog” (Presidency, 2022, p. 73). The JET-IP indicates that National Development Plan (NDP) aspirations for environmental, social and economic goals could be enhanced through the decarbonisation of freight logistics and a much greater portion of freight being moved by rail than by road which is supported by the Green Transport Strategy (Presidency, 2022). The integrated JET-IP goes so far as to provide a very specific target for transport – “by 2030, the rail share of corridor freight transport will be 30%, and by 2050, 50%” (Presidency, 2022, p. 164).

The inclusion of a modal split target in JET-IP is important in using energy and the environment as a lever to influence the modal split. Intermodalism supporters could extend this target to reflect how intermodalism could advance such aspirations and outcomes. The energy plan is integrated, complex and contains clear plans for funding and financing. The test of its success will lie in the commitment and managed implementation led by the office of the Presidency.

Many key role players, and especially Government, have recognised and acknowledged the current challenges and shortcomings. Efforts are being made to harness the expertise that exists in the country to address these issues. SOCs need to reflect evidence that they are making strides towards fulfilling their stated mandates. Alignment between major sectors of the economy (such as energy and transport) is an encouraging development.

4.2.3 A National Roadmap

The theme “A National roadmap” is discussed in terms of the sub-themes strategic direction; actor role clarity; strategic execution; and system enablement. Policy and strategy changes are proposed by participants to alleviate and address systemic challenges. All possible areas of intervention must be considered as potential imperatives for advancing intermodalism and weighed for the impact that they could have in leveraging change.

4.2.3.1 *Strategic Direction*

The South African freight transport system continues to function and distribute freight around the country, albeit sub-optimally and not at its full potential to be cost-effective, efficient and globally competitive. There is a growing admission by actors in the system that the status quo is not sustainable; is not geared to meet future market demand and growth; and that the implementation of solutions for intermodal freight could contribute to improvements.

In addition, policy changes that have been gazetted, but not yet passed as law (Rail Policy White Paper 2022), have created anticipation, but also a degree of uncertainty about the future structure of the system. More critically there is a need for clarity of the functions that “system parts” should perform and who should fulfil those functions (such as the development and operation of container terminals, designation of dedicated intermodal corridors and future rail operators on the national rail network) in the intermodal system structure in future. Meanwhile, actors are positioning themselves to seize opportunities that are likely to emerge.. Research respondents, particularly in focus group discussions, have expressed the need for strategic direction, integration and decision-making to guide actors at a national or country level. An integrated and national view of South Africa would aim to share a common vision for freight intermodal and to build awareness and understanding of the benefits of new approaches for the many stakeholders, society and the economy. Such consensus-building would have to specify the opportunities, and how actors may gain access to the system to participate in and harness those apparent opportunities. This openness of linking opportunities and benefits could result in a more inclusive approach to addressing change and may be pivotal to success in the business and societal structure of South Africa.

“Missing the common message. Some people understand and have the capability, capacity and resources to participate, even though it's fragmented. But there's so much more benefit for the whole of South Africa across the total supply chain. If everybody can be brought on board, share the common vision” FG1: Rail Actor

Creative strategies and approaches for South Africa, with its unique current challenges, are required. These should differ from competitive and even developmental approaches adopted in first-world countries and other large economies to attract competition from new actors and investors.

In addition to informing system structure for actors, a national roadmap is also required to inform policy, focus investment, determine the need for enabling regulation and establish structures or institutions to drive and execute the strategic plan in an integrated and properly paced manner. It was also emphasised that transport policy must, of necessity be aligned with other national policies such as industrial policy, urban and spatial planning, land use, skills development and infrastructure planning to be effective.

“Good transport integrated Intermodal system will also be ESG compliant - environment, social and governance. I think that's critical, integrated into spatial and urban planning. It's critical so that we don't get the spatial and urban planning people going off and doing their own thing” FG1: Logistics Actor

There should also be policy integration at the level of national programmes such as the Motor Industry Development Programme (MIDP) to realise benefits between manufacturing and transport industry investments. Instead, many policies and programmes are not aligned to improve the entire system.

“No alignment between automotive MIDP and investment strategy for Transnet and other players to get MIDP benefits to the manufacturers aligned to the guys that have to actually do the hard work to get the stuff to the ports. There's lots of misguided policies" FG2: Logistics Actor

The strategy (and commensurate policy adjustments) must be informed by accurate data to improve success and specific targeting of interventions. Data should support the approach to consensus building and provide solid commercial and scientific data that can be “translated” to the identification of opportunities, for example, based on market demand growth, infrastructure requirements for effective intermodal processes and specific areas where investments are to be made. Quantification of potential direct and indirect benefits to current and new industry actors would also aid strategy development and implementation.

There is no doubt that comprehensive policy frameworks do exist, but they lack specifics regarding practical means for how actors will fulfil roles, or the allocation of accountability for driving plan execution with precise implementation time horizons. Some even imply that policies constrain momentum and should be simplified, revised or reduced to be less restrictive and more enabling. Perhaps rather than embarking on lengthy policy development approaches, a more practical and simplified road map and approach for inclusivity is required. Implementation urgency is critical:

“Rail policy or national infrastructure plan, road freight strategies, all of these policies and strategies are sound. They talk about what our biggest issues are and what needs to be done. What we find the greatest issue is, is how quickly it's done. Ability for government to follow their own policy as quickly as they can. The number one thing is getting decisions and implementation of existing policy. We've got a new rail policy we've got a national infrastructure plan, but things just take too long”. FG1 Terminals Development Actor

4.2.3.2 Actor Role Clarity

In the absence of strategic direction to provide role clarity, actors are responding to system pressures and developments reactively. Well-intentioned interventions (but possibly motivated by own or vested interests) could lead to transport performance improvements that realise benefits for some, and even for the country, but are unlikely to bring about real and sustainable changes in behaviour, choices and systemically improved intermodalism.

Without an integrated view, legacy and current challenges and imbalances stand the risk of being perpetuated.

“And it’s important that we define this collaborative strategy that creates the synergy because there's definitely synergy; but with each one of us not knowing where we are going... We would then stop working against each other... how government plays a role in fostering open access with some sort of legislation that doesn't throw away the Intermodal business players like road, because those players have definitely got a space to play in the spectrum” FG1 Intermodal Rail actor

Given the pending promulgation (Rail Policy White Paper 2022) and new (National Infrastructure Plan 2022) legislation that makes provision for the entry of private sector actors, new relationships will need to be forged. Relationships between the private and public sectors are inevitable, but also between players that have traditionally been competitors, such as road and rail modes providing complementary services in a new regime. Private investment in port and inland container terminals, for example by global ports operators or shipping lines, could also result in current customer-supplier relationships transforming to business partner relationships with completely revised ownership, operation and control structures evolving.

4.2.3.3 Strategic Execution

As indicated under the theme “need capability and capacity”, there is a need to build institutional capacity and a sense of urgency to implement. While issues are discussed, players become frustrated by the huge amount of time consumed in navigating red tape to reach a point of implementing plans or policies and simply finding ways to address challenges and constraints.

It is noted that, as far back as 2005, Government had tried to provide strategic direction to the freight landscape and intermodal approaches in the form of the National Freight Logistics Strategy. The issue is rather that guiding policies take too long to be developed and simply do not get implemented. Existing policies lack the detail that would drive implementation.

“...lack how you have good old fashioned strategy in a company. Put your strategy first then talk about the structure that's going to drive the strategy. We have a problem; we do not have clear policy. And this policy does not say who's going to do what and by when” FG 1: Logistics Actor.

Lack of policing and law enforcement (indicated as a systemic challenge) perpetuate the status quo and may well weaken the drive for new policy implementation.

The government certainly has a responsibility and accountability (stewardship) to society and businesses to address failures and to implement its policy recommendations. Instead,

government is distracted by political manoeuvring. Recommendations were made for a national forum or neutral body to be constituted to support the government and guide integrated decision-making that leads to rapid implementation. Such a national structure would need to be representative of, and acceptable to system actors (including National and Provincial Government and organised labour) whilst still ensuring inclusivity. Forums would need to be vested with authority by the government and industry with the requisite power to act in the interests of the economy.

New approaches will be required to build consensus. More challenging will be the availability and focused allocation of resources (hard and soft) in areas where they are needed most. A roadmap for implementation must be orchestrated and paced in a manner that reflects tangible results that would build confidence and responsiveness to implementation in other areas.

4.2.3.4 System Enablement

A further issue of the national roadmap theme for a common vision, data-based strategy and policy to define actor roles, regulation and resource allocation to enable fair implementation, is that of system readiness for change. Determination of readiness by way of assessments may be important for the precision of targeting and leveraging interventions, but in all probability, may have greater chances of success where paradigm shifts are made by actors when the status quo is allowed to be challenged and even disrupted.

With the current state of dysfunction in the system, it will be more important to find appropriate ways of creating an empowered, conducive and enabling business environment that makes it easier to attract competition to the system and for role players to enter the market with a clear view of how risks may be mitigated.

Whilst promoting the potential positive outcome of a national view, it would also be naïve to believe that a grand national plan or a mindset of “private sector to the rescue” will address the huge challenges that the country faces. Resources are limited and priority areas will need to be identified for the most impactful advancement. In the same way, as system decline was visible gradually, and then rapidly escalated, ways need to be found to bring about gradual areas of improvement, build awareness and create critical mass for more parties to build on success such that small improvements can be made visible and then accelerated.

“...from a systems perspective, it's a logistics system that's in a state of decay... It requires identifying the pockets of small wins and moving those pockets forward and using them

as benchmarks to do other things. I'm sort of saying modular incremental improvement ... if we have the money, if we invest in it, are we actually enabling people to engage with that system” SysIntervene I

“... making sure that you manage business benefits, manage freight intermodalism benefits. And ultimately you end up in a situation where things start to improve gradually; and then start to accelerate because suddenly you get traction. But without planning – You fail to plan. You plan to fail” SysAca N

There is less of a need for new policy than there is for strategic direction to define the function of system components, create parameters for different modes to promote synergies, clarify system actor roles and enable relationships. Participants do indeed indicate the need for a “strategic game plan” or master plan for freight, and more particularly for freight intermodalism, to map integrated strategy implementation and to define the infrastructure that is required for the country. A master plan would help to avoid fragmented developments of a system that requires proper integration.

“We need one mission and someone driving it. And then the supported processes to execute” FG2 Customer Actor

“...discuss the contributing factors...that would help to facilitate the journey or the roadmap into this” FG1: Rail Actor

In the absence of clear strategic direction, system actors are reactive and those who have the resources and interest in fixing “a broken system” are reactively implementing aspects without a proper view of an integrated eco-systemic approach and outcome:

“...if we don't have a definitive master plan with roles and timing, it's going to be piecemeal and it's going to be lastminute.com, reaction stuff to fix something. And when it does happen, we fix it and we actually don't know whether that's actually the right solution driving the right kind of behaviour in the supply chain” Container M.

The finding of the theme “A National roadmap” should be viewed in the context of the documentary analysis of the plan and policy development related to the freight system.

Documentary Analysis Findings

The expression of the need for National strategic direction in the form of plans and policies warrants a review of the prevailing policy environment in South Africa, which reflects the Government’s urgency in attending to critical issues and challenges in South Africa’s network businesses – including transport.

- i. The Economic Reconstruction and Recovery Plan (ERRP) was announced by Government in October 2020 to reset the economy in the context of unmet National Development Plan (NDP) 2030 targets; spur recovery from the Covid pandemic and the economic recession

before the Covid outbreak (Government of South Africa, 2020). The ERRP included the development of specific interventions for the transport sector – particularly the parts owned and operated by Transnet. Operation Vulindlela (National Treasury, 2021) was created as a special unit in the Presidency and National Treasury to fast-track the implementation of structural reforms of network industries. This work includes a priority focus on policy reforms for ports and rail and paves the way for regulation of and increased competition in the transport sector, supported by greater private sector participation. It is anticipated that reforms will also lead to developments for a shift from road dominance to intermodal transport.

- ii. The National Infrastructure Plan 2050 was gazetted on 11 March 2022 and provided the vision for mission-critical infrastructure networks, including freight transport, with detailed attention given to the development of intermodal freight infrastructure and practices. (Government of South Africa, 2022)
- iii. The White Paper on National Rail Policy was approved by Cabinet on 23 March 2022 and launched by the Minister of Transport on 9 May 2022. The launch statement indicated that “...the Policy takes a holistic view of the trajectory of the development of our rail system. This Policy not only creates policy certainty but also introduces radical structural reforms in the sector” (Government of South Africa, 2022) to increase the competitiveness of the rail sector.
- iv. The White Paper on National Transport Policy 2021 was gazetted on 27 May 2022. This paper recognises that mode-specific plans exist and that the policy intends to provide an overarching and integrated policy for transport in the country. This paper also contains a specific policy on seamless intermodal services (Department of Transport, 2022).
- v. The Economic Regulation of Transport Bill 2020 was tabled in parliament at the end of May 2020 and passed in September 2022. The Bill aims to "consolidate the economic regulation of transport within a single framework and policy; establish the Transport Economic Regulator; establish the Transport Economic Council” (Sabinet, 2022). The Bill seeks to address structural distortions such as monopolistic dominance in the transport industry and to “level the playing field”.
- vi. On 16 January 2023, the Department of Transport issued a tender seeking the services of a consultant for the development of a freight road-to-rail migration strategy. (Department of Transport, 2023) This also seems to support the rail policy intent.
- vii. A plan addressing the strategic direction of transport, the National Land Transport Strategic Framework (2023 - 2028) was gazetted and published for public comment on 3 March 2023. The strategic framework gives effect to the National Land Transport Act by serving as "a five-

year framework for integrated land use transport planning system” (Department of Transport, 2023) and favours the development of intermodal facilities for passenger and freight services.

The Rail Policy intends to create space for private sector investment and effective economic regulation that enables equitable access to both the primary and secondary rail networks. While rail is a well-established industry in the country, it has operated for more than a century without a cohesive National Rail Policy, that provides a seamlessly integrated and holistic strategic direction for the sector. An aim of the policy is "to place the rail on a sound footing to play a meaningful role as a backbone of a *seamlessly integrated transport value chain* able to make a meaningful contribution to the economy". (Government of South Africa, 2022). The reference to integrated value chains supports the notion of intermodalism and the role of rail in contributing to competitive supply chains.

It was also indicated that “A National Rail Master Plan anchored on the National Transport Master Plan 2050 (NATMAP) *will be developed*; setting out a sustainable approach to strategic rail network planning and a long-term plan that informs all future developments of rail in the country (Department of Transport South Africa, 2019). The Department of Transport has also indicated that, in addition to providing strategic direction, further momentum for State and private sector collaboration will be afforded through the publication of a Private Sector Participation (PSP) framework. These developments should address many of the calls for plans, policy certainty and actor role clarity as expressed by research participants.

The National Land Transport Strategic Framework provides “the guiding principles that integrate various modes of land transport within the planning context of the NDP”. “It sets ...the overarching goals, vision, and objectives for each element of the transport system” (Department of Transport, 2023). Of more relevance to freight intermodal is that the framework indicates objectives for road and rail and emphasises the need to develop hubs, ports and logistics to enhance intermodal efficiency.

An integrated and National approach is however indicated in the Land Transport Policy – and which supports the focus group calls for a National view or National “sit-down” that includes all system actors. “There will be a national approach to a total freight-transportation system, involving Government, customers and users, and owners and operators working together. Modal, spatial and institutional integration must be encouraged. To remain customer focused, the freight-transport system must be responsive to changes in customer demands, logistical developments and market forces” (Department of Transport, 2022, p. 61). The policy discussion on intermodalism indicates that Government will not dictate modal choices but would create an environment that promotes economically and environmentally sensible modal choices in the interests of optimising capacity

utilisation (for example, disincentives to reduce heavy trucking on roads) and achieving modal integration. The policy also highlights the need to improve the rail infrastructure condition and efficiency of rail operations (Department of Transport, 2022)– both of which are critical precursors (and were emphasised by research participants) to advancing intermodal practices.

The National Infrastructure Plan 2050, on the other hand, contains more specific intentions to develop infrastructure that enables intermodalism. As proposed by SMEs, SEZs should be developed (to contribute to localisation and industrialisation) “by driving the establishment of Special Economic Zones around intermodal transport linkage nodes” (Government of South Africa, 2022, p. 4). Integration of modes and facilities is also emphasised in that “there will be a plan to integrate rail, road, ports and intermodal hubs and freight villages by 2022/3...and that the upgrading of the six ports of entry to become one-stop border posts be complete by 2025” (Government of South Africa, 2022, p. 6). This infrastructure policy intent would (need to) be closely aligned with and supported by the finalisation of plans for African regional freight logistics, the Port Master Plan, the National Rail Policy and Rail Master Plan, the Road Funding Policy, and a revised Road Freight Strategy.

In the budget review for 2023, National Treasury has also emphasised the need for significant private sector investment and for structural reforms in transport (especially freight rail) and logistics to cut bureaucratic processes and create an environment conducive to investment and economic growth (also raised by research participants as critical imperatives). National Treasury has also stressed the need for accelerated implementation of plans which would be aided by the efforts of Operation Vulindlela (Treasury, 2023, p. 3).

In summary, an enabled and ready environment that has a clear strategic path with time frames, and includes regulatory and policy aspects informed by the strategy, with clear actor roles could provide some impetus for advancing freight intermodalism. It is, however, doubtful that a grand plan and revised policy frameworks alone, would trigger the significant transformation required to truly develop and advance the country’s freight intermodal system. Documentary analysis indicates that policies and plans have been developed to provide guidance, but have not been appropriately actioned to drive change. Other interventions and approaches need to be explored.

4.2.4 Seeking Solutions

The theme describing systemic challenges indicated that South Africa does not have a well-functioning freight intermodal system capable of contributing to the country’s economic growth and competitiveness or developmental goals. Freight solution interventions are

proposed to achieve cost-effectiveness and throughput to improve the way that the freight sector serves the market and contributes to the economy. Freight intermodal practices, designed well and effectively implemented, have the potential to contribute to these goals depending on choices that are made by system actors, and the quality of the interfaces between connecting system parts. The theme “Seeking solutions” is discussed by way of four sub-themes, Choices and trade-offs; Interfaces driving value; Technology and innovation; and Efficacy of solutions.

4.2.4.1 Choices and trade-Offs

Cargo owners require freight to be moved from the point of production to the point of consumption and, in reality, would select a freight solution that offers a price that they are willing to pay for the value that they expect to receive. The value may typically be stated in terms of service performance criteria such as:

- i. Cost – competitive pricing for the level and suitability of service offering;
- ii. Time – scheduled collection at the point of origin and predictable delivery at the destination at the specified time;
- iii. Quality of cargo – safety and security of cargo when handling and in transit so that cargo loss or damage is prevented
- iv. Environmental sustainability – not mentioned by research participants as a strong criterion for service selection, but rather in terms of reducing congestion, accidents and emissions.

Ideally, such criteria would be met by simply using a single mode of transport and as few nodes or handling points as feasible. This is not always possible, for example, when the operational requirement is to move cargo from a port in one country to the door of a consumer in another country, or from a domestic production point to a domestic inventory storage point until required for distribution to a point of consumption. In more complex transactions, intermodal solutions are unavoidable and approaches are designed by the cargo owner (or their shipping and forwarding agent or LSP) to fulfil cargo movements as efficiently and cost-effectively as possible.

“Intermediaries add costs and time. Want to handle containers or freight in the supply chain as little as possible. But Intermodalism does open the door to provide a door-to-door service which is not possible by rail or by sea on its own.” SC Consult G

Designs essentially mean ensuring that the best modal choices are made at that time and circumstance, for the freight type and distance with good connectivity to ports, terminals and distribution centres (or nodes). Long haul is safest and cheapest by sea freight and by rail for longer distance land transport. First and last mile is always by road. In terms of intermodal cost effectiveness, cost drivers do not only comprise internal costs that a transport or node operator incurs but should also include internalisation of externalities costs to the country. Critically, the overall intermodal cost of the transaction must be more cost-effective than using a single mode with few nodes, and as such, must minimise the time and costs of transferring freight between modes and nodes.

“We only actually have two objectives with logistics: Throughput and get it as competitively cheaply as possible. Now, that price objective, price includes both internal and external factors...But the total package then just needs to be cheaper. Even more freight will shift to rail, to intermodal systems, and the total cost will come down because the density cost savings on the rail, will actually bring down the total cost of logistics in the economy” Academia J.

A freight solution characterised by efficient interfaces in a connected value chain will have a greater potential for efficient freight throughput flows that also reduce costs. Principles that improve throughput and reduce costs include, but are not limited to:

- i. Unitisation or modularisation of freight in standard containers reduces handling of freight, increases the ability to load and offload using standard equipment for all transport modes, and thus increases efficiencies and reduces costs.
- ii. Coordination of similar types of freight flowing in the same direction enable consolidation of loads and increase density or concentration to realise scale cost benefits of modes and at nodes or terminals.
- iii. Alignment of capacity and capability between modes and nodes reduces bottlenecks, congestion and delays that add costs.
- iv. Coordination for agile transfers using efficient loading and offloading equipment and methods reduce idle time, dwell time and cost.
- v. Cooperation to reduce levels of congestion reduce dwell time and release capacity for subsequent movements.
- vi. Appropriate use of modes for the freight type and time, improve equipment, fleet and infrastructure asset utilisation and velocity.

Trade-offs, however, often need to be made in designing solutions. Some common trade-offs to consider when implementing intermodal solutions were indicated. For example, valuable

goods (e.g. iPhones), perishable freight (e.g. fruit), goods that are urgently required (e.g. medication, spare parts to repair critical machinery), goods required on shelves for a market launch or event need to flow as quickly as possible, and more costly air freight rather than sea freight may be used in such cases despite the significantly higher cost.

“Air freight demand has picked up because of the condition of sea freight. Orders running late, e.g., because of shipping line schedules being behind or port congestion or Covid outbreaks, manufacturing delays. So, sea freight orders get converted to air freight because people need stock. Capacity reduced during Covid. Big disruptions within the supply chain like Suez Canal closure, Ningbo, Shanghai, puts pressure on and then air freight demand increases and then pricing increases. Would have smaller reliance on air freight, or reduction in demand for air freight, if ports and rail are more efficient because you’d have less backlogs and could meet lead times. Would be less need to move stuff by air freight.” Analyst D

The consolidation of many containers onto a train for transport by rail to an inland terminal served by rail significantly reduces costs. The trade-off, however, is the dwell time or idle time spent waiting for a large number of containers to be delivered and gathered or consolidated to load a full train. Dwell time could then counter grouping effects and add to costs if not appropriately coordinated and operated according to schedule time adherence. Dwell time costs and delays (versus consolidation benefits) are likely to be critical factors in the case of perishable or urgent cargo.

“If, over a short period of time, you can consolidate a lot of containers then it’s obviously possible to fill more trains. which will also make the consignment cheaper because you will then have a more densified railway option” Academia J

Another potential trade-off that must be considered in intermodal choices is that of capacity availability, for example at ports. Innovation in shipping has resulted in ever-larger-sized container ships (with carrying capacities of between 12 500 and 25 000 TEUs) being used by major shipping lines. This means that vessels discharge a greater number of containers at a time at the port. The ports of Durban and Cape Town were not designed to handle these current high container volumes and increased volumes give rise to bottlenecks or capacity constraints. Capacity imbalances between maritime and landside facilities and modes, while providing shipping economies of scale, create challenges for other role players.

“Shipping lines and carriers play a critical role. Congestion at the ports. Aware that vessel sizes have more than doubled and vessels are discharging a greater number of TEUs at the ports. Durban and Cape Town ports were not designed to handle that. So the whole Intermodal discussion becomes critical. Critical for Back of Port facilities to support quick, mass evacuation of TEUs. Warehouses start mushrooming closer to the port e.g. Durban area, whereas historically, would have found an Intermodal solution.” FG1 Rail Intermodal Actor.

The use of intermodal solutions should be considered in terms of capacity availability and utilisation rather than incurring expansion investment in national roads arteries and of warehouses in the port precinct to deal with increased volumes of containers. The use of the back of port facilities served by scheduled rail shuttles to support the quick, mass evacuation of containers from vessels and ports to terminals close to hinterland consumption areas, could alleviate port congestion and the need to invest in the creation of additional capacity. In the same vein, rail could be used to convey a high volume of full and empty containers between dense terminals, rather than expanding the N3 road corridor, which would require high land use and significant investment cost to government.

“You just need less land for rail to transport *the same volume* than you need for road... we have calculated that if rail remains stagnant, so that means the current 10 million tons on rail, does not grow, the N3 road, will probably in 30 years’ time *need eight lanes in both directions*. So, it's going to be *a 16 lane highway*. Now there is just no place for it” Academia J

“Have to look at options. Otherwise, because there isn't enough space for so many lanes for road” Analyst D

Intermodalism is typically discussed in terms of maritime import-export freight movements between ports and the hinterland. Another potential choice for the usage of intermodal solutions is for the conveyance of goods *within* South Africa – domestic intermodalism – where significant opportunity exists to move and consolidate freight at key nodes or super terminals (located close to Durban, Cape Town and Johannesburg) served by efficiently scheduled rail shuttles, as opposed to road trucks travelling long distances on road highways that run parallel to under-utilised rail corridors. This is an opportunity that has barely been harnessed in South Africa (despite partnering attempts by LSPs and bimodal developers over the past decade), even though it could be a profitable new line of business for the rail organisation and will be sorely required by the country in future years, with many benefits in terms of efficiencies and lowered logistics costs to the country.

“Basic solution that will have highest impact is two systems which will be Gauteng-Cape Town and Gauteng-Durban. Need three massive terminals: One through the South of Gauteng. Two on the urban edge of Cape Town, (maybe Kraaifontein): Three on the urban edge of Durban (e.g. Cato Ridge). ... Need a railway that works. Railway is just required to shuttle up and down between these three terminals without any shunting or train building. Just move the shuttles up and down between the three points... LSPs in South Africa, have approached the railway with solutions.” Academia J

The establishment of a domestic intermodal system for the country goes hand in hand with the development and strategic location of dense hubs, Special Economic Zones (SEZs) or

freight villages served by long-distance, dense rail corridor systems. (SEZs are typically subject to different economic regulations and aim to incentivise investment in that area). Hubs create scale and value-add benefits and have the potential to support and stimulate regional and international trade.

“What kind of terminals or what kind of freight village do we need to construct? Or logistics nodes or hubs? What role is it actually going to play in our logistics system? That needs to be defined and then encouraged. And whether it be by tax incentives or whether it be by regulation or whatever” Container M

Trade-offs will always have to be made by customers and their agents when making freight solution choices. The consideration then, is which mode and node choices and their intermodal combinations, could provide the rationale for a service that is most efficient, cost effective and provides a neat solution at that specific time, to meet customer requirements and optimise operator circumstances.

Benefits and trade-offs should be considered in the development of freight solutions that include the rail mode. Whatever freight movement choices are selected and executed, without a well-functioning railway, there is no essence of freight intermodalism in the country. All domestic freight would be conveyed by road as would all imported and exported freight be moved to and from ports by road; a situation already proving to be costly and unsustainable.

“Return cargo for exports should be moving on rail straight into port. Should be able to drop off cargo containers at a node. Let that be railed into a port and then onto vessels. ...If you load on to rail at City Deep, it should go straight into the port and get loaded. Should be very little reason to be moving cargo via road freight down into Durban port. And that could also help alleviate some of the port congestion. The number of trucks operating in and around the port, in the entrance, and Bayhead often gets congested.” Analyst D

“Rail networks are a fundamental pin in this whole process; making sure the rail networks are working at design capacity” FG2 Customer Association Actor

“One of the solutions for *sustainable road freight* transport is to move appropriate freight to rail. So, part of the sustainable road freight solution is to get more of freight on the rail” TruckTech P

Both SMEs and freight system actors have indicated the critical role that rail transport can and should play in the movement of freight for the benefit of the economy. As a primary imperative, not only for freight transport but more specifically for freight intermodalism, the country’s existing railway system and capacity must be restored, secured and utilised.

“Have got to fix up our rail service” Intermodal L

"If we want to run an Intermodal system, we have to have a railway line that works" FG1 Freight Association Actor

"To be able to do landside container intermodalism you really need rail. Rail is a key element in it, otherwise what's the point? For the road just takes it straight through." Intermodal L

"Companies should do supply chain optimisation in terms of the feeder and distribution systems and long hauling, get it much, much safer on the rail by using intermodal transport" Custodian H

"For the good of the world, we need to use rail more, but bring in the private sector to help us do that. They are ready and eager to do that" SCConsult G

Improving the rail system (and creating greater capacity to meet demand on dense corridors) could be advanced through pending legislation and economic regulation that allows private operators to access existing rail infrastructure. A change in the system structure in the form of timeous third-party operator access, implemented appropriately, may be a significant stimulus for change in the freight and freight intermodal systems.

4.2.4.2 Interfaces Driving Value

Research participants typically describe intermodalism in terms of flows of freight *by and between* modes in a supply chain or value chain:

"Freight intermodalism, taking it from a pure transaction point of view of cargo moving. Intermodalism would work if it's *sea freight*, it's going to have potentially three parts. First from origin movement, might be *rail or road*. Then the *sea freight* portion, and then again at destination point, could be a *rail or a truck* movement. Consider that for international logistics for a client. And you could also then have an *air freight and sea freight* combination. Could potentially have four or five movements *across different modes*. Depends on the type of transaction." Analyst D

Certain participants go beyond the focus on modes or modal choices or combinations. Additionally, they stress the need for (or lack of) integration, connectivity and seamless transfers and transitions between modes or between modes and nodes to enable intermodal or transmodal connectivity and inter-operability between the freight system parts.

"You do not see a lot of *integration* between different modes of transport. And that's where, in an inadvertently integrated company like Transnet, you would hope that it would *integrate* well, but even there it doesn't necessarily *integrate* well. So, the rail to port to maritime, that *integration* is sub-optimal" SysAca N

"South Africa's economy, from a freight perspective, [the priority is] unblocking ports and getting better *integration*" FG1 Provincial Government Actor

"[Need] better *connectivity* to back of ports from ports and from inland. And long-distance connectivity." FG2 Port Terminals Actor

"[Need] an efficient, accessible and *integrated* intermodal freight system that is underpinned by *integration across modes* of freight transport, and encourages *interoperability*" FG1 Logistics Actor

"A lot has been said about rail but never under-estimate the rail *terminal interfaces*." FG1 Transport Engineering Actor

Beyond stating the need for integration and connectivity in the system, the following extracts serve to illustrate *how the interfacing parts* in the system are *connected* in the process. Statements highlight the critical role to be fulfilled by nodes with appropriate transfer equipment for handling unitised freight (in a container or swap body) between different modes and facilities. Synergistic relationships between connected parts of the system also have the potential to optimally utilise and create capacity.

"Intermodalism, only when you've changed either from road to rail, or pipeline to road, or ship to road. It's that concept of actually *doing that transfer...* using *highly effective transfer methods*. In a *container or swap body...container gantries or reach stackers...* Anything that changes modes and has a *highly effective transfer from one mode to the other*. Must be in the flow of the cargo. Right from ship to rail to a warehouse. That's intermodalism." Intermodal L

"If there is no *synergy between different modes*, ... throws the supply chain out of proportion, and hence forces a specific mode of transport. How do the public and private sectors work together to put in place that *capacity and capability back of port?* Expansion of *infrastructure capacity*, and significant improvement in operational performance to handle and deal with shipping line progress that's happened over the last few years, but also as they will continue to do going into the future." FG1 Rail Intermodal Actor

The emphasis placed on transition and transfer nodes alludes to relationships between system parts, system actors and intermodal concepts (people, technology and innovation) and reflects how participants perceive the importance of interfaces between parts, in realising system performance and value creation.

"Gives that type of *value or success* into each *touch point* of the value chain. We could *create, extend and also defend* some of these value chains. But in the Intermodal space, we've got different parties interested in ports, from road users to rail to ports to the extended port where some *transhipments* are taking place. These are *critical touch points* in the value chain to create the total competitive supply chain that we are looking for." FG1 Rail Intermodal Actor

"*Nodal points* that are of necessity to *transfer from the one mode* to the other*development of equipment* and things like that. We find that the *terminals or transfer points*, more than nodal points, or the *handshakes between intermodal solutions*. Those handshakes, because of the equipment, are not always viewed as a huge risk, but they obviously are." Logistics I

"*Points of transfer* are obviously the biggest problem". Academia J

“And if your system of interest is the rail system, got to be cognizant of the port systems, the road system, then everything else and *how those interface* with your rail system. And then you've got to also understand what other logistics services are overlaid on top of those transport settings”. SysAca N

“We need to have more *Intermodal exchange points* in order to be able to start having intermodalism. If you can't move cargo *between two points, between different vehicle types*, then how are you going to sort out each mode of transport doing what we're trying to do” FG2 Dry Port Operator

The graphic overleaf (Figure 12) highlights the interfaces between the connecting system parts (as discussed above) and how they may create value in the system. The graphic represents an ideal for the freight intermodal system “as it should be”.

Research participants' perspectives have specified various key interface points, between system parts, to be optimised for improved freight system functioning and value creation. Key interfaces between nodes and optimal modal connectivity (where interfaces take place) are illustrated in Figure 12, which also illustrates the imperative of effective land-maritime interfaces. Effects of ideal interfaces between actors, nodes and transport modes are illustrated to reflect how an ideal system operation could address systemic challenges and key performance indicator (KPI) improvement of parts, that could lead to whole system improvement.

Strategic institutional or relationship arrangements between actors, that could advance the effectiveness of interfaces, were also stressed during discussions. Such arrangements are addressed in greater detail in subsequent theme sections (“CCC networks” and “A better system”).

Improvements in interface efficiencies can best be realised when the multiple actors fulfilling the interface tasks have full knowledge of what type of freight will arrive when and for what destination, to prepare transfer equipment and storage areas. Foreknowledge of delays, changes and disruptions enables preparation and readiness to make real-time arrangements and manage deviations accordingly. In a value chain where the interactions between the actors can create value, the system develops and grows as a result.

Value creation through Interfaces between Connecting Parts: System As It Should Be

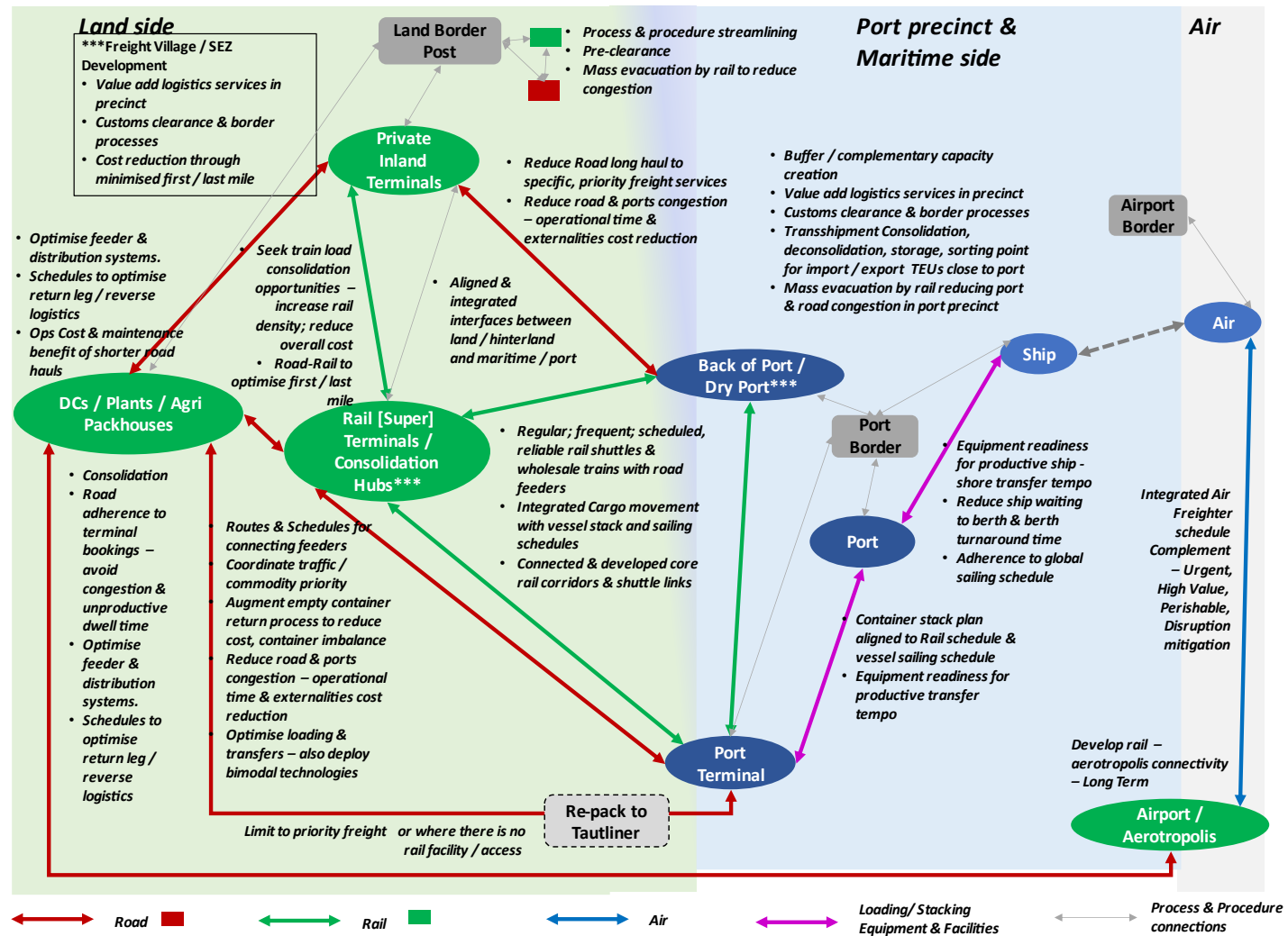


Figure 12: Value creation between connecting parts; the system "as it should be" (Researcher construction)

The principle of consolidating similar freight types flowing in the same direction, to increase density or concentration that realises scale cost benefits, may also be viewed as creating value. The value may be created by developing dedicated intermodal freight corridors (not congested with bulk mining freight) to densify freight corridor routes that optimise asset and capacity utilisation across *all* modes of transport based on corridor demand. Such corridors have the propensity to create value where nodes are located in a network and connected to dense nodes or terminals. The interfaces will have to be effective and will require sharing of data to enhance sharing of assets and empty leg utilisation.

“Need to reduce variability in the supply chain. variability is an accumulation of different stages in a supply chain. There's a difference between cost and value if something stands in a shunt yard, it doesn't *add any value*, it's just costing” SC Consult G

This implies, not only better utilisation of rail corridors but also the most appropriate utilisation of road freight modes, on freight corridors where there is high demand for intermodal freight. The optimisation of *all* modes on a corridor is affirmed by an actor in the road freight industry who stressed:

“...the need to identify main corridors and really put in place intermodal connectivity between the various modes. They cannot compete with one another. If they cannot complement one another and ensure that the freight is moving, we're in trouble” FG2 Road Actor.

Terminals (and SEZs or freight villages) have the potential to create value in a corridor or freight intermodal solution by, for example:

- i. facilitating efficient cross-border transfers;
- ii. consolidating agricultural produce to be transported to ports for export;
- iii. decongesting ports by reducing the number of trucks entering and leaving the ports precinct;
- iv. establishing value-added services (container cleaning and repair, refrigeration services, warehousing and distribution; packing, unpacking and sorting) in the terminal precinct;.

Value could be created provided that the capacity and capability to cost-effectively transfer freight from nodes to transport modes is effective at these interfaces. The concept of freight villages also has the potential to optimise first and last mile road modes.

“What other countries are moving towards [is to] try and get your warehousing and distribution located around or very close to your container terminal, your rail terminal. So they become one unit. In Europe, they call it freight villages... taking the pack and unpack that happens in Durban and shift that up to Gauteng. Long-term, it must be a

solution for Africa, for a couple of reasons. 1. Gauteng is the warehousing and consumption hub of South Africa. So why not take the warehousing to where the consumption and the storage hub is wanted? 2. Gauteng has land. Durban doesn't have land. And the land in Gauteng is flat. Durban land is terrible land to build warehouses on. 3. Supply chains get cheaper going through Gauteng. Then, you then face the choice of the container must get from Durban to the warehousing, unpack and pack up in Gauteng. What's the cheapest way to do that? Rail, [then it] doesn't have the cartage last mile leg because everything is in the same precinct. Then rail has competitive advantage, it's cheaper" Intermodal L

Documentary Analysis

Documentary analysis mentions the strengthening of on-dock rail capacity at container ports (not specifically highlighted by SMEs or system actors in focus groups), with rail linked to a strategic network of hinterland intermodal terminals. In the US (e.g. Long Beach) and Australia (e.g. Melbourne), large projects are currently underway to create on-dock rail capacity to streamline processes for transferring containers between container ships and trains. Such interfacing maritime-landside approaches support reduced costs, requirements for less double handling, increased stacking space and shortened dwell times at ports.

An example of value creation was also shared in a focus group discussion where a government representative actively driving the development of a corridor linking automotive production hubs in Tshwane (Gauteng) with the ports for export, indicated that a key driver of investment in nodes (e.g. Tshwane Automotive Zone) is the assurance of sufficient rail slot capacity. Adequate rail capacity will, in turn, drive investment in nodes (hubs, SEZs, terminals, etc.), that benefit the logistics system and the economy.

"There are OEMs and users, other than Ford, that are quite clear that there is a huge appetite for those who want additional rail slots so that they can create dry port investments, bonded warehouses, intermodal sites. The bottleneck is rail slots. If you can position enough rail slots, the dry ports investment largely takes care of itself" FG2 Provincial Government Actor.

The growth in volumes, fed by sufficient rail capacity, drives terminal density and economies of scale, making investment in nodes viable. This logic around terminal investment attractiveness could also drive the establishment of appropriate nodes or terminals for freight traffic moving to Africa for future demand growth anticipated by new AfCFTA agreements.

The corridor most critical for intermodal freight, which must work effectively for global competitiveness is the corridor between Durban (KwaZulu-Natal) and Johannesburg (Gauteng). The N3 road corridor which is currently extremely congested with heavy truck vehicles and the rail corridor, which is operating significantly below design capacity, are

destroying value. Alternatives need to be found to address the challenges on NatCor in the interests of manufacturing and production in the economy.

Proposed interventions present opportunities to attract investment in new assets and facilities and the maintenance and upgrade of existing assets. Such investment may attract local and foreign investment (such as the DP World investment in the Port of Maputo and the July 2023 announcement that the Philippines based organisation, International Container Terminal Services (ICTSI), has partnered with Transnet / Transnet Port Terminals to develop and operate the Durban Pier 2 Container Terminal), stimulate economic growth and contribute to job creation, cumulatively creating value for South Africa's economy that is supported by a competitive transport and logistics sector.

The sub-theme "interfaces driving value" (summarised in Figure 12) was confirmed by an actor (who favours the discipline of systems thinking) who described the concept eloquently:

"My view is to talk about value chains as ecosystems where the *interactions between the players is where value is created* and the *ecosystem survives and thrives* as a result." Logistics Actor E (in a follow-up discussion after his participation in FG 2)

This actor also shared some profound insights in likening the interfaces in an intermodal system to the spaces or pauses between notes in a piece of orchestrated music:

"The space in between successive notes is determined by differences in their pitch or frequencies, duration, tempo, and volume; it bridges the gap between successive notes in order to create rhythm, dynamics, melody, and harmony.

Likewise, the character and nature of a business system is defined by the *space in between its component parts—interfaces that are the connections or interactions between the nodes* that constitute a system. And the behaviour of a value chain is determined by interfaces between its business functions. Business mechanics depends on interfaces between its journey, vehicle, and destination.

It aligns beautifully with the notion that value in systems is created through the interaction of its participants." Logistics Actor E

Research participants indicate the necessity of a high-level process of multi-actor goal congruence to integrate planning, activities, processes and procedures. This would lead to improved availability, allocation and deployment of resources for operational execution according to the integrated plan.

The purpose of the freight intermodal system (derived from literature and participants' remarks) may be viewed as:

- i. Creating a smooth flow of containers (or unitised freight) between modes and nodes e.g., between ports and the hinterland, regional terminals and consumption areas.

- ii. Connecting and integrating land side-maritime side activities (and air freight should the circumstances require this connectivity).
- iii. Integrating regional and domestic corridor development.

The pursuit of this purpose by actors would be advantageous if actors can see the benefits, not only to the system but also to their organisations. Such benefits may include:

- i. Each part improves its performance in pursuit of a common purpose. This in turn drives improvements in overall system performance. Greater benefits should flow to all actors.
- ii. Optimised modal cooperation would contribute to smoothing (less variability) of flows and lead to a reduction of pressure on nodes (e.g. reduction in ports congestion). Performance would be visible in reduced congestion; shorter waiting time and more optimal utilisation of equipment at nodes (e.g., loading equipment at a port or inland terminal).
- iii. Efficiencies across the system create (or make available) capacity leading to cost optimisation of parts for overall system cost reduction.
- iv. Optimise infrastructure, rolling stock, equipment capacity utilisation and alignment.
- v. Productive and sustainable investment in intermodal system infrastructure and assets.
- vi. Integrated freight intermodal KPIs driving whole system improvement.

In figure 13, the researcher has made use of the Da Vinci TIPS™ model (The Da Vinci Institute, 2020) as a way of illustrating how the interfaces and connecting parts of a freight intermodal system may drive value through the interactions between technology, people and innovation contributing to improved benefits for all actors and stakeholders.

Each of these aligned processes leads to improved performance attributes of both the parts and the system whole. These connected processes should strive to create a steady rhythm and tempo of continuous, predictable and fluid freight flow across supply chains. It is the effectiveness of these transfer points, the interfaces or touch points in the value chain where transitions between nodes and modes occur, that make or break the flow of freight and that could add costs to the total solution if they are ineffectual or poorly managed.

The described synchronised process (illustrated in Figure 13) would aim to achieve freight intermodal *system-level* goals, purpose, outputs and outcomes. System goals should thus be

pursued and attained by operators to optimise their operations *and* the interfaces with other system parts.

System goals have been expressed in terms of:

- i. Building supply chains with a competitive advantage: costs, service quality, innovation and responsiveness to meet demand.
- ii. Total system reliability and predictability leading to efficiency and cost-effectiveness.
- iii. Appropriate (and affordable) levels of investment in modal infrastructure capacity and nodal facilities (and optimal location) addressing modal imbalances; and developing high volume domestic (NatCor and CapeCor corridors) and regional corridors (e.g. North-South).
- iv. Enable a shift from unimodal to intermodal freight logistics for sustainable solutions (environmental, economic and social sustainability).
- v. Driving down total logistics costs to the economy (including by accounting for both operator internal costs and externalities costs), and optimising capacity and asset utilisation.

Interfaces and Connecting System Parts using *Technology, People and Innovation* to Drive Value

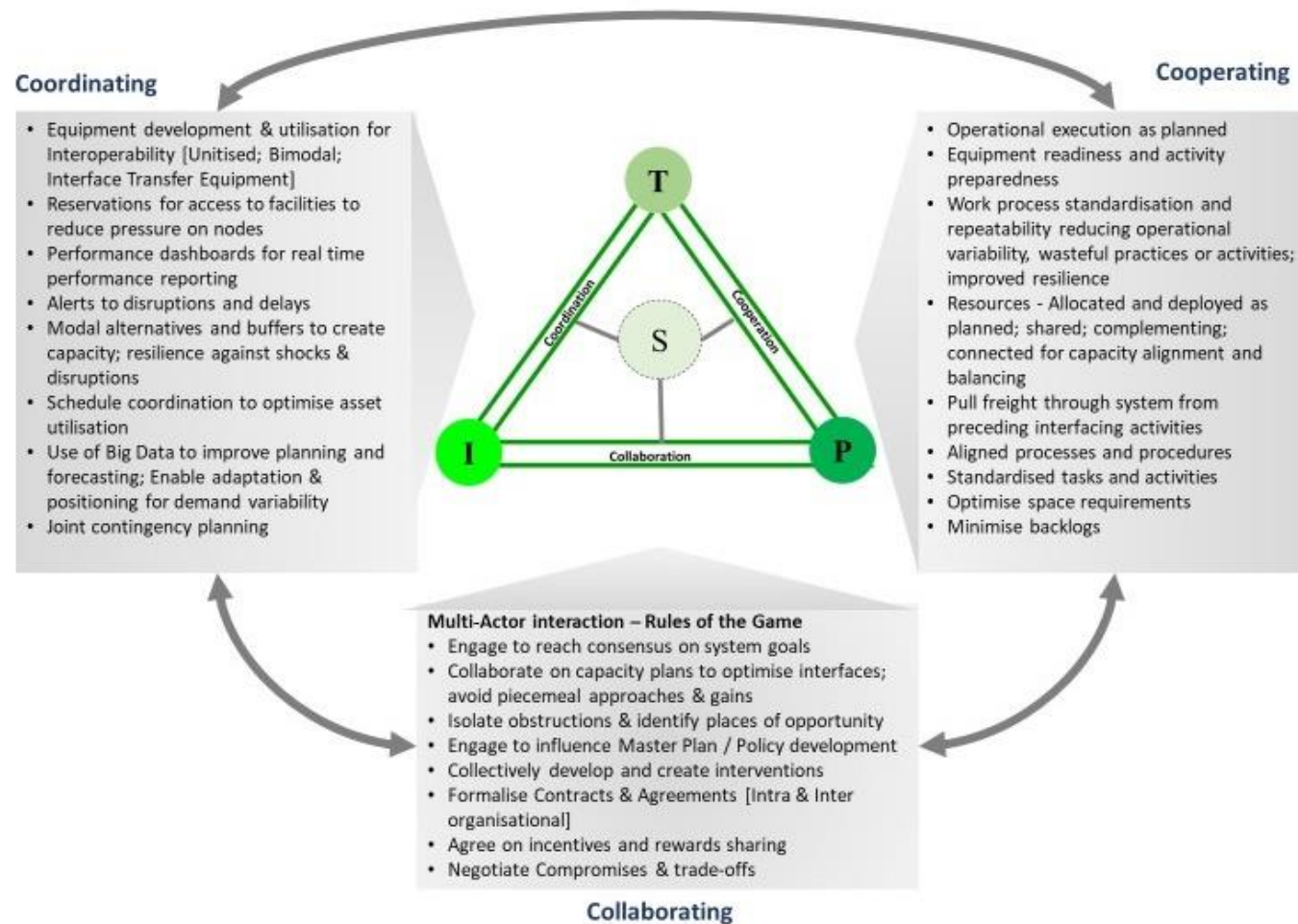


Figure 13: Interfacing parts and *Da Vinci TIPS™* model (The Da Vinci Institute, 2020)

Discussions also revealed *enablers* of connectivity and integration (Table 6 below) that are prerequisites to improving system performance.

Table 6: Interface Enablers and Prerequisites

Category	Enablers & Prerequisites
Master Planning	• Freight system capacity development to meet demand • Port terminals that have near or on-dock rail capacity • Ports (and other land-side capacity) development aligned to maritime shipping capacity and innovation • Rail terminals in a location with good road accessibility and truck staging facilities • Back of Port close to port served by rail (and road for drop off and pick up) • SEZ location and development • Weighbridge locations • Regional and key RSA freight corridor development
Policy Interventions	• Tax or subsidy incentives • Total transport system regulation: price regulation, legislation and enforcement • SOC structural and institutional reforms
Volume	• Unitisation of cargo in containers, on pallets, use of swap body and bimodal unit technologies for ease of handling, loading, and transporting large volumes between modes and nodes
Infrastructure Management	• Port, road and rail network maintenance and protection against theft, vandalism, sabotage and social unrest • Load [over-loading] and safety management and enforcement
Partnering contracts / compacts	• Contracts between transport operators and nodes to clarify roles, complement, improve systems coordination, process and procedure streamlining • Contracts between shippers and freight customers (e.g. producers, growers, importers and exporters)
Innovation	• Smart borders development • Smart technology • Automation • Digital integration systems • Information systems
Funding & Financing	• Innovative funding and finance model development (including ventures with international players and with African and global development banking institutions) • Financial investment and support from funders and developers

4.2.4.3 Technology and innovation

Value creation at interfaces requires visibility of freight movements and sharing of information. Digital technology platform developments are gaining momentum and are being deployed through the implementation of innovative technologies and information systems to advance freight transport planning, operations, practices and transaction payments.

In terms of hard infrastructure, investments should, and are being made through the development of bimodal technologies, for example, *RailRunner™* vehicles that can move

seamlessly on either road or rail (hailed by rail locomotives or by truck horses) without the cargo being handled during the transition, as goods remain in the same loading unit and thus provide a true intermodal solution.

“RailRunner is privately owned rolling stock, loaded and unloaded in privately owned units hauled by Transnet locomotives on Transnet rail from point A to point B without subsidies. And by giving the client a 20% reduction of cost. RailRunner will do for Africa’s logistics, what cell phones have done for African communications” FG2 Bimodal developer

Innovation should also be encouraged in the rail sector through the design of multi-commodity rail wagons such as swap bodies that could have greater opportunities for securing back-haul cargo and improving asset utilisation, as has been achieved in the road freight industry. Such equipment could also be exploited to develop domestic intermodalism where there are untapped opportunities.

“...look at options for Performance Based Standards (PBS) vehicles to try and make the cost as low as possible. Probably also opportunities for innovation in rail. I mean things must be quite stagnant, and I don’t know how well South Africa is doing in terms of engineering in rail.” TruckTech P

While much emphasis is placed on road and rail modes of transport in intermodal freight, some have also expressed the need to consider other alternatives more broadly and futuristically. Interesting options include exploring the use of cargo capsules, underground pipes or tunnels, conveyers to serve last mile or central business districts (CBD) where space is at a premium, overhead container conveying technology, monorail, magnetic levitation and barges on canals around Durban (specifically indicated by a ports actor in FG2).

“Opportunities, monorail, magnetic levitation and barges. We've got all these canals around Durban, things we haven't really explored further. Double-decker trains as in US...RailRunner is a great concept.” FG2 Port Operations Actor

Alternatives mentioned by participants focus largely on other means to transport or move freight. There was less attention given to technologies that enhance intermodalism, with the exception of references to bimodal technologies such as swap body units or RailRunner™. Incidentally, this technology also optimises terminal location and loading transfers through its “Terminal Anywhere™ solution” (RailRunner, 2023). Apart from allusions to ideal terminal locations and efficient transfer equipment; research participants did not highlight the imperative for technologies or innovations in business approaches, operational processes and modern loading and offloading equipment that could improve efficiencies at the critical transfer points between modes and nodes.

“Rail is not the only option for South Africa. Now, just to be crazy. There's so much freight on the N3, a conveyor belt would be possible. Just a 500-kilometre-long conveyor belt. So rather than a terminal outside of the city, just have an underground system that takes the containers directly to port. So, there's a lot of alternatives. that one has to think about, it's not only road and rail.” Academia J

A network of value could also be improved through the integration of IT platforms and digital interventions that allow for visibility and tracking of cargo throughout the value chain. Such an integrated digital strategy would contribute to tracking and measurement of cargo flows and areas of congestion, capacity planning, better communication between actors, alignment of schedules and available resources, management of the processes and for continuous improvement.

The challenge may lie in collaborative approaches for the development of an integrated system or platform, that is shared by role players to provide a single transparent view of freight processes that allows for alternative plans to be made amongst actors in the event of disruptions. Inroads have been made by the Durban Port Forum in this regard.

The “Port Forum”, comprised of port community members in Durban, has recently developed a “Daily Dashboard” (Transport Forum, 2023) which reflects the performance of the corridor. This is in real-time and can be accessed by forum members and provides actors with a snapshot view of system performance (Figure 14).

System performance is reflected in measures for shipping, port handling of ships, container handling, rail utilisation and truck queues giving a broad view of intermodal freight delivery. Such efforts could improve coordination and should be developed further and even extended to other terminal facilities.

Innovation in digital technologies and inclusivity in the form of a concept likened to “Uber for Containers” could also improve value at interfaces.

“...need an integrated digital strategy to make sure that everybody is included in the communication around moving cargo from point A to point B, type of Uber for containers” FG2 Port Operations Actor.

Various applications are already being used by road freight operators in South Africa (for example, (LIVE-FR8, 2020) with the benefit of linking cargo loads to available truck capacity. Such technologies improve interfaces between rail and road, and between nodes, improve asset utilisation and could add value and contribute to advancing intermodalism.



Daily Dashboard



DURBAN CHAMBER
OF COMMERCE AND
INDUSTRY NPC



Figure 14: Durban Port Forum Daily dashboard (Transport Forum, 2023)

The ever-increasing development of technology such as 4IR, 5IR, Artificial Intelligence (AI), digital twins and financial triplets can play a role in advancing intermodalism.

“Artificial intelligence is behind all of this, which is also developing. So, I think we're going to see lots of interesting developments in future” Custodian H

Information systems are strengthening the visibility of the supply chain and access to information is advancing the development of intermodalism by enabling role players to work together. Advances being made in blockchain technology are said to be enhancing import-export processes, information security and transaction payments.

“Creating this digital platform [Cargo Connect] can act as the integrated hub, it's intermodal transport. They're managing that. Intermodal is actually creating opportunity for the role players to stand together, to work together, to integrate” Custodian H

While digital technologies and modal hardware improvements could all contribute to a more efficient freight intermodal system that creates value, efforts could be made to review processes and procedures and deploy technologies to simplify freight and information flows. Improvements could be achieved through reducing laborious and costly activities such as border processes, double handling by storage, re-packing and re-transportation from warehouses, all of which add costs without greatly contributing to value.

“Lack of simplicity - does not mean cutting out things that are necessary, but we need to review if all processes and procedures that currently exist, are really necessary because every process and procedure added into an action is coming at an expense of consuming time and money.” FG1 Road Freight IT Actor.

4.2.4.4 Efficacy of Solutions

While system actors and experts alike propose a wide range of interventions that could contribute to the advancement of freight intermodalism, the imperative of understanding the system and how it works, and defining the issues precisely from the perspective of actors, before rushing in with interventions, is recommended.

“Need to be clear when we talk about creating some realism in terms of the problem that we're trying to solve because often, we tend to talk past each other because we're all trying to solve a million problems with the same solution. Need to articulate the problem a bit more.” FG2 Intermodal Actor

“Cargo owners will always wait for the market to come to them. Very few of them have been interested in partnering and being innovative. They are relying on service providers or the logistics industry, to come to them with solutions. Logistics I

It is also necessary to assess the efficacy of interventions, that is, their ability to achieve a desired or intended result, and to identify areas and means to begin a change process. The alternative is to run the risk of implementing a costly but potentially sub-optimal solution, one that may address a part of the system, to the benefit of a few actors, but not improve holistic system performance.

“How many times do we say “We need the solution. We need a solution. We need the solution”. Systems thinking isn’t about solutions...you start talking about the perfectly wrong solution” SysAca N.

“Hopefully if you do find the money and the people that are willing to do it with, In all likelihood, it’s a sub-optimal solution.” Container M

"The challenge is how and where to start" FG2 Road Freight Actor

It is proposed that the advancement of South Africa’s intermodal freight system will require the development and implementation of not just one, but a set of interventions, as indicated by a focus group actor, a combination of interventions will be required:

“It is not about doubling of the N3 versus the rail system; this OR that. That’s not a systems conversation. The systems conversation is this *and* that *and* that *and* that *and* that. And the magic is to orchestrate all of those things to happen as close to possible at the same time so that you can systemically move the system forward notch by notch by notch” FG2 Logistics Actor

Interventions must be targeted to address the identified delays, bottlenecks and weak interfaces (based on scientific knowledge and sound data), that perpetuate current challenges and threaten the health and improvement of the entire system. Furthermore, South Africa’s intermodal or supply chain systems have recently been disrupted by criminal or unrest activities which have the effect of shifting variables or otherwise undermining interventions that have been implemented.

“Without the intelligence from a security cluster perspective, it makes it very difficult to have a successful systemic approach to this because every variable keeps moving. You can’t say that I’m done with the signalling and then it gets stolen. You can’t say that I’m OK with the traffic that’s going down on the N3, and suddenly people with overweight high things damage your bridges, for example, so... the trigger for me is actually consolidating the intelligence and the security cluster across all of this. So that when you have the system intervention and you’re doing all these initiatives, they’re not undermined by the fact that the variable, or your initial point, has moved because someone else criminally has taken us backwards” FG2 Infrastructure engineer.

“Policing and law enforcement. Do you want the system to work in South Africa? You need to have SAPS, NPA, traffic police everybody coming to the party. What for? Cable theft, fuel theft, R250 million worth of fuel but it’s R2 billion worth of environmental damage! Can’t get a successful prosecution taken through the system. That’s a failure of

police, the failure of the NPA, failure of the justice system, failure of society” FG2 Logistics Actor

These circumstances require innovative thinking, perhaps unique to the South African environment. Collaboration amongst system actors should aim for goal congruence and consensus on the nature of required interventions to develop systemic solutions that add value. The references to the security and intelligence clusters, the environmental impacts of criminality, and the judicial system further indicate that the freight transport system must be considered in the context of a much greater country system.

The selection and implementation of solutions, furthermore, should address the pace and testing or piloting of concept solutions so that they may be applied in a modular manner. This approach could result in pursuing more optimal proposals. Concerning the development of intermodal solutions between the railway and LSPs at least a decade ago, an SME reiterated the notion of trying out approaches. This perspective was also shared by other SMEs:

“Rather than trying to dot every i and cross every t, what should have happened is that the railway should have maybe tried a concept service in this regard, just to see how it goes. Just do it, to have some more density on the rail system”. Academia J

“It doesn't have to change the whole country; it can be done as a pilot project on an appropriate corridor”. TruckTech P

“It requires identifying the pockets of small wins and moving those pockets forward and using them as benchmarks to do other things. I'm sort of saying modular incremental improvement...Comes back to the concept of readiness, modularity, enabling systemic change without actually taking control of it” SysIntervene I

The potential for system enablement through actor collaboration, cooperation and coordination (CCC) is explored in the next theme discussion.

4.2.5 A CCC Network

Analysis and findings thus far have indicated that the development of cost-effective and efficient freight intermodal systems could address some of the country's freight challenges (such as the road-rail modal imbalance and its consequences, expensive transport and storage solutions, congestion at ports and borders, poor connectivity between modes and nodes) and could improve the country's competitiveness and economic prospects. There are calls for policies and strategies to clarify roles and direction. Many, however, doubt that adequate and wilful institutional capability exists, particularly at SOC and Government levels, to assure speedy implementation.

Successful Intervention implementation and goal achievement can only materialise through collective efforts amongst the system actors. The generated theme “A CCC network” (where CCC incorporates collaboration, cooperation and coordination) is a key aspect of intermodalism (as described by the value-creating potential of interfaces). The findings of this theme are discussed in terms of complementarity, private sector positioning, competitive collaboration and CCC principles.

Research participants' extracts that inform the CCC theme are contained in the analysis contained in Annexure G which indicates the nature of actor interrelationships and interaction of parties to the interactions (generally working together, participating and partnering, or specifically described as cooperation, coordination or collaboration). The analysis reflects the stated function or purpose of the interaction or relationship. The analysis also alludes to the willingness of actors to collaborate (or interact). The nature of the inter-organisational interaction (collaboration, cooperation, coordination or all three simultaneously or at different times) is dependent upon several factors that could encourage (or constrain) cooperation and collaboration. Table 7 overleaf strives to summarise the complexity and dynamics of system network interactions.

Table 7: System network interactions: Collaboration, Coordination and Cooperation for the context and circumstances

Interaction	Interaction Types (Examples)
Time horizon and Interaction frequency	• Engagement in different forecasting, planning, resourcing, and execution time horizons (short, medium and long term or strategic, tactical and operational) • Coordinated decision-making guided by a national view e.g., for focused investment in intermodalism • Engagement, alignment or agility of interaction based on timeliness of innovation, solution or response required e.g. routine, urgent, crisis. Constant, daily quarterly, annually
Interaction Agenda	Interaction between multiple intermodal activities performed by connected system actors, e.g. • Alignment of system key performance indicators (KPIs) • Collaborate for the joint benefit of all in the supply chain • Coordination between systems for planning scheduling and resourcing alignment • All system actors' cooperation for partnering and contracts • Alignment on capacity availability and asset utilisation • Integration of processes and procedures • Disruption and resilience contingency planning and actions • interfacing activities to improve transfers and exchanges, for example, Infrastructure-Operations inter-operability and interfaces; Intermodal Mode-Node (e.g. port-rail) and Node-Node cooperation (e.g. Port-Dry Port); Complementarity between transport modes (e.g. Road and rail); Coordination and availability of equipment to make transfers at the planned time
Actor attributes and characteristics that promote (or constrain) relationships	• Degree of goal congruence and a willingness to make trade-offs in cases of divergent goals and interests to be served • Actor incentives (motivation and reason to make it work) • Actor positions of authority, power or influence that interacting actors wield to catalyse interactions • The political will to get parties to collaborate meaningfully and to get greater private sector involvement • Choice (and willingness) of actors to participate, engage, interact, and integrate • Clarity of benefits of collaboration • Recognition and acknowledgement of the strength of interactions in creating value at interfaces • Pressures from customers in the market, labour, interest and lobby groups
Technology	• The existence and accessibility of shared platforms, digital information and technology enable collaboration and support interactions • Systems interface to enable visibility of freight location and time for effective transfers • Communication to integrate effort (and avoid costly duplication) • Coordinate between systems to enable collaboration between (competing) actors while protecting IP

4.2.5.1 Complementarity

Intermodalism requires that a system is built up of effective interfaces between modes, at the nodes or places where interfaces and transfers occur, the points at which freight is transferred from one transport mode to another. This requires alignment of planning, schedules, capacity availability, knowledge of delays, etc. Intermodalism also implies complementarity between modes of transport in a seamless process where all elements are properly connected and utilised to complement each other and work hand in hand as one.

These interfaces are the basis of the need for coordination in an intermodal system. Cooperative processes are unfortunately not the norm in South Africa, where collaboration at key interfaces is lacking and modes compete rather than operate in a complementary fashion:

“There can only be an intermodal system where the various modes are operational, reliable, efficient and complement, not compete with, one another...We don't have an Intermodal system. We have bits and pieces that try and work alongside one another and generally compete with one another. And, from the road point of view, that is what we need to fix first.” FG2 Road Industry Actor

Complementarity between modes also requires interfaces to optimise and appropriately use the strengths of all modes. The challenge in complementarity, however, is that rail performance reliability has declined, and this jeopardises the capacity of the rail mode to perform its rightful task in the system. Where road and rail do not complement each other, pressure is placed on nodes (the ports, terminals and border posts) that cannot complement each other and lead to inefficiencies and bottlenecks along a total corridor for flows of freight between ports and terminals.

Transnet is a significant actor in the system and is currently accountable for roles of national rail network owner and rail operator, operator of the container and automotive inland and ports terminals and National Port Authority, all of which are core elements of intermodal systems and should naturally coordinate in an integrated organisation (which is not always done effectively) to the benefit of the freight system. Private sector actors are required to cooperate, coordinate, complement and collaborate with Transnet, *and* with one another if the country is to develop competitive freight intermodal systems. There is not an unwillingness amongst industry actors to collaborate, rather a fragmented system has evolved based on legacy, planning, policy and systemic performance issues.

Collaboration is a requirement for operationalising a more efficient freight system. While some suggest that government should define and enable a stakeholder engagement and

collaboration strategy, actors themselves (sometimes led by local government or industry associations such as the SAAFF) are already organising and mobilising coordinating efforts amongst a range of private and public role players, where they collaborate to address a specific industry challenge in a part of the system.

4.2.5.2 Private sector positioning

The notion of collaboration in South Africa has gone beyond the mere need for operational coordination and cooperation, it has progressed to a strengthening trend towards formal public-private partnerships. Formal alliances and partnerships are also underway between various private sector system actors (for example, DP World, Imperial Logistics and J&J Group). These dynamics in the industry are likely to alter actor roles, system structures and functioning.

Documentary Analysis

“DP World’s Imperial obtains approval for the acquisition of 100% stake in Africa-based J&J Group. Dubai, UAE, 19 July 2022

Imperial, owned by DP World, announced today that all the requirements relating to its 100% acquisition of the J&J Group have now been fulfilled. The transaction relating to the acquisition of the first tranche of shares (51%) of the J&J Group, which was announced on 29 July 2021, was closed on 18 July 2022. This will be followed by the acquisitions of the second and third tranches of 46.5% and 2.5%, respectively.

J&J Group offers end-to-end logistics solutions along the Beira and North-South corridor in South-East Africa, specialising in the transport of break-bulk, containerised, project, fuel and out-of-gauge cargo between Mozambique, Zimbabwe, Zambia, South Africa, Malawi and the Democratic Republic of the Congo.

Sultan Ahmed Bin Sulayem, Group Chairman and CEO of DP World, said: “This acquisition strengthens DP World’s position in Africa as an end-to-end logistics provider, by adding J&J’s significant presence along these key corridors in Africa – a market where trade is expected to grow at more than twice GDP driven by population growth, accelerated urbanisation and rising middle classes.”

Mohammed Akoojee, Chief Operating Officer of DP World Logistics, Group CEO at Imperial, added: “This acquisition complements our ‘Gateway to Africa’ focus as it optimises and expands our reach in Africa by providing scale in end-to-end cross-border transportation services in key countries and new industries. This is possible through well-established routes, port capabilities, a well-developed asset base, including a fleet and warehousing space, as well as an entrenched customer portfolio.”

Through the acquisition of the J&J Group, Imperial will be positioned for quicker go-to-market outside of South Africa and end-to-end access to certain key countries and corridors (port to customer) in Africa.

“We are excited for J&J to partner with Imperial and believe that the operations of these two businesses are very complementary. This combination offers existing and potential J&J clients a true gateway to Africa,” explained Carlyle and Ethos Private Equity, currently the controlling shareholder of the J&J Group" (DP World, 2022).

Greater levels of private sector involvement in South Africa, would require decisions being made by Government (and Transnet) to clarify frameworks for the operation and ownership of intermodal assets and how such partnerships on national assets would be enabled. Clarity on these roles, and policy certainty, will be critical in building trust, transparency and a clear agenda that provides a foundation for collaboration and partnering.

Since 2021, Transnet had in fact, published “Requests for Interest (RFI)” to assess the appetite for private sector involvement in rail and port terminals and in third-party rail access on certain corridors. Experts expressed concern that Transnet appeared to be primarily seeking a cash injection and would resist loss of control, whereas the private sector seeks a controlling stake in operational assets and would demand guarantees that would mitigate the risks of deals involving Transnet (and that Transnet may be unprepared for the nature of responses to their RFIs).

“Joint ventures or partnerships - they want the kind of management controlling stake. Maersk - has APM terminals. CMA; MSC, Cosco. There's so many of them and they're all showing willingness and keenness to get involved” Analyst D

In the interim, proposals have been made for government to take responsibility for rail infrastructure rehabilitation and funding, (for example, through a rail infrastructure agency similar to SANRAL for roads infrastructure (Havenga *et al.*, 2023) and private sector involvement in rail and intermodal operations. Such models would dramatically change the structure of the system and the rules (and regulations) for how it is operated. In fact, at the time of writing (February 2023), and after the issue of the RFI seeking private sector interest in access to the rail network (the terms of which received criticism from the industry) Transnet had adjusted their approach and Transnet Freight Rail had issued a formal call for qualifying bids for the award of a 20-year operating lease (Transnet SOC Ltd, 2023) for private sector actors to “take over” and run the Joburg-Durban container corridor, the corridor with significant potential for intermodalism.

There is significant (and increasing) emphasis on the greater role that the private sector should play, co-operatively in the industry, in partnership with the public sector. There is a sense of a mindset of “the private sector to the rescue” to rectify the system where Transnet or the government have recently floundered.

“Bring in help. Bring in your Big Brother, the private sector and say come and help us to offer a supply chain that can compete better” SCConsult G

A more competitive system may result from attracting actors that compete in the system, in an ideal world, to improve service performance, drive down costs and create value at interfaces. Public-private partnering would benefit Transnet through the injection of financial resources, assets (especially network rehabilitation, rail rolling stock and port equipment), skills and know-how. In addition, the private sector may harness opportunities for business growth but also stand to benefit by having greater control and influence over improving utilisation and returns on their assets while bettering service offerings to their clients.

Collaborative efforts (that enable intermodal solutions), must, however, have a primary goal of driving down costs to the cargo owner, and the consumer and ultimately ensure that the overall intermodal cost is lower, to drive down the cost of logistics to the country.

“If we have this real integration, the integrated system must guarantee a lower cost than the individual parts put together. But if we get that right and we have the entire system running at a lower cost...”. FG2 Intermodal Actor

To develop intermodal freight systems, collaborative arrangements are also required between private sector players in the country. This may, however, introduce greater complexity as new players fulfil different roles. There is a global trend of private-private partnering which is gaining momentum in South Africa in the form of partnerships that reflect vertical integration of services by major players.

“...two big moves in the last 18 months: Dubai Ports World acquiring imperial Logistics. And along with Imperial acquiring JJ Group in Mozambique. The other is Maersk through APM [Terminals] with Grindrod intermodal. So, these guys are vertically integrating further and positioning for Open Access in the South African market...If you've got three or four of those big vertically integrated players operating within our system, that would be really the absolute icing on the cake” Container M

Major players are often strategically positioned through global alliances, that further strengthen reach and connectivity with trading partner countries and enable access to integrators (for example, logistics service providers and freight forwarding agents), port and inland terminals, as well as shipping, air, road and rail modes of transport in various countries, which could benefit South Africa.

Recent trends in South Africa (and in neighbouring Southern African countries) indicate that global players are positioning in readiness for opportunities that are likely to come about as policy changes allow and encourage greater access to Transnet-operated rail corridors and intermodal rail and port terminals. In addition to the opening up of rail and terminals

opportunities, a “separation” of the Port Authority function as a subsidiary of Transnet (Treasury, 2021) is underway and will also change the system structure and roles of actors.

“Big logistics service providers like Imperial, Unitrans and now Bakers, of course, has just bought a lot of the Barloworld fleets. They would be willing or keen to look at intermodal because they would want to move the product as efficiently as possible to be more competitive. So, if it involves rail then they'll do it.” Truck Tech P

Collaboration thus becomes a much more complex notion than simple private sector coordination with Transnet. Far greater market and competitive forces are at play between sophisticated and integrated global players (such as Maersk and MSC shipping conglomerates) competing with one another.

4.2.5.3 Competitive collaboration

Partnering developments between core actors raise optimism for the growth and competitiveness of intermodal freight systems in South Africa. Developments will also require a fair degree of collaboration between State, Transnet and private sector role players, and also a collaboration between large private sector competitor entities. Each organisation or conglomerate, in reality, exists to grow their own business and profits, and theoretically would have little motive to collaborate with a competitor unless there are visible benefits or shared goals that transcend individual or firm-level goals, and ultimately strive for the achievement of improved overall system performance.

It must also be borne in mind that collaboration in intermodal freight is a delicate and complex concept which may require of actors that they cooperate with parties who are traditionally competitors. Competitive collaboration (a collaboration between competing organisations) in the systemic sense gives rise to such terms as Co-opetition (Cooperation + Competition) or Co-opertition (Co-operation + Competition).

“Intermodalism, it's what is incentivising the correct mode of transport to be used for a particular movement. What is incentivising entities collaborating or bringing about the concept of co-opertition? For operation and competition in one.” SysAca N

It is apparent that large industry players are seeking management and control of logistics and supply chains on their terms with minimal Transnet interference. In Europe, there are many examples of successful partnerships between the railways and terminals reflecting models of joint ownership of facilities to facilitate intermodal shipments. Changes in management, ownership and control indicate the likelihood of significant structural changes in the industry that could change the rules of the game for the future.

“Its partnerships. Many intermodal terminals in Europe, jointly owned by the railways and by intermodal operators. Terminals that are jointly owned by e.g. Bundes Bahn and Deutsche Bahn and by various terminal operators, sometimes even truckers or big LSPs.” Academia J

Collectively, actors could achieve more than any vested or controlling interest or individual effort could achieve alone. SMEs referred to models for vertical integration, and new approaches may be required for horizontal integration both within (transmodal which may be required when private operators enter the rail system) and across modes. Some governing principles (rules of the game or framework conditions) for collaboration will however have to be wrought with the multiple actors likely to compete for opportunities.

Such competitive collaboration, while benefiting the greater system, may require trade-offs to be made by individual firms, for example, the willingness to share information (such as schedules, delay notifications, location of cargo and availability of resources) that could enable collaboration and improved intermodal performance. Actors would, however, surely draw the line at the sharing of competitively sensitive information (such as customer details, and tariffs). Technology developments and digital applications could encourage collaboration on sharing operational information whilst limiting exposure to commercially sensitive data. Again, the benefits of information sharing would need to be transparent.

“People won’t want to share their IP [Intellectual Property] with other people. Especially in competing industries. So, should be wise in how you are doing it to allow people to *cooperate*, knowing that they *compete* but also *collaborate* at the same time. But if somebody sees that, barriers to trade will be diminished, they will definitely collaborate. A platform is going to enable them to conduct business and safer and more efficient transportation. They will make use of it. As long as they believe their IP is protected in the process, then they will *collaborate*” Custodian H

Actors would have to be incentivised to collaborate, cooperate and coordinate to advantage choices that promote intermodal practices. The benefits of such interaction would have to be made clear to all actors to be effective.

“For actors to *collaborate* - make *the benefits clear* to them”. SysIntervene I

4.2.5.4 Collaboration principles

Effective public-private collaboration or competitive private-private collaboration may require the development of a framework of collaboration principles that foster collaborative relationships between a complex system of role players. Some proposals for such enabling principles were made.

While some propose that an inclusive national forum be established to stimulate collaboration amongst intermodal system actors, such a top-down structure would, in reality, probably prove to be broad, unwieldy, cumbersome and slow in taking decisive actions. Rather, specific collaboration points of opportunity or places where synergy or value could be created (also refer to Interfaces that create value) should be identified to benefit or incentivise multiple role-players who have a reason to make it work.

“We need to have a national sit down around the future focus of transport in South Africa and across borders. Necessary to rethink transport around intermodal opportunities.” FG2 Port Terminals actor

“Need coordinated decision-making. Needs to be a good national view that stretches across silos to say this is how we're going to do this”. SysIntervene I

A collaboration network may be initiated by essential actors in an interface community, for example, a port community or an inland container terminal community. The network could share goals and interests towards defining the value that could be created through collaboration (reducing port congestion or increasing container consolidation at a terminal). The collaboration network would be incentivised to develop interventions themselves, for implementation that would create value for that community.

“Durban container terminal. [SAAFF] is in a discussion with senior management around making the systems of road freight more efficient. I want to see a group putting together a comprehensive landside strategy for Durban Port. We're *making a lot of noise* about getting that together - would involve a *comprehensive group of people* who are involved in landside operations – Transnet Port Terminals (TPT), Transnet Freight Rail (TFR), road hauliers and shipping lines, etc. One of the critical elements we need if we're going to improve the performance in Durban port” FG1 Industry Association Actor

An example of collaboration in a specific freight community is reflected in the statement of objectives (Figure 15) of the Durban Port Forum (Transport Forum, 2023) and their specific intent to collaborate towards improving system performance:

OBJECTIVES:

The Durban Port Forum set itself the over-arching goal to improve fluidity in the Durban port system by December 2023.

- **Advocacy** with governance institutions to introduce systems and processes that will **reduce congestion and speed up the throughput** of cargo.
- **Collaboration** with industry bodies to jointly work on **Smart Port City initiatives** such as introducing a **port community system** that will ensure transparency and accurate reporting of data for all port users.
- **Engagement with port users and Transnet** to **reduce truck turnaround times, increase rail utilisation, reduce ship operating times, improve port efficiency, and to ensure that volume targets are achieved by terminal operators.**

Figure 15: Durban Port Forum objectives (Transport Forum, 2023)

The researcher interprets this as a way of extending the collaboration concepts of the Port Forum in a modular fashion, such that several collaboration networks could be built around a shared goal, for example, of creating value at interfaces, (along a corridor between a port and the hinterland container terminal) to benefit all participants by driving value.

*“Whoever is a player in that supply chain, needs to **work together** with other players for the **joint benefit of all** in the supply chain”* SCConsult G

*“And ultimately, all sectors of the economy are using the same logistics system. And if they can see **benefits of that collaboration**, then you know, it **may happen more broadly**”.* SysIntervene I

“Needs to happen not only at government and SOE level. Needs to be truly inclusive. It needs industry. Needs to really have the key actors in there. Transnet centre, Government. But in putting that together, the right people need to be playing the right roles as well. Not have it government-led with the other guys as an add-on- really needs to be driven by industry demand” SysIntervene I

Benefits evidenced by a collaboration network could incentivise other areas to emulate them and extend such collaborative efforts in their area. Original collaboration groups could also seek to identify the benefits and opportunities of collaborating with other collaboration communities to drive interventions. An example of the modularity of evolving and expanding collective networks may be seen in a recent specialist press article (extracts reflected in the box below) about a collective effort, amongst all actors, in data development to integrate planning and track performance of the system at the Port of Cape Town, as has been implemented at the Port of Durban:

Documentary Analysis

"In a bid to enhance operational efficiency and competitiveness, Minister of Finance and Economic Opportunities, Mireille Wenger, joined together with officials from the Department of Economic Development and Tourism (DEDAT) and prominent stakeholders in the port logistics value chain, including Transnet National Ports Authority and Transnet Port Terminals, to unveil a new online data dashboard that was co-funded by DEDAT.

Minister Wenger says: "This dashboard, which measures key indicators such as truck and vessel turnaround times, vessel time at anchorage and at berth, the average size of vessels calling, the time truckers spend in and around the Cape Town Container Terminal area, as well as key data on how weather conditions influence operations, will take us closer towards our *collective goal of improving the performance of the Port of Cape Town*."

This dashboard is an important step towards improving performance at the port by embracing technology, artificial intelligence, and predictive analytics technologies to model the optimal supply and demand for infrastructure. This will make planning, implementation, and management visible in real-time. It will enable stakeholders to better plan and *coordinate*, which is a key requirement for efficient functioning at the port." (Bizcommunity, 2023).

Collective efforts, through collaboration and coordination, could start the process of building a network and would require a systemic view of the corridor. This means the ability to see the bigger picture and how the actors in the parts of the system could complement one another for the good of the system and the country.

Other enabling (or hygiene) factors to stimulate the development of collaboration networks would include goal congruence, clear communication, shared platforms, trust, transparency and willingness of actors to engage and to take shared responsibility for creating value for the corridor or precinct.

"It takes two to tango. If Transnet is prepared to negotiate and play fair, the private sector will bend over backwards." SCConsult G

"Instead of trying to *collaborate* and building up trust together, there's a bashing exercise going on. Which doesn't help us come to working together for a solution that, with many role players all needing to do their parts well and communicate what they're doing. And at the moment, we have this sort of intentional bashing that's happening with Transnet by many role players. And I fail to see how that's moving us any closer towards any of the solutions" FG2 Dry Port Actor

"Communication is most important because, on different levels, people are working in silos. Developing and doing good work. But it's not integrated and they're duplicating stuff that other people are doing as well and they're wasting time and money. There

should be a proper platform *for integration* where people know what the other people are doing” Custodian H

The biggest challenge to building interactive approaches may be the capacity and initiative of active role-players (or actors) to kickstart the process and to lobby, campaign and garner support that will catalyse business opportunities and incentivise collaboration.

“Political will is definitely a big factor. To get the changes to start it's got to be political will. To get the parties to talk together, *to collaborate meaningfully*. And I think industry would be willing if there's a business opportunity. But I think Transnet needs to be open to options to address the challenges. It's just going to be that political will to make a change or make the necessary changes that are required on different corridors in different regions.” TruckTech P

The unsustainability of the current system and its deep challenges with the potential for resultant chaos may even be the trigger needed to mobilise actors to unite and collaborate, to change behaviour in the system.

“We've been using band-aids instead of surgery, but our supply chain needs surgery. And needs *active role players* in order to roll up their sleeves, put their vested interest aside and start working together to start moving cargo in the country.” FG2 Road Industry Actor

Would collaborative models and approaches be sufficient to provide the impetus required to address a dysfunctional system? Systemic approaches also need to be considered.

4.2.6 A better system

The final theme generated through the analysis of the data is labelled “A better system” as a core imperative for the advancement of freight intermodalism in South Africa. This requires reflection on the sub-themes “Goals at odds”, “Systems outcomes chain” and “Shifting mindsets for change” as sub-themes.

4.2.6.1 Goals at odds

Intermodalism is an integrated system and by its very nature, requires a good degree of goal congruence amongst system actors to achieve the objectives of the system, for the benefit of customers, cargo owners, investors, operator actors and the country.

“Road transport goals vs cargo owner vs the rail operator, terminal operators, the Dry Port operators...All of those should have a congruent goal - if there's no congruency in their goals, then it's not going to work”. Logistics I

While the stated “common” objectives of the freight intermodal system centre around efficient, cost-effective and seamless transport solutions driving competitiveness, the self-

reinforcing systemic challenges of the current system (refer to the theme “So much at stake”) are variously described as being at the point of collapse, chaotic and do not indicate a purposeful system that is integrated, self-correcting or sustainable.

There is no doubt that the country and the freight industry in South Africa face enormous challenges. Over the past few years alone (early 2020 to the end of 2022), the freight industry has had to work at overcoming seemingly insurmountable disruptions of logistics and supply chain operations. The Covid-19 pandemic (from March 2020 to early 2022) and consequent severe levels of lock downs restricted transport and logistics operations (Luke, 2020).

Rioting and looting of businesses in Gauteng and KwaZulu Natal disrupted operations and movement of cargo (9-18 July 2021) (Presidency, 2021). Shortly thereafter, Transnet was the victim of a cyber-attack which severely disrupted operations at port container terminals (22 July 2021) (Booth, 2021).

Severe flooding in KwaZulu Natal (April and May 2022) caused serious damage to rail, port and road infrastructure and equipment severely impacting transport operations on the critical N3 / Natal Corridor (Freight News, 2022). Incidents of truck driver protests and blockades on the N3 (Govender, 2022) destroyed vehicles and prevented the flow of traffic (June 2022). These are just some of the events that have resulted in reduced productivity, efficiency, competitiveness and increased costs for transport and logistics supply chains.

While many share the notion of common goals for the macro economy and the country, the means to achieve goals are constrained by actors’ interests or individual goals (notably profit) within that system, which leads to sub-optimal overall system functioning. Shared common goals are not currently seen as a driver that unites actors to collaborate and act collectively.

“...people are operating pretty much in a vacuum and doing what they are going to do, to the best of their ability. To the best of their own motivation, which is obviously profit, which is a good thing, but it's not necessarily going to result in those highly effective supply chains.” Container M

“The goals of the system are larger than the goals of the independent parts. And even when you're dealing with a company like Transnet. You might have to provide a sub-optimal.... have a Loss Leader on one particular aspect in order to get the goals for the greater good to thrive. You've got to look at what it is that makes, or that brings about, the best for the collective. The greater good. There are certain services that you've got to provide, as a country, in order for your country to operate effectively” SysAca N

“We need to fix the *collaboration* between all these systems. And as South Africans, we’ve never done that. One of the things that we have got to be very careful about is, we’ve got to be aware of vested interests masquerading as moral principles. People

banging their chests and saying mine's the best, mine's the best. None of that fixes the system". FG2 Logistics Actor

Getting freight intermodalism to work effectively as a system, may require actors to make some sacrifices or trade-offs. The pursuit of own individual firm, or own community goals and interests, is perpetuating challenges and hindering the achievement of so-called common goals and objectives (particularly emphasised by focus group participants). These own or vested interests lead to sub-optimal performance and destroy rather than create value. Agreement on system goals and levels of performance could give rise to systemic properties (or even emergent properties) for example, improved service and total lower cost solutions.

"Have to join forces in the real sense of the word to make that change. We should maximise for the value chain itself by generating volumes, *but each player should not take too much for themselves*. Then when you come to the end, how do we make money out of that? If we have this real integration, *the integrated system must guarantee a lower cost than the individual parts put together*. And it might seem like a ridiculous statement. But if we get that right and we have the entire system running at a lower cost, then we can churn out more and then maximise revenue for all parties mutually along those lines, otherwise independent costs *and looking after ourselves in each community* of that supply chain just will not give us the maximum efficiency and revenues". FG1 Intermodal Actor

"For the system to work, has to be a South African national effort. Say we are all going to *sacrifice a little bit; all going to give up a little bit* of the turf which we want to control and we want to be right." FG2 Logistics Actor

Instead of working together for the good of the system (and the country), actors are operating individually and not systemically. While many may operate in their own interest, it has to be acknowledged, that most do not have the resources, the capacity or even the jurisdiction to fix the entire system.

"People start developing their own infrastructure to buffer the inefficiencies of not having sight of predictability from Transnet's side. People will keep doing workarounds with the view of their own supply chain and their own perspective But *they will not take a look at the systemic system... But not trying to fix all systems because they don't have the resources for that*." SysIntervene I

The lack of capacity to address the system as a whole may require smaller groups, (potentially in a corridor or a specific interfacing community), combining their efforts in their local area and building up small areas of improvement that serve as examples of modular, incremental improvement that could gain momentum for additional efforts in the network. A National Master Plan that guides efforts is required to guard against system fragmentation.

"Have the big plan of where it needs to go, but then start working very local and *incremental and very modular*. To *improve things bit by bit*, because if you're working

within resource constraints as severely as we are, I don't think you really have a choice"
SysIntervene I

The focus on individual versus system or country interests was provided by an actor by way of an analogy. He also emphasised the notion of all actors in the system (customers, suppliers, operators, etc.) benefiting when greater goals of supply chains or the economy are adopted to unite actors:

"There is an active interest by players to *protect their own vested interests* because it means that they can get their cargo in eight hours and everyone else can get in line. However, there's no drive to say let's all get our cargo in three hours. Surely that's a better approach then, as *we all start benefiting*. How do we go about this? Well guys very simply, it's time to start putting our *self-interests aside* and start doing what's *best for the country* and *best for the supply chain* because we've seen what putting self-interests ahead of all other goals does to the supply chain and SA" FG2 Dry Port Actor

The ideal would thus be the collective pursuit of system-level performance.

"And the system is more than the sum of its parts, isn't it? Such a rich definition that includes people, hardware, software, processes, documentation, policies, that's all things to achieve system-level results. System level results in performance" SysAca N

4.2.6.2 System outcomes chain

The discussion of greater system goals (where the system processes produce efficient and effective freight intermodal solutions, and that the system is greater than the sum of its parts), resulted in goals statements in the form of structures and actor inputs to the process, short- or long-term goals and interventions and the impact that they would ultimately have. A systems intervention expert proposed that the bigger system picture be viewed in terms of a systemic outcomes chain:

"Given the economy that we are at, needs to be cost-effective. If we get that right, there will be a positive economic impact. Look at the *outcomes chain* – start with *inputs*, are we putting in the investment that we need; is it targeted at the input level? Then at the *output level*. Are we improving efficiencies and reducing costs? And then at the *outcomes* level - are we moving freight better? And at the *Impact* level is our economic performance better? Is logistics support of economic performance improving?"
SysIntervene I

Two other SMEs and a focus group actor also described the intermodal system goals along similar lines of linked concepts and their effects or consequences. (The statements that served as key inputs to this systemic view are contained in Annexure H). These views have allowed the researcher to develop a system outcome chain diagram which is illustrated in figure 16.

Freight Intermodal System Outcomes Chain

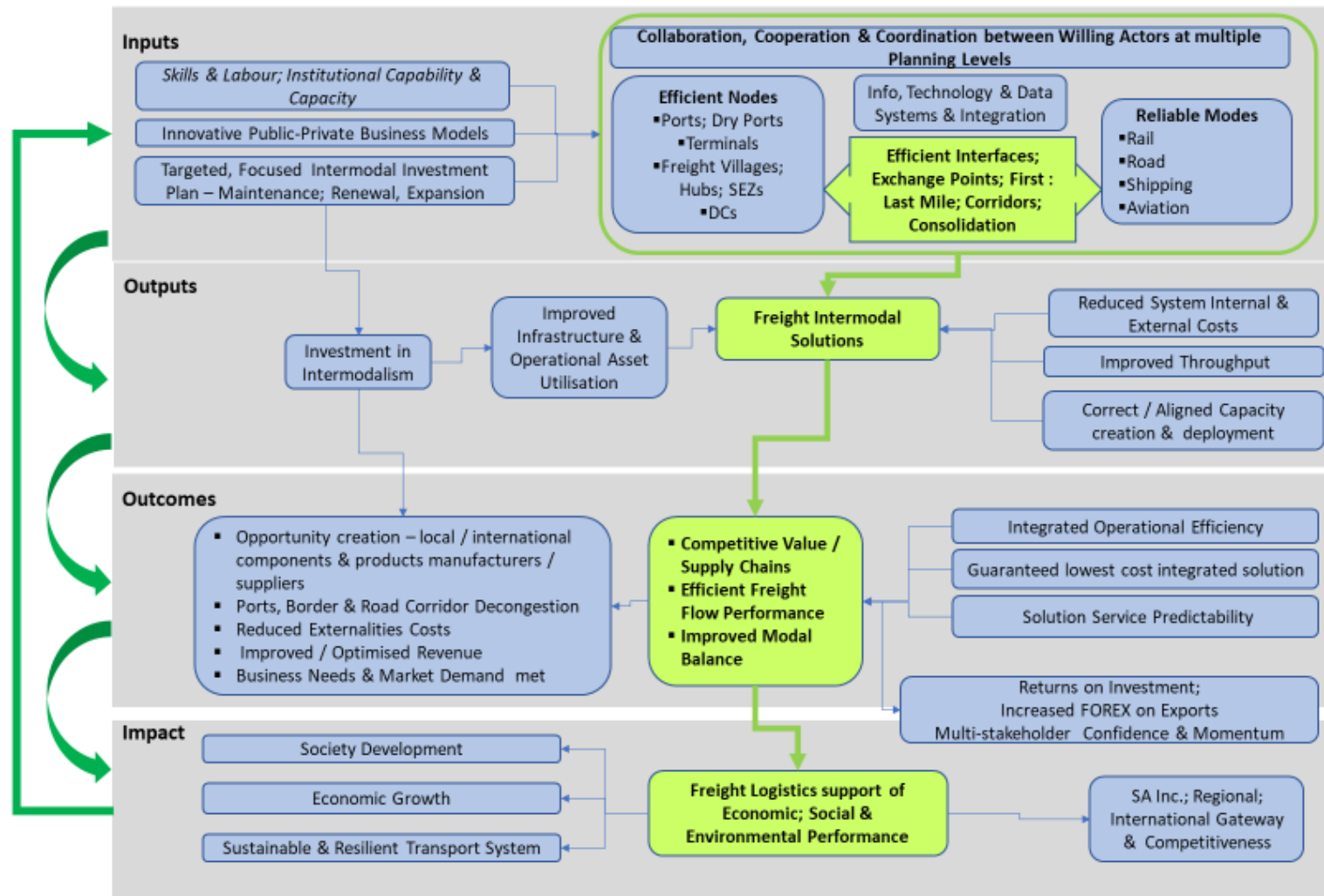


Figure 16:Freight intermodal system outcomes chain (Researcher construction)

The diagram corresponds, to a degree, to descriptions of the system “As it should be” and improves understanding of a “bigger picture”. Such a view could serve as a foundation for improved goal congruence amongst actors. The diagram does not contain all necessary constructs (e.g. enablers, benefits, paradigms, system performance measures), but does provide input for the development of a conceptual model for advancing South Africa’s freight intermodal system. Viewing the system in terms of greater macro system outcomes could contribute to alignment or a collective system perspective. This mindset could represent a point of leverage to enable the system and begin a movement for change, amongst all actors.

4.2.6.3 Shifting mindsets for change

Statements made, particularly by actors active in the system, indicate that there are signs of a shift in mindset from individual to greater system goals. Many participants have expressed the need to see the “bigger picture” to improve system functioning or to grow the pie so that all benefit from a greater slice.

“That's what the end goal is and until we've got that *broader picture* in place, ... it's not necessarily going to result in those highly effective supply chains...” Container M

“Number one is to *understand freight as a system* in our country, and *understand the bigger picture*.” SysAca N

Integration between actors in the system cannot be forced (for example, by regulation or legislation. SMEs cite examples of actors who develop ways to get around regulations). A change in mindset would require actors to overcome barriers and boundaries in the interests of the system outcomes and impacts. Change must be driven by a real desire and intent to collectively improve the state of the system for the country.

“I'll fight to the death to see how Sandra's work gets accepted, not just at DoT, but DPE. In the road freight industry, in the ports industry, this is the whole thing about systems. It really is *crossing boundaries*, really getting outside of your comfort zone and really getting passionate about *figuring out how do we make it all better*”. FG2 Logistics Actor.

A patriotic and collective mindset is critical for South Africa at its current level of national challenges. This would require the exploration of innovative approaches that would truly change behaviours, not only by system actors but also by society and those “interest groups” who routinely conduct unlawful actions that disrupt the system and detract from goal achievement.

“Ultimately to get the logistics system to work - Got to break through *political barriers, personal barriers, commercial barriers*. And to really get collaboration; create a little bit

of discomfort through the whole system...In our world, we're *trying to optimise every subsystem at the expense of the whole system.*" FG2 Logistics Actor

Findings contained in themes "So much at stake" and "Capability and capacity" highlight the systemic challenges that require actors to consider both the nature and extent of the change needed and to develop appropriate responses that will drive change (and overcome resistance to change). Interventions will have to be tailored to appropriately assess, pace and address systemic changes.

"What do we need to challenge there to make things not work so sub-optimally? Is it a *big change or is it a small change?* Is it a twinge?" SysAca N

"Human tragedy of truckers being stuck in a border queue 20km long. Congested ports and ports deterioration. People jump up and down for a while but *nothing happens to change it...*The economy is suffering; our exports are down...people have seen this - whether it's politicians, executives But *it's just not changing*" Logistics I

"There's no Big Bang, quick fix, magic solution, magic wand, political intervention that we can get before the elections happen in 2024. It's every little bit of unsexy, unpleasant, hard work. *Hard work that we need to switch on all at the same time*". FG2 Logistics Actor.

An actor highlighted the major challenge of mindset change in highlighting the popular tendency to pursue solutions that are viewed as "quick fix" interventions or are targeted at the level of visible events.

"But what we love doing is the great *programmes, plans and projects and press releases and fantastic events.* Somebody spoke about political will, that's a workshop on its own. That doesn't get the system to get better" FG2 Logistics Actor.

Such interventions are often those that generate enthusiasm but are usually expensive and are often systemically sub-optimal. This focus group actor went on to reference Donella Meadows (Meadows, 2023) and systems thinking approaches regarding interventions that are usually more inexpensive, and difficult to achieve, but have a much greater systemic impact:

"The *really hard stuff; the stuff that makes the system work...*Those are the hard things; those are the difficult conversations. Go back to the Donella Meadows model - those paradigm shifts and transcendents. Those are the hardest things to achieve. They're the cheapest, but they're the most effective...". FG2 Logistics Actor

The Meadows reference that the actor cites (also noted in Chapter 2: Literature Review) refers to a model for identifying the points in the system that may be leveraged to bring about change. She proposed 12 places to intervene in a system as points of leverage with varying degrees of effectiveness which the actor emphasises as the potential of addressing and transcending paradigms to leverage change and make the system work.

Changing mindsets appear to be imperative for advancing freight intermodalism in the country and could be very effective in mobilising a collective approach to identify the key types of leverage that would make a real difference in the country.

“...actual knowledge management, making sure that you manage business benefits, manage freight transportation or freight intermodalism benefits. And ultimately what you do then is you end up in a situation where things start to improve gradually; and then start to accelerate because suddenly you get traction.” SysAca N

South Africa requires leaders and thinkers who embrace systems thinking concepts. Individuals skilled in such approaches could be powerful campaigners in developing actor alignment around systems thinking methodologies and paradigms.

“...But it's not doubling of the N3 versus the rail system that needs to be fixed. It's all an end game. That's the thing about systems that really, just always comes back to haunt me, is when you go with it's *this or that*. That's not a systems conversation. *The systems conversation* is this *and* that *and* that *and* that *and* that. And the magic is to orchestrate all of those things to happen as close to possible at the same time so that you can systemically move the system forward notch by notch by notch”. FG2 Logistics Actor

It was also suggested that there should be more enablement of actors in the system. A key aspect is a mindset change to the concept of a systems approach, with multiple human actors' and stakeholders' readiness and capabilities, to change behaviour and move away from the notion of merely having a grand plan and trying to take control of a very dynamic and competitive system to serve the market.

“*Agility and responsiveness* to changing industry demands both local, regional and international” FG1 Logistics Actor

“Demand is there. So, what's going to *change the behaviour* and some of it could simply be that we need to get people to have skin in the game in rail. Which is in the private sector getting involved” Container M

“The *unintended consequences* - You've got a lot of *unpredictability in the system* when there are human actors in it. You know which is part of the reason why you *need to let things evolve* rather than over-plan it.” SysIntervene I

“...Comes back to the concept of *readiness, modularity, enabling systemic change* without actually *taking control* of it” SysIntervene I

There are many dynamics at play in the South African context and multiple perceptions and views are held across many disciplines. A systems expert stressed the importance of fully understanding the system (for example using the iceberg model) before attempting to intervene and trying to change it:

“Take the iceberg model, classically used within systems thinking. Look at events above the water line, then look at the patterns and trends. What are the structures that

influence the patterns and trends and how those structures, how the different parts fit together and then under the mental model, which is our beliefs, our values, our assumptions that underpin all of that? Those things that explain how everything comes together. You start to apply that from a systems perspective...” SysAca N

The researcher has developed an “Iceberg Model” (also known as the four levels of thinking) visual of the system of interest (Figure 17). The visual representation attempts to provide a big-picture way of understanding the system and various levels of where its problems are situated. Maani (2013) also notes that the value of using this model lies in identifying deeper-level obstructions and issues (places to intervene) and finding creative ways to leverage those powerful points, all the while considering the unintended or even adverse consequences that they may give effect to. It is, however, more typical of society and organisations to focus actions on events they can see, often leading to quick-fix approaches over the short term.

- i. The events depicted are some of the very visible incidents or happenings that have occurred in the past three years. People typically react to these more visible events, often with short-term solutions.
- ii. The patterns and trends (denoted by arrow direction) were raised by research participants and were largely discussed under the theme “So much at stake”. Trends also reflect many of the “early warnings” of behaviours and actions that have intensified over the past three decades (and that have gone unheeded). Patterns initially emerged slowly and have accelerated rapidly (especially since 2020). Stakeholders typically adapt to such trends over time, without effectively addressing them, thus perpetuating sub-optimal performance.
- iii. Structures influencing the system were largely discussed within the themes “Capacity and capability” and “A national view”. The visual highlights deep underlying structural issues in terms of weaknesses in plan and policy development and implementation, the lack of clear roles, timed programmes and capable, capacitated institutions for transforming from road-only to intermodal solutions. Structural weaknesses also reflect how capable and dominant players have generated responses and built competitive strategies and positioning tactics to harness growth opportunities presented by a structurally distorted system. Addressing systemic challenges requires more effective ways of generating interventions that adjust structural issues to bring about change.



Figure 17: Freight Intermodal System Iceberg (Researcher construction)

- iv. In terms of mental models, extracts reflect beliefs in the ineptness of Government and SOCs and that the private sector would offer superior solutions and performance. There is, however, a strong mindset reflected in the need to work together, as South Africans, to improve the overall freight intermodal system as encapsulated by the theme “A better system”. It is the latter aspects of (collective) values, beliefs and mindsets that may bring about real change through actors working together to create innovative interventions that could change behaviours.

4.3 Conclusion

Every effort has been made by the researcher to follow a rigorous and consistent process in the thematic analysis of a relatively large qualitative data set (transcripts of more than twelve hours of detailed interviews and focus group discussions), where actors shared explicit and deep perspectives of their view of the system. The data was read multiple times, coded according to inductive and deductive codes, and categorised and reviewed iteratively. All recordings, transcriptions, notes and ideas have been retained with a view to others being able to assure the credibility and trustworthiness of the analysis.

Initial categories of codes were repeatedly refined and revised to synthesise patterns across the data and to generate themes. Findings presented by way of the six themes (So much at stake, Need capability and capacity, A National roadmap, Seeking solutions, A CCC network and A better system) build a story of findings derived from the data. Systems thinking tools were used to deepen analysis, interpret and build an understanding of the system and its imperatives for advancement. Themes were presented to reflect the integrated nature of imperatives (encompassing a fusion of technology, innovation and people), that experts and system actors deem to be important to the functioning and advancement of South Africa’s freight intermodal system.

The themes provide many of the concepts for building a framework that aims to address the research aims, objectives and questions. The findings will be discussed in the next chapter in the context of literature and models to build a possible view of what may really be implemented in South Africa’s situation.

5. CHAPTER 5

DISCUSSION OF THE FINDINGS

5.1 Introduction

The purpose of this chapter is to interpret and evaluate the findings, presented and described in the preceding chapter. Findings are discussed in the context of the stated aim, objectives and research questions as well as the literature reviewed.

The research problem is founded in the view that South Africa has an inefficient and immature freight intermodal system. The researcher believes that the adoption and application of systems thinking approaches, principles or theories could contribute to practical application for overall system performance improvement. The study aimed to determine the constructs (for example, innovation, technologies, relationships, interactions and mechanisms) that could be applied by system actors to advance freight intermodalism in the country and achieve macro-level outcomes.

Research questions, more specifically, sought to determine:

- i. Why freight intermodalism in South Africa has lagged in development and implementation and how a systems thinking approach, if applied collectively by system actors, could develop and transform freight intermodalism in the country towards the attainment of macro level system outcomes?
- ii. Why the pursuit of common or collective (vs individualistic) objectives may “unite” the actors and lead to intermodal system optimisation?
- iii. What factors determine with whom system actors will associate, build relationships and co-create to better the performance, functioning and macro-level outcomes in the intermodal system?
- iv. Why it is important to identify the prerequisite hard and soft constructs and system interdependencies that promote (or constrain) cooperation between actors towards the advancement of intermodal solutions and outcomes?

- v. How the identified constructs for freight intermodalism could be systemically arranged to form a conceptual framework for application in advancing intermodalism?

The chapter reflects on the appropriateness of applying a systems thinking lens to the research problem and questions. The discussion of findings also considers the effectiveness of the research design and methodology in exploring and understanding the perceptions of research participants, especially participants who are actors in South Africa's freight system.

The triangulation of themes with data sources, methods and theory served to verify the findings as trustworthy, or to refute them and present alternative findings or directions for further research (Gibson & O'Connor, 2017).

It is envisaged that the research and analysis may contribute to the body of knowledge about the value of applying a systems thinking approach to intermodal freight systems in South Africa, and the contribution of collective common objectives and multi-actor approaches for enhancing intermodal system performance. As indicated by the research title "The imperatives for the advancement of freight intermodalism in South Africa: A systems thinking approach" the research and analysis also aimed to:

- i. identify appropriate imperatives and interventions for change and improvement in the system; and
- ii. aid in the development of a proposed conceptual framework that could be applied in the real world freight industry of South Africa to realise system level performance outcomes.

From a systemic viewpoint, it is critical to attempt to determine how proposed interventions may impact each other and the system, by enhancing or constraining, enlarging or diminishing their effects and thus altering the outcome or changes that they aim to bring about. If applied by systems actors to build consensus and encourage a meeting of minds, such an approach could drive the development, imperatives and implementation of interventions, that may systemically advance the development of South Africa's freight intermodal system.

This chapter provides an overview of triangulation approaches used to substantiate findings. The key findings, presented as six themes (So much at stake, Capability and capacity, A National roadmap, Seeking solutions, A CCC network and A better system) are elaborated

upon and interpreted. A conceptual framework is then proposed, and an overall conclusion is provided.

5.2 Data triangulation

Findings were derived from the qualitative multi-methods data collection research methodology that resulted in several datasets being analysed and interpreted (Noble & Heale, 2019, p. 67). The researcher's analysis and interpretation of the datasets (through coding, categorisation and themes generation) resulted in the origination of six themes (with sub-themes) that may contribute to a richer understanding of the issues surrounding the phenomenon of freight intermodalism, and the identification of imperatives for application in South Africa's freight intermodal system.

A combination of triangulation approaches (methods, data source and theory triangulation) was used (Moon, 2019) in the endeavour to verify, strengthen and confirm research findings and the correctness of the themes, towards enhancing credibility and trustworthiness (Noble & Heale, 2019). Triangulation was also used to guard against subjectivity in the interpretation of data in this qualitative study (Jonsen & Jehn, 2009).

The triangulation methods and their relevance to the study are discussed. Figure 18 provides a summary of the themes and reflects the triangulation approaches. The findings are then interpreted and contribute to building a strategic framework that identifies possible interventions for freight intermodal system performance improvement and implementation to realise goals and purposes.

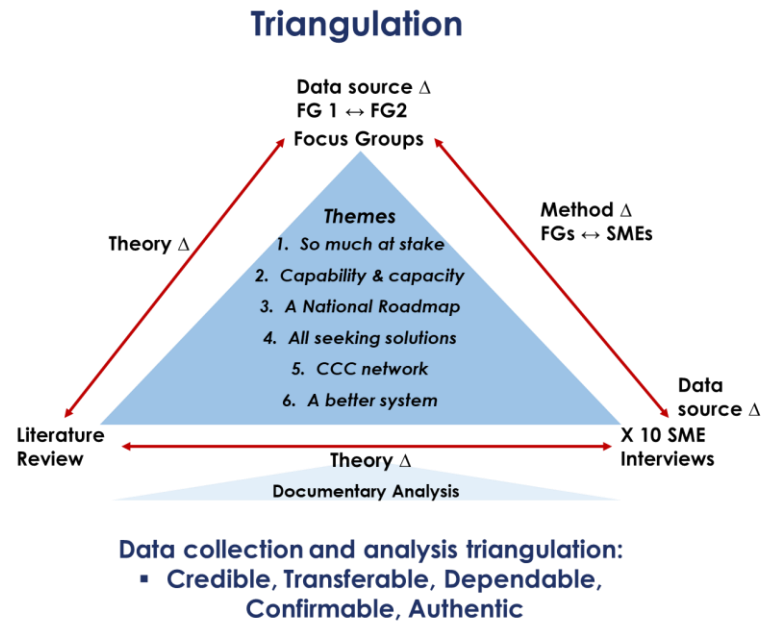


Figure 18: Themes and triangulation approaches (Researcher construction)

5.2.1 Methods Triangulation

The three different research methods that were used to collect data were documentary analysis, SME interviews and focus groups. Each method had a very specific purpose in the *sequential* process of the research. Despite the difference in the purpose of the three research methods, there was significant congruence between all three. This congruence enabled the researcher to develop the six themes using combined data collected from SME interviews and focus groups:

5.2.1.1 Documental analysis

The documental analysis was primarily used to develop an understanding of the system in South Africa, its sub-systems, actors, boundaries and interrelationships between system elements and actors. This review was also used to enable the researcher to construct a graphical view of the system of interest and its boundaries. Ongoing documental analysis of policies gazetted, specialist media articles, conference presentations and press releases, throughout the research study, were also used to track and gain insights into freight and intermodal developments. South Africa's freight system is dynamic and over the past three to five years has reflected many changes and disruptions. The current inefficient, immature and even dysfunctional state of the freight system suggests that novel interventions (unique

to the South African situation) are required. The dynamic nature of the system is reflected in:

- i. transport infrastructure deterioration (and especially rail infrastructure), during and following the Covid-19 pandemic and lockdown interventions, that has made system inefficiencies and imbalances increasingly visible;
- ii. evolving policy changes (new policies proposed and gazetted or promulgated) with commensurate expectations for changes in actor roles, processes and system structures;
- iii. the business context of Government and SOC operational, leadership, financial and reputational challenges that negatively impact the freight industry and instigate calls for freight industry reform and intermodal development;
- iv. relationship developments between system actors such as concession awards, partnering, alliances and acquisitions that are evolving system structure and dynamics and require new actor roles, rules and regulations;
- v. changes to services offered, for example, service discontinuation or new routes or services introduced, with resulting shifts in freight flows and changing roles of gateway ports;
- vi. supply chain shocks following external events such as the Covid-19 pandemic and ensuing levels of lockdown, social unrest, cyber-attacks, and climate effects of flooding disrupting transport and logistics operations and undermining the resilience of supply chains;
- vii. prevalence of socio-economic trends such as rising inequality, poverty, unemployment and criminal challenges contributing to sub-optimal system performance as well as to the road, port and especially rail infrastructure deterioration.

Documentary analysis enabled the tracking of international intermodal or logistics developments to identify trends that could be relevant to, or impact South Africa (e.g. Chinese port Covid lockdown closures affecting the arrival of ships at SA ports, shortages of containers due to blockages in global supply chains).

The analysis of the available documents contributed to a better understanding of the constantly evolving freight intermodal system (to formulate the current mess) and to obtain perspectives of the system dynamics such as legacy developments and patterns or “march of events”, “behavioural patterns” and “drivers of change” (The Da Vinci Institute, 2019, p. 29).

Documentary analysis also confirmed the growing extent of actor interactions and the potential for integration, investment and improved resilience that are impacting the structure of the industry, for example:

- i. Strategic acquisitions and alliance partnerships between Southern African companies and global actors (e.g. Imperial Logistics and DP World) in Mozambique to strengthen supply chains and harness opportunities in Sub-Saharan Africa.
- ii. Private Public Partnering (PPP) is evident in the recent announcement of the 25 year joint venture between Transnet (Transnet Port Terminals), who will have majority ownership, and the Manila-based International Container Terminal Services (ICTSI) to develop, operate and grow the Durban container terminal.
- iii. Institutional and legislative reforms are accelerating the introduction of private rail operators who are bidding and positioning to competitively operate trains on the national rail network. This development presents opportunities for improved agricultural and intermodal services, especially on the Joburg-Durban corridor.
- iv. Documentary analysis (and focus group participant inputs), also highlight the progress of commercial agreements (between provincial government, Transnet, investors and car manufacturers) for the development of a high capacity rail corridor to facilitate the export of cars manufactured in Gauteng.
- v. Corridor developments in Sub-Saharan Africa reflect the growing prevalence of partnerships between governments (African as well as US and the EU), international private sector companies, development banks and SOCs. Examples include development of the Lobito corridor (Angola, Zambia and the DRC) and the Trans-Kalahari Corridor (Namibia and Botswana). Such developments aim to increase investments in infrastructure to support regional economic growth. They also provide alternative rail routes and alternative ports’ access thus improving resilience of countries.

Documentary analysis assisted in developing possible industry and macro-level measures of performance, and more importantly, highlighted similarities and differences between research participants' views and documentary sources. For example, research participants highlighted the lack of policy and plans. Analysis of relevant policy developments reflected that these aspects are being developed but possibly lack real and integrated implementation urgency:

- i. Government has developed many policy documents that relate to freight intermodalism and are working on implementation;
- ii. There are aspects of misalignment between various policies which could fragment the intent to implement the policy;
- iii. A freight transport Master Plan is lacking, although there is government commitment to developing one.

5.2.1.2 SME Interviews

The rationale for the SME interviews was to obtain theoretical knowledge, insights, views, opinions and perspectives on the phenomenon of intermodal freight systems. The researcher sought to gain a deeper and transdisciplinary understanding of how experts apply their knowledge specifically to freight intermodalism in the South African context. Furthermore, the SME interviews should be seen as a means of providing context, content and tactical preparation for the focus groups that followed sequentially (Creswell, 2003). Also, refer to Annexure C which highlights some of the SME perceptions that were used as researcher and facilitator background for the focus group preparation.

5.2.1.3 Focus Group discussions

The staging of focus groups was a deliberate endeavour to observe the dynamics between research participants (as freight intermodal system actors) and to derive perceptions of the *lived experience and interactions and inter-relationships of the system actors* who actively operate in South Africa's intermodal system. A key tenet or premise of the study was to uncover the extent to which *a focus group, as a proxy representation of actors in the actual freight intermodal system in South Africa, engages (systemically or otherwise) towards the*

development of collective or common viewpoints, goals, objectives, and possible interventions as proposed by the research questions.

The focus group discussions were deemed to be extremely valuable in that participants engaged actively and spontaneously, as one would expect they would in the system reality. Actors consistently referred to the need to break down barriers and rise above individual vested interests to work towards the goal of improved system functioning in the interests of the country. This attitude reflected a degree of willingness to work together (collectively) to advance the system as proposed by the research question.

SMEs suggested modular approaches such as pilot projects and concept testing, the implementation of which could build momentum and gain traction for subsequent improvements. A focus group actor on the other hand emphasised that a number of interventions would be required and implementation should be paced to occur as simultaneously as possible. .

The three data collection methods thus served very different purposes in the study and did not intend to yield the same results. There were however many areas of convergence (with some disparities) between the data collection methods which are discussed in subsequent sections of this chapter.

5.2.1.4 Data Source Triangulation

To further validate the correctness of the themes generated, data source triangulation was used. Data for this study was collected through multiple methods conducted by the researcher sequentially. Direct sources of data comprised ten SME interviews and two facilitated focus groups. The use of a graphics artist to visually record the focus group discussions in real-time added another primary data source in the form of rich pictures (please refer to Annexure F for the graphic renderings). The credibility of the findings can thus be assessed by comparing or triangulating data sources in various ways:

5.2.1.5 Triangulating between SME data sources

The comparison between the ten SME interviews revealed:

- i. The shared concern about the current state of the intermodal freight system (see the theme “So much at stake”), with descriptions ranging from inefficient to non-existent,

confirms the need to intervene in the system to avoid negative outcomes for South Africa's macro goals for economic growth and development.

- ii. All expressed their dismay at the deterioration of the rail system and the urgency to restore it as a vital element for intermodalism to evolve.
- iii. Intermodalism could enhance the competitiveness and resilience of supply chains, address modal imbalances and contribute to sustainable transport systems in the country.
- iv. The selection of SMEs to include two experts versed in systemic disciplines provided fresh perspectives on the scope of the system, possible systems thinking tools that could be used, and that the research should strive to develop interventions that are unique and appropriate for South Africa (as opposed to first world solutions). The "systems" SMEs also emphasised that interventions should assess actor readiness for change and for adoption of intermodal practices.
- v. SMEs were not overly positive about the *willingness* of system actors to work together and indicated various provisos that would need to be in place to encourage private sector actors to collaborate with the public sector, (SOCs and Government) for example, openness to negotiate, transparency, clear agendas and willingness to give up control.
- vi. Almost all SMEs indicated the need for the private sector to have greater involvement in Transnet businesses.
- vii. SME participants reflected on the role of the Government (as an important system actor) in enabling industry, rather than merely imposing regulation and controls.

5.2.1.6 Triangulating between focus group data sources

Both focus groups were characterised by robust discussion around what is required to drive the system closer to a desired state (As it should be).

The graphics artist independently captured and interpreted the discussion and her visuals (refer to Annexure F) support the researcher's observations and contributed to the development of the themes.

In systems thinking terminology, the visuals represent a "rich picture" (Conte & Davidson, 2020). According to Conte and Davidson (2020), rich pictures may be used as a representation

of a complex system that could serve as an aid in conceptualising the ideas and diverse views of multiple actors with the intention of co-producing interventions or solutions. In the case of the focus group discussions, the rich pictures were used to *record* the discussion or exchanges between participants, and not specifically to use them to co-produce or co-create options, as time did not permit. Many participants did however contact the researcher the day after the focus groups requesting that the graphics be shared. It is possible that actors merely found them interesting or would use them to promote awareness or further the discussion in their environments. Conceivably they could be used, and further extended, to co-create alternative options to the freight intermodal challenge (as proposed by the research question).

There were few material differences between the discussion topics by the two focus groups and the nature of interventions required for improvement, with only subtle differences in emphasis and nuance detected.

- i. Both groups expressed the urgency of addressing freight system challenges in the interests of South Africa. (Theme “So much at stake”).
- ii. Focus Group 1 raised the issue of what should be measured for target-setting to meet market requirements. This aspect was not addressed by Focus Group 2.
- iii. Another key difference was that Focus Group 2 placed significant emphasis on systems theory and systemic principles (it was later verified that two of the focus group 2 participants have a strong preference for systems thinking principles), and the need to rise above own goals and interests for the benefit and good of the system. (Theme “A better system”). This attitude confirmed a core tenet of the research and the essence of the research questions.
- iv. Focus Group 1 specified the need for Government support (or even legislation) to compel actors to collaborate to address intermodalism and build synergies among actors. They proposed a National Forum as a means of facilitating collaboration. Focus Group 2, on the other hand, indicated the need for a “National sit down” but made statements that indicated a more self-directed approach with actors willingly and proactively reaching out and crossing boundaries to help each other. This suggests an

approach with less rigid control and more agile decision-making at the system actor level. (Theme “A CCC network, “A better system”).

- v. Both Focus Groups emphasised the need for a clear Master Plan to guide the country’s freight transport and logistics system. (Themes “A National view” and “Capability and Capacity”).
- vi. Both Focus Groups expressed the need to address interfaces. Focus Group 1 discussed this through the practices of capacity alignment and harnessing synergies. Focus Group 2, on the other hand, made statements emphasising the value to be gained by focusing on the aspects to improve the interfaces between modes and between nodes and modes. (Theme “Seeking solutions: Interfaces driving value”)

5.2.2 Theory triangulation

The findings are further corroborated when triangulated with theory to aid interpretation (Moon, 2019, p. 103). Findings were presented as themes which were described in the preceding chapter. The codes that were used to build the themes were derived by deduction and induction. Annexure E highlights the twelve codes and their definitions that were used to categorise and sort data to generate themes. As was described in Chapter 3, eight constructs were originally derived from the theory through the transdisciplinary literature review (Chapter 2 contains comprehensive descriptions of the constructs elicited from the literature). An additional four codes were induced through the analysis of collected data. The original codes and the induced codes are summarised in Table 8. This analysis reflects the strong degree of convergence between theory and the analysis of collected data, and its interpretation used to build themes.

Table 8: Theory Triangulation - constructs and codes

No.	Derived Construct Codes	Code Refinement
1	System Goal, Purpose, Outcome and Benefits	Goals and Interests
2	Multi-Actor Interrelationships	Collaboration, Coordination, Cooperation
3	Systems Customers	Intermodal versus Modal Choice and Solutions
4	Policy, Politics and Influence	Plans and Policies
5	Nodes, Links and Connections	Interfaces or Touchpoints
6	People, Skills and Capabilities	Institutional capacity and capability
7	Technologies and Innovation	Technologies and Innovation
8	Economy and Environment	Challenges, Barriers and Constraints

No.	Derived Construct Codes	Code Refinement
	Additional Codes induced through analysis	
9	Capacity	
10	Systemic system	Related to systems thinking theoretical framework
11	Costs	
12	Performance	

The constructs derived from theory and enriched by triangulation support the interpretation of findings and contribute to the development of a conceptual framework for the advancement of freight intermodalism.

5.3 Interpretation and discussion of findings

The stated aim of the study was to determine the key constructs, the relative importance of the constructs and the *relationships between the constructs* that should be collectively developed by the industry role-players to build a systemic framework that contributes to the outcomes for advancement of intermodalism in South Africa's freight transport system.

Each of the findings is discussed in the sections that follow. Findings are reflected upon and situated relative to research questions, literature and industry developments.

5.3.1 So Much at Stake

The dire state of the South African freight system, as described by research participants under the theme "so much at stake", is (unfortunately) officially confirmed by documentary analysis. Statements by the government confirming the state of the freight system reaffirm the extent of the systemic challenges, the urgency of the issue, and the concern that system actors reflect regarding the current state of affairs.

It must be noted that the challenging state of the system, which has been described by research participants, refers generally to the country's freight transport and logistics system, and not always directly nor specifically to freight intermodalism. It must, however, be acknowledged that freight intermodalism is indisputably part of the country's (whole) freight transport and logistics system. Furthermore, the development of intermodalism has the potential to address some of the challenges of the system and has huge potential to stimulate a shift of traffic from road to rail, (a shared goal described by policy and by research participants) and to positively impact economic and developmental outcomes.

Freight intermodalism is also part of South Africa's greater trade, political, social, environmental and economic systems and, in this regard, has the propensity to influence these systems, just as it is impacted by the greater country and freight industry systems. This accords with the systems thinking characteristic indicated by Luisi (2016), that the system interacts with, and influences its environment, and is in turn influenced by that environment (Luisi, 2016). As summarised by documentary analysis, efforts by government are a positive indication of the intent to implement structural reforms that could drive intermodal development and its contribution to the economy. These are aspects that were also raised by research participants.

Findings illustrate the vast systemic and complex nature of freight intermodalism in the country, with its multiplicity of actors with varying degrees of influence, ownership, interest, control and decision-making power. The structure of the system (and the interactions between the system parts) indicate that freight intermodalism should be understood holistically and treated as a complex system as it reflects a complex and real-world problem (Crainic *et al.*, 2017), that comprises many parts or sub-systems within the greater system (Flodén, 2009).

A typical characteristic of a system is often stated as its capacity to self-organise or self-regulate (Luisi, 2016; Meadows, 2023). This does not appear to be the case with the freight system in South Africa, which has not been able to self-correct despite early warning signals of sub-optimal and declining overall system performance. The impact of external events (such as the Covid-19 pandemic, flooding, and criminality) accelerated system decline and triggered a much greater awareness of system weaknesses and failures. This reflects a system that is dynamic, constantly changing, unpredictable and could even lead to chaos (Mayrhofer, 2004).

The freight sector has grown, but parts (for example, ports, rail and road network conditions) have deteriorated, prompting actors to effect changes (Meadows, 2023). The system, in its current state, is not sustainable and requires intervention for a more effective impact on the country, the customers and the industry sectors that it serves.

Ideally, freight intermodalism should be evaluated in terms of the competitiveness of a logistics solution or supply chain for the customer. An SME interviewee succinctly highlighted the more integrated notion of intermodalism (as opposed to the competitiveness of modes) as:

“Supply chains compete. Not commodities, not products, not modes” SC Consult G

Instead, most participants tend to evaluate the state of freight intermodal in South Africa in terms of the intense competition between the rail and road modes. This limited interpretation does not address the roles, interfaces and relationships of distribution centres, border posts, ports and terminals that are nodal points of mode transfer, consolidation and distribution. When considering the transfer or interface points (and not merely maritime, road and rail modes) the systemic nature of intermodalism becomes apparent in terms of the integration and collaboration required to create a product or service, at the lowest integrated total cost, much greater than the sum of modes.

The process of freight intermodalism to fulfil a supply chain service or provide a logistics solution (system purpose) must be viewed and understood systemically in terms of how all parts are aligned, integrated and connected by actor activities, technologies and information. A smooth shipping process, for example, with effective offloading of containers at the port, is diminished if, for example, rail cannot evacuate the containers, or if trucks are unable to enter the port to collect containers. This is but one example that reflects the interdependencies of parts of the system, and the inability of a single part to achieve a system-level goal (e.g. lowest costs, efficient intermodal solution) on its own.

The South African freight intermodal system does not merely require fine-tuning to improve or address the freight intermodal sub-system challenges, but rather, radical change is required, to improve the overall freight system functioning in South Africa. Interventions must be implemented by actors to bring about a change in the notion of freight intermodalism as a *means* to contribute to addressing the challenges of the self-reinforcing loop of visible chaos of the current state.

A systems thinking approach is thus deemed to be an appropriate theoretical framework for exploring the research question. A systemic view allows for a deeper understanding of the systemic characteristics, and most critically, the interfaces and interdependencies between them. If actors were to apply the basic principles of systems thinking theory collectively, this approach could lead to actors’ development of innovative interventions, technologies, relationships and interactions. Systems thinking principles that could be applied by actors in a freight intermodal system include:

- i. Developing relationships and interactions as actors who acknowledge that they are inter-dependent upon each other;
- ii. View the system as one that has a specific purpose to achieve outputs and outcomes;
- iii. Pursue the common purpose through clear, shared goals;
- iv. Shared goals and purpose may direct actor behaviour and actions;
- v. Develop systemic interventions for systemic challenges.
- vi. Actor competence, behaviours and actions can balance or reinforce feedback loops and improve system-level performance.

5.3.2 A National roadmap

The finding, a National roadmap, revealed the research participants' concerns about the lack of strategic direction regarding South Africa's position on freight intermodalism, industry regulation and uncertainty of clarity on the roles and functions that actors should fulfil in the dynamic industry system. The lack of clearly understood plans and a vision for the future detract from the concept of intermodalism as a purposeful system, and this could be contributing to poor goal congruence, fragmentation and sub-optimal system performance.

The urgency and need for the study on freight intermodalism were confirmed by both Focus Group and SME participants. This was expressed by their references to the current gross under-performance of the intermodal system as well as the importance of a cost-effective, efficient and competitive freight transport system in the interests of South Africa's economic growth, development and performance, urgently and for the future.

In terms of the research project, data was collected from SMEs during February and March 2022 and focus groups were held in July 2022. This timing context may be relevant to the findings in that several policy developments, relating to transport and freight intermodalism, took place in this time frame (See Figure 20). This context could well have influenced the opinions reflected by research participants.

Both the volume and timing of the publication of bills, plans and policies accord with statements made by SMEs and focus group actors that policy clarity and certainty are urgently required. The documentary analysis of policy environment developments, contained in Chapter 4: Findings, provided an overview of the plan, policy and tender documents (also

illustrated in Figure 19). These developments provide some context to research participants' discussions that gave rise to the theme "A National roadmap".

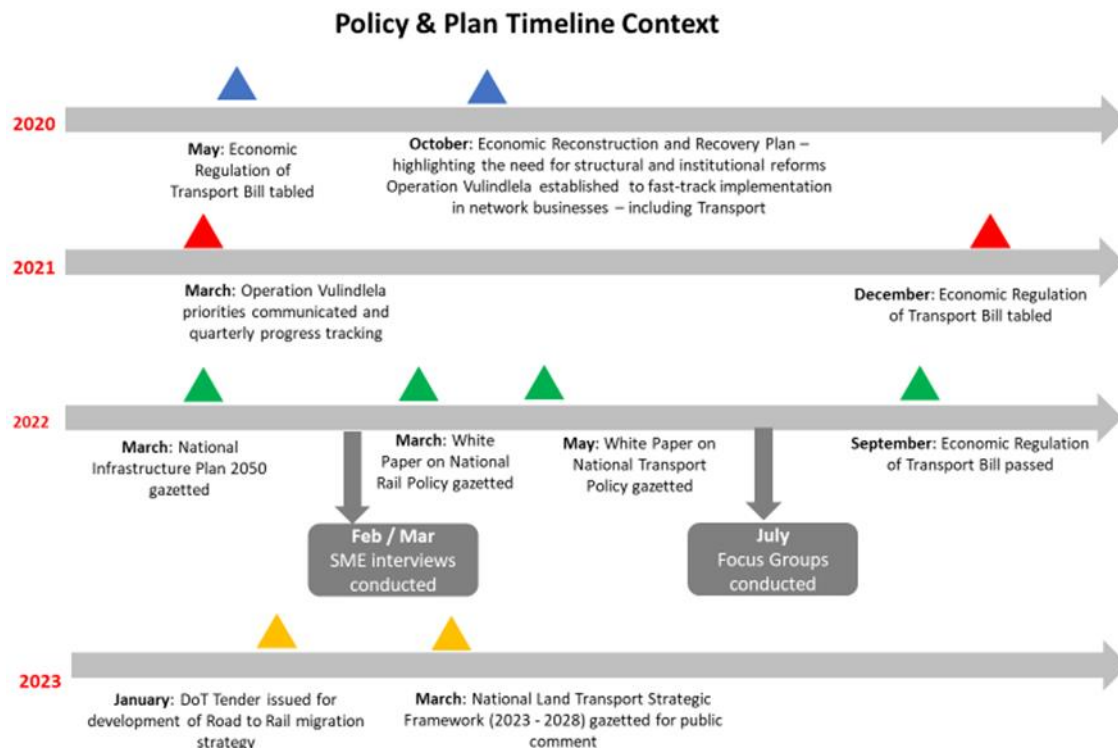


Figure 19: Plan, policy and data collection context

Policies and plans share a common goal of promoting transport sector development as a key contributor to economic growth and the intent to facilitate a shift of freight to rail by:

- i. enabling competition in the rail sector;
- ii. regulating monopolistic behaviour;
- iii. reforming rail and port monopolistic structures;
- iv. encouraging private sector participation in rail and intermodal exchange facilities; and
- v. attracting investment and private sector capital to the rail and ports sectors.

Not all the policy papers, however, provide specific clarity on the intent of the Government to advance freight intermodalism. In most cases, the thrust is placed on the shift of freight from road to rail, as opposed to a shift from road-only solutions to intermodal solutions, which holds potential for environmental externality and cost benefits (Delbart *et al.*, 2021).

Policy extracts support the findings described by the theme "A National roadmap" and reflect some areas of fragmentation or misalignment between policies. This would create both

expectation and uncertainty for actors, and in particular for private sector players who are poised to pursue opportunities that the changing policy landscape envisions. It is also clear (from the policy documents, frameworks and plans) that government will be increasingly reliant on the private sector, to introduce competition to the market, also to assist in financing and to crowd in funding. The greater role of private sector was specifically highlighted by SME participants.

In their evaluation of the literature on intermodal (and synchromodal) transport, Crainic *et al.* (2017: p.25) found that European institutional authorities are very involved in “the improvement of freight distribution within urban areas, particularly by reducing the environmental impact” and the...” direct involvement of the public sector in smart city and city logistics projects.” Such institutional involvement is less evident at local and municipal government institutions in South Africa, where capability and service delivery are not strong. Crainic *et al.* (2017: p.25) also observed, “no significant presence of public authorities as decision-makers... in the national context”.. The discussion of the finding “A National Roadmap”, however, reflects a major role to be played at the national level by government actors, to transform the transport sector in South Africa.

Plans will have to distinguish between interventions for implementation over various planning and time horizons. This planning implementation clarity is not evident nor integrated with policy papers and frameworks (which leads to calls for Master Plans, regulations and implementation structures). The descriptions of the current state of the overall freight system (which is visible to logistics actors, their customers and especially to the public who share roads with freight truck operators and communities that are affected by over-burdened roads) indicate the urgency for fast-paced implementation of interventions in the context of the country’s current challenges. At the same time, plans need to be developed at a long-term strategic level to assure the creation (supply) of infrastructure to meet longer-term demand forecasts. These infrastructure developments must be informed by accurate data and naturally take time to design, fund and build.

The current state (and the desired state) descriptions provide the context of the reality (The Da Vinci Institute, 2020), at this point in South Africa, and that the implementation of interventions is urgently required. The required interventions could well be rather different in ten or twenty years, in as much as the interventions proposed by national agendas (such

as Moving South Africa in 1995) were valid then, (and many proposals still are), but the current urgency, evolving structures and infrastructure deterioration, outdated digital technologies require different paradigms, imperatives and approaches right now. Consensus-building processes and communication of plans for intermodal freight infrastructure would also assist in building a shared view of the system and clarity of the purpose it intends to fulfil now and for future generations.

As the policy and National planning environment indicate, there is a critical urgency to restore the rail sector as a matter of priority. In the case of South Africa, planning horizons should receive immediate focus on interventions that can be implemented now and in short to medium terms. Plans should also include the less costly (and potentially easier to achieve interventions that are enabled by collaboration, coordination and cooperation) operational and tactical planning between actors on aspects such as:

- i. schedule alignment to improve processes at intermodal interfaces (between nodes and modes);
- ii. availability and allocation of resources;
- iii. load consolidation to optimise asset utilisation and reduce costs;
- iv. sharing of information and alerts on performance, disruptions or delays to allow for joint contingency planning and resilient responsiveness.

These shorter-term corrective interventions may contribute to strengthening negative feedback loops, which could in turn play a role in weakening the strong self-reinforcing positive feedback loop (see theme “So much at stake”) that is currently contributing to a sub-optimal or dysfunctional freight intermodal system. The key challenges to be overcome now, in terms of a national view, are strengthening policy alignment, promulgating Acts to legalise policy intent (with appropriate supporting regulation), and building institutional capability and capacity to drive implementation as a matter of urgency. The poor track record in policy implementation requires novel approaches to ensure action.

This analysis of policy prescripts illustrates the increasing tendency of system actors to collaborate to resolve systemic challenges. Greater interaction between public and private sector business and government appear to have a current focus on addressing the damaging consequences, conflicts and freight system impacts on the country and could sometimes even

be interpreted as an “us versus them” paradigm. It is apparent that many systemic challenges have manifested due to a lack of policy implementation, an aspect that must be rectified for the development of the freight system in future. These dynamic and fledgling interactions should strive to build a foundation for future collective approaches that could evolve to win-win paradigms between government and business to co-create innovative interventions and drive timeous implementation of a shared plan. Such an outcome is plausible through integrated and deliberate efforts that endeavour to elevate debates beyond own group interests to those of the country, for the country. As performance improvements become visible over time, changed mindsets may evolve to accelerate future intervention implementation.

The theme “A National roadmap” partially addresses the secondary research question regarding hard and soft constructs that are required to promote cooperation between parties (and that could contribute to the development of a conceptual framework):

- i. National (Master) plans are required to provide a collective and shared view of strategic direction or statement of an “As it should be” state that would define the system's purpose;
- ii. Actors can play a role in influencing the development of plans and policies for a desired future;
- iii. Consensus building in National plans would pave the way for the development of changed industry or system structures and relationships, improved actor role clarity, goal congruence and implementation impetus;
- iv. Strategic, tactical and operational level plans would indicate some of the hard constructs required for system advancement, including transport infrastructure network requirements, intermodal exchange facility development, databases and equipment requirements;
- v. Soft constructs such as political will, system and national interests above own aspirations, capacity to implement and actor cooperation and integration are also imperative.

Concerning the question of why common goals and objectives could unite actors towards system optimisation, clear National plans could provide common objectives that actors may

envision and rally around in pursuit of system-level improvements. There are, however, many other factors that play a role in unification through shared goals. These will be addressed in subsequent sections.

5.3.3 Need capability and capacity

As indicated by the findings “So much at stake” and “A National roadmap”, South Africa is at a critical point in its development as a democracy. The legacy structural and infrastructural challenges of the dynamic freight system must be rectified, and an array of policies must be developed, processed through Cabinet and implemented to start showing evidence of visible changes in the system.

Funding must be raised and contracts entered into, to turn intent into reality. In the budget review document (2023), Government reiterates the need for reforms to improve the capability of the State (Treasury, 2023). The task is massive and daunting and will require people with skills, expertise, stewardship, capacity, capability and accountability for driving the needed transformation. In this current era of South Africa’s development, political ideologies (Barron, 2023) are perceived to outweigh more pragmatic observance of business, transport economics and systems thinking principles. Ways need to be found to leverage and implement interventions to drive real change.

Leveraging change, for the benefit of many, was cited by research participants as a function of political will:

- i. to reflect leadership commitment;
- ii. to implement transport and other policies and unblock bottlenecks;
- iii. to drive policy and process centrally with appropriate devolution of powers and functions to local government or municipal level;
- iv. to take the necessary and difficult decisions for change; and
- v. to drive policy implementation.

Perhaps more apposite, are systems SME and Focus Group 2 Actor views who made interesting comments to the contrary (and are reiterated):

“Somebody spoke about political will, that's a workshop on its own. That doesn't get the system to get better” FG2 Logistics Actor and;

“We always talk about political will and access to funding... those are precursors or hygiene factors that need to be there... are we enabling people to engage with that system?” SysIntervene I

These sentiments raise the issue of both readiness of system actors and the preparedness of Transnet (or government) to relinquish control of dominant parts of the system. Political authorities have the power to change system structures and the rules of the game. It is posited that a more enabling (than controlling) mindset would meet with less resistance and be more successful in transforming the status quo. This could be extremely challenging to achieve within the context of current divergent ideologies and paradigms and would take dramatic events and courageous, agile, committed leadership to effect complex system-wide change in South Africa.

Evidence indicates that policy and plan development is strongly underway (refer to Figure 20) although the real challenge may lie in the institutional capability and capacity to align, integrate and execute plans timeously and with the necessary urgency.

It is also pertinent to note that many of the freight system challenges and inferences about the lack of governance, skills and capability in government and SOCs that were cited by research participants were confirmed in the policy documents (referred to earlier in this section). These policy documents (issued by government) all indicate the current weaknesses in policy implementation because of skills erosion, corruption and inappropriate management appointments.

Policy documents confirm that weaknesses are most prominent at the local municipal government level (and somewhat at the level of provincial structures). Ineptitude at some levels hinders the devolution of accountability from the National Government to areas where freight, logistics and intermodal transport planning and implementation should be driven from, including at mega-municipal and inter-provincial levels. Transport-related policies emphasise human resources and skills development interventions, for example, the establishment of centres of excellence, support from tertiary institutions and even making provision for issuing rare skills visas to attract talent from other countries. The private sector is also called upon to assist in the development of skills required to advance the transport and logistics sector.

Research participants frequently propounded the need for the private sector to support Transnet and the government, not only through the provision of capital and investment in the freight system, but also in the transfer of technical expertise, mega-project management, business skills, commercial acumen, best practices and performance standards. This reflects the interdependence of the actors in the system, not only in processes or structures to advance freight intermodalism but also in the need to share skills, resources and capacity-building efforts. The range of support indicated, reinforces the concept contained in the TIPS™ model (The Da Vinci Institute, 2020) of the interaction of technology, people and innovation at various levels of the system.

As was indicated in the Literature Review (Chapter 2) of this study, whilst many countries globally, experience challenges in finding the right skills and talent for available jobs in the dynamic transport industry, South Africa's case is made critical by the skills shortage. The logistics or supply chain sector requires a range of skills from digital to engineering and finance, in addition to logistics and transport skills and experience. Heyns and Luke (2012) have indicated that not only are formal academic qualifications in short supply in South Africa but also critical skills-sets such as analytical, interpersonal, creative big-picture thinking and problem-solving, cross-functional coordination, communication, customer service and teamwork skills that are vital for effective global, complex supply chain working. More specifically, in South Africa, is a need to develop skill sets in business ethics.

The significant role that the private sector is expected to play, in turn, necessitates the need for the government (and SOCs) to build skills and abilities that are required to initiate and manage the myriad interactions and formal agreements between the parties, for example:

- i. developing new public-private models;
- ii. building relationships with private sector role players;
- iii. collaborating, decision-making and coordinating at multi-actor and stakeholder levels;
- iv. procurement, contracting and contract management for the many facets of support that the private sector could provide to the State and SOCs.

South Africa's capacity and institutional capability challenges may be extreme, but they are not unique to the country. Many developed countries (including the US) (National Academies of Sciences, 2018) are also faced with critical issues in governance, funding, system

performance, transport asset management and institutional and workforce capacity. These issues are likely to become increasingly ubiquitous as the world embraces new technologies and innovations that aim to improve freight and logistics performance but could also bring unintended consequences to the fore.

One of the critical issues relating to intermodalism, cited in terms of governance, is that “Layers of institutional complexity confound the creation of efficient transportation networks and intermodal connections in ways that even the most creative minds struggle to resolve” (National Academies of Sciences, 2018, p. 17). This challenge is made more difficult as responsibility for multi-state (or multi-provincial in South Africa) initiatives is devolved to local levels. The presence of similar issues in South Africa will require significant capacity building now and in the future. Furthermore, the interdependence of various government levels and multiple stakeholders in private and public spheres is increasingly complex “as private trucks, aircraft, barges, and ships use public infrastructure for the movement of ... freight and the growing dependence on private companies to finance, build, manage and maintain public infrastructure” (National Academies of Sciences, 2018, p. 18).

South African policy makes provision for similar institutional structures and trends (devolution of responsibility to provincial and local government and for greater private sector participation) which will require new capabilities in both regulation and governance. Increasing demands are being made on the private sector to finance major infrastructure projects, for example, port expansions to accommodate container mega vessels with improved intermodal capacity. The longer-term sustainability of the private sector to sustain such project financing could mean the need for innovation in the development of very different models for the future.

In their work on sustainability logistics, Brodin *et al.* (2020) also address the capability and capacity of role players to implement solutions. Typically, there is knowledge of policies, plans and requirements for sustainability but there is inadequate alignment between actors in putting the intent into practice. The authors refer to this as the “understanding into action conundrum” or “implementation deficit disorder” (Brodin *et al.*, 2020, p. 599). South Africa’s system role players also reflect a similar conundrum where research participants indicated that Government needs to assure clarity and how to implement their own policies! A Focus

Group 2 actor also emphasised that there are many systemic challenges but a lack of a place to start.

South Africa has a skills challenge, and various stakeholders have identified the imperative to develop skills beyond traditional transportation training. Another critical issue that arises is the transdisciplinary nature of skills required for a technologically and digitally advanced transport system. The transport and intermodal sector workforce of the future “will need higher skill levels in fields such as information technology (IT), as well as diverse disciplinary perspectives, to address increasingly complex social and environmental issues” (National Academies of Sciences, 2018, p. 25).

The development and integration of physical infrastructure are vital for intermodalism to grow and progress. It, however, becomes increasingly apparent that the quality of human managers, and the interactions between system actors at various levels and between private and public sector players, may be the vital ingredients that could make or break freight intermodal advancement. It is hoped that fruitful multi-level interaction could be the start of a virtuous circle for developing both public and private sector capability and capacity to drive transformation, which in turn creates employment and other viable opportunities in the freight sector and an appreciation for the advancement of freight intermodalism.

Capacity and experience in (intermodal) corridor development do exist in the country and must be retained and harnessed in the interests of building viable transport and intermodal corridors in South Africa and promoting intra-regional trade in the Sub-Saharan region. The efforts being made in addressing current imbalances and weaknesses are sure to serve as a fertile training ground for building skills and institutional capacity for a very stimulating future industry.

This discussion confirms some pertinent issues regarding the research study:

- i. The freight intermodal system is transdisciplinary, dynamic, complex, interactive and systemic and must be analysed, managed and developed as such.
- ii. Skills development is imperative for system improvement.
- iii. South Africa’s freight intermodal system requires extensive research and development for future generations whilst remaining focused on implementing many interventions designed to rectify the “current mess” and revitalise the system *now*.

- iv. The urgency of the challenge and the need to accelerate the pace of reforms is emphasised.
- v. Novel approaches and models collectively developed by actors for implementation by these actors are required to accelerate implementation timeously and affordably.

More specifically, the findings contained in this theme strongly address the secondary research question of identifying the soft constructs that constrain or promote actor cooperation needed to advance freight intermodalism.

- i. Skills, competency development, capability and capacity are required, particularly in the public sector (Transnet and government departments), to enable structural reforms, planning and implementation of policies.
- ii. While private sector actors' express willingness to engage and exploit opportunities, critical *interactions and relationships* required between freight intermodal actors are constrained by negative perceptions about the State, its agencies and SOCs and their propensity to relinquish control, engage and negotiate transparently.

Relationships and interactions between human managers are imperative for system level performance and advancement.

5.3.4 Seeking solutions

Research participants indicate several interventions or practices for advancing intermodalism, for example, the development of freight villages, Strategic Economic Zones (SEZs) or freight hubs, information systems to enable information visibility that supports intermodal practices, and the role of intermodalism in supporting the economy (also indicated by policy papers and literature).

All proposed interventions are worthy of consideration. A systems thinking approach to selecting and prioritising interventions, assessing their impact, their capacity to transform and anticipating potential intended and unintended consequences of human behaviour, would be appropriate in addressing the research question of this study that explores intermodal freight as a system. Once again, the systemic fusion of technology, people and innovation is imperative.

Given the urgency of change required (noted by both SMEs and Focus Group actors), it would be preferable to determine the most appropriate actions or interventions that are likely to bring about the greatest change, at least cost and in the shortest time. The challenge is to determine the factors for applying interventions that are strong points of leverage to change the behaviour of actors for the betterment of the system (Koskimaki, 2021).

A focus group actor proposed that the advancement of South Africa's intermodal freight system will require the development and implementation of not just one, but a combination of interventions, and that their implementation is "orchestrated". SMEs on the other hand indicated the need for more modular approaches such as pilot projects and concept testing that, if they prove to be successful, may gain momentum. Small or modular improvements could gradually reflect enhancements that rapidly accelerate and spread with positive consequences that are unthought of now.

In terms of solution efficacy (a sub-theme of "Seeking solutions"), interventions however, sometimes push in the wrong direction. In a developmental country like South Africa, demand growth is forecast and greater volumes of intra-regional freight are projected to be moved between countries on the continent, especially in light of the implementation of the AfCFTA agreements and gateway ports development in countries other than South Africa (Prommel & Arjoonan, 2021).

An obvious response to freight volume growth would be to invest in infrastructure capacity creation which could have the benefit of increased investment and job creation. There are however, other means to provide for expected growth, that could be less costly, but could also create jobs. This is where interaction across the system is required for innovation to flourish, and where coordination could lead to more agile responses being implemented (and potentially less costly interventions in a country with high debt).

South Africa has a legacy transport infrastructure network, serving both freight and passengers, that has evolved since the 1800s. The network comprises all the physical infrastructure elements required to perform and fulfil intermodal tasks: rail and road networks, container ports and equipment, inland rail and port container terminals, road and rail rolling stock, warehouses and distribution centres (DCs). These elements are not always well connected, nor are interfaces between the intermodal elements optimised. The system was not originally designed for intermodalism (nor the rising demand for imported fast-

moving consumer goods (FMCG); beneficiated goods; and growing agricultural fruit exports) but has evolved out of necessity, not necessarily in the most ideal manner. The importance of interactions is confirmed by trends in managing integrated solutions with interdependent variables as opposed to the management of separate solutions with independent variables (Gharajedaghi, 2011).

Research participants' recommendations and proposals (and literature and documentary analysis) for intermodal improvement include various interventions. These are considered in terms of leverage to change the system and whether they are deemed to be imperative in South Africa's context. The section that follows discuss this further.

5.3.4.1 Building buffers that create capacity and system resilience

Theory as well as suggestions made by research participants indicate network improvements that could change the way freight flows and that stabilise the system. This may be done by installing infrastructure that reduces congestion and improves capacity through the creation of buffers that create additional capacity and build supply chain resilience, and in so doing, strengthen negative feedback loops to advance intermodalism. Facilities that create buffers include, for example, the establishment of dry ports located close to sea-ports served by rail shuttles to reduce ports and port precinct congestion, create additional container stacking space and provide facilities for a stable cold chain for fruits and perishable goods.

Documentary analysis mentions the strengthening of on-dock rail capacity at container ports (not specifically highlighted by SMEs or system actors in focus groups), with rail linked to a strategic network of hinterland intermodal terminals. In the US (e.g. Long Beach) and Australia (eg. Melbourne), large projects are currently underway to create on-dock rail capacity to streamline processes for transferring containers between container ships and trains. Such interfacing maritime-landside approaches support reduced costs, requirements for double handling, increased stacking space and shortened dwell times at ports.

Dry port (or on-dock rail) facilities also aid in aligning the capacity of intermodal elements or creating additional (or spare) capacity when very large container ships offload numbers of containers greater than SA ports were designed to handle. Where projects are underway in SA, for example, Cato Ridge Dry Port outside of Durban, greater levels of collaboration, cooperation and coordination (The Da Vinci Institute, 2020, p. 17) (at strategic, tactical and

operational levels) that promote the efficiency of interfaces between modes, are required amongst actors to realise the full benefits that the facility investments were designed to deliver.

Over the past decade, actors in the industry have been innovative in creating buffers to improve supply chain performance, gain market share and guard against rail unreliability and unpredictability. Buffer creation has taken the form of building warehouses or DCs close to ports and inland hubs to hold stock. These DCs are mostly served by long road interlink trucks. This practice is costly but increases reliability and predictability, it does however intensify road congestion and challenges land use.

The practice of de-stuffing containers and re-packing them (referred to as cross-docking) onto interlink trucks (for pallet loading footprint advantages (SC Consult C) and to reduce the cost of transporting empty containers back to ports (FG1 Freight Association Actor)) may also be viewed as capacity creation. While cross-docking practices may improve speed and efficiency, they cannot truly be considered intermodalism as the actual cargo is handled instead of it remaining in a single loading unit from origin to destination. In the literature on intermodal and synchronomodal systems, intermodalism is specifically defined in terms of cargo remaining in a single unit: “combination of at least two modes of transport in a single transport chain, *without a change of container for the goods*, with most of the route travelled by rail, inland waterway or ocean-going vessel and with the shortest possible initial and final journeys by road” (Caris *et al.*, 2013, p. 105).

These buffers do create or increase capacity and better service delivery to customers (benefitting some actors) but have systemic effects that could be detrimental to other system actors, the economy and society. The use of interlink trucks, for example, results in increased numbers of longer road trucks on major road corridors and within the precinct of the port, compounding congestion and other externalities and their associated cost effects. This further embeds the self-reinforcing loops that give rise to overall system inefficiency.

The mushrooming of DCs close to highways (with concomitant investment costs) to store and quickly distribute goods handled by LSPs or wholesalers, served by road-only transport, leads to under-utilisation of existing rail container and automotive terminals infrastructure (Logistics I) which start becoming white elephants that are no longer strategically located to interface efficiently with road modes for intermodal optimisation.

The development of buffer facilities must be diligently planned for the long-term vision, at the level of the system, to avoid costly (and not always necessary) investment funding and land use. In the short to medium term, all actors should be encouraged to optimally utilise infrastructure that already exists before investing in and creating new facilities in a misaligned manner. This may seem a noble and obvious intervention that could contribute to corrections (strengthening negative feedback loops) in the system but is unlikely to have much leverage unless:

- i. actors can see real, short and medium-term benefits of such practices;
- ii. actors are incentivised to act in the interests of much greater system benefits that make sense (applying penalties to comply is likely to be met with resistance);
- iii. purpose and benefits of existing (and properly maintained) infrastructure utilisation are communicated, shared and supported.

5.3.4.2 Intermodalism versus modal choice

Discussions about the dire state of the freight system emphasise the concept of modal choice such as road mode versus rail mode versus intermodalism versus what makes supply chains most cost-efficient and competitive. The researcher has a professional preference towards the choice of the rail mode and, more specifically, for rail-based intermodal solutions (based on her career experience) and which she views as more cost-effective on dense corridors due to lower externalities costs (more efficient fuel usage, reduced environmental impact in terms of harmful emissions, reduced road congestion, road accidents and more optimal land use). In evaluating scenarios for intermodalism (modelling optimal solutions for road and rail networks with optimal numbers and locations of existing and new terminals) Delbart *et al.*, (2021) indicate that “results suggest that expanding the rail network will cost less in the long run” (Delbart *et al.*, 2021, p. 6).

The expectation was that research participants would favour the road mode as being the more reliable and innovative choice for transport or logistics solutions. Instead, both SMEs and focus group participants (including customer actors) indicated the need and desire to migrate greater volumes of suitable freight to rail. This observation was most surprising when expressed by a focus group participant, who is a well-known and influential actor in the road freight industry. In his words:

“There are far too many trucks on the road and we cannot sustain this. The XXX [association name deleted in the interest of actor anonymity] has been pushing for rail to play its part and to grow” Road Freight Actor Focus Group 2

While many advocate that more freight should be transported by rail than by road and that rail should better fulfil its transport task in the economy, not all participants specifically *translated this intent or paradigm* to the development of intermodal solutions or for the inclusion of the rail mode in intermodal solutions. A logistics SME had highlighted the need for significant improvement in the South African railway performance if rail is to be selected for inclusion in solutions.

“It's impossible [for rail] to leverage advantages of cost and safety against the significant disadvantage of the poor performance, poor service, the lack of reliability, predictability and the potential of damage to the cargo...you're not going to find those in the complexity of embarking on intermodal solutions”. Logistics I

Significant volumes should be migrated to rail. Rail inclusion and use would require that absolute priority be given to the restoration and security of the rail infrastructure and operational improvements, with revised models for ownership and accountability for rail infrastructure maintenance.

Deterioration of the rail system set in gradually (effects of the self-reinforcing feedback loop) and then accelerated rapidly, especially during and after the Covid-19 pandemic. Restoration will take many years if funds can be raised. This intervention, while imperative for intermodal development and sustainability, is costly but could leverage significant benefits over time.

The call by Transnet (early 2023) for private operators to apply to operate the Joburg-Durban container corridor was unprecedented (although many have lobbied for such change). It is apparent (Mahlaka, 2023) that there is a private sector appetite to exploit the business opportunity to operate this corridor. Should appetite translate to actual readiness (funding and availability of required skills, assets and resources), this development could have a promising and very significant impact on the container corridor and could address imbalances and bottlenecks (evidenced by reinforcing feedback loops) and potentially advance intermodalism in the country over the medium term. This development may prove to be a powerful leverage point for system change if it can be implemented without undue bureaucratic delays and resistance by interest groups (such as labour).

A discussion of intermodalism versus modal choice and benefits (and the role of rail) would be incomplete without an objective reference to the downsides of intermodalism. The view is that intermodality (including the incorporation of rail for long-distance land freight) is more environmentally friendly and could be cheaper than road-only offerings, especially where externalities costs are allocated and accounted for. Rail would also have to retain its environmental advantage by staying abreast of road innovations (also indicated by SME TruckTech P) to reduce emissions (Dekker, Bloemhof & Mallidis, 2012). Globally railways are innovating through the use of, for example, hydrogen fuel technologies, solar powered locomotives, superior rail wagon designs, digital maintenance technologies and in-cab signalling.

There are other drawbacks (or trade-offs) to be considered in the quest to advance intermodalism. For example, whilst cost is a key deciding factor in choices that are made by shippers, solution alternatives are weighed in terms of service quality, transport time and reliability, in addition to cost. In their work on sustainable (or “Green”) logistics supply chains, Brodin *et al.* (2020) have however, found that whilst many LSPs strive for environmental innovation, many customers (shippers) state that they are environmentally compliant, but when it comes to making procurement choices for transport and logistics services, they reflect less concern for “green” issues (Brodin *et al.*, 2020).

A disadvantage of intermodalism lies in its complexity in that “it requires more coordination than single mode transport” (Dekker *et al.*, 2012, p. 673). Concerning performance criteria, “intermodal transport is slower than unimodal road transport, ... due to trans-shipments and consolidation, and road transport is more flexible than other transport modes, thereby hindering a modal switch” (Delbart *et al.*, 2021, p. 2).

Given these disadvantages, to qualify for selection by customers or shippers, intermodal solutions must use technology, innovation and coordinate activities (particularly the interfaces between them) to improve planning flexibility, reduce delays at transfer points and share real-time information to be able to meet customer requirements. The efficiency of transitions at exchange nodes will prove critical in adding value for shippers and logistics integrators to effect modal switches to lower overall cost solutions. Transparency of all costs may also be a lever for change. The need for efficient interfaces (to enhance service offerings

and create value) was addressed as a sub-theme “Interfaces driving value” and is elaborated upon in the discussion of the finding “A collaboration network”.

5.3.4.3 Develop domestic intermodalism, corridors and freight villages

Freight transport processes are typically described as flows of imported containerised maritime freight from a ship → a port → a port terminal → a hinterland terminal (or from a farm to a terminal and then to the port for export by sea freight). These flows are typically described by research participants with calls to unblock bottlenecks and improve efficiencies of the Natal corridor (rail NatCor or road N3), South Africa’s high-volume container or import-export intermodal route between Johannesburg and the Port of Durban. At least three SMEs and a focus group actor cautioned against the over-expansion of the N3 road corridor as not being a sustainable systemic solution. Other corridor and freight densification interventions that have the propensity to advance intermodalism should be pursued:

- i. The opportunity for the development of domestic Intermodalism (specifically distinguished from import-export or maritime intermodalism) should be pursued to exploit long-distance, high-volume freight traffic being moved *within* South Africa between freight villages or super terminals located at major hubs such as Johannesburg, Durban and Cape Town (Academia J). Hubs could also be created at border towns that serve as gateways to Southern African corridors (e.g. Mbombela or Komatipoort and Musina) to support regional trade with Mozambique and Zimbabwe, and reduce border congestion (FG2 Provincial Government Actor). Bimodal technologies such as swap body containers and RailRunner™ could be used (as opposed to standard maritime containers) to facilitate domestic intermodal solutions.
- ii. While much focus is naturally directed to the challenging Natal Corridor, a major project is underway to develop the South Corridor as an alternative high capacity and potentially dense intermodal and automotive corridor between Gauteng (Tshwane) and the Eastern Cape (Port of Port Elizabeth) to serve the Tshwane SEZ. Such projects should be supported to stimulate exports by the manufacturing sector, catalyse investment and raise foreign earnings. Investment in, and development of terminals or hubs is dependent on the assurance that rail capacity will be provided in this intermodal

process. Rail is preferred by the developers for its potential cost-effectiveness in shipping a high number of cars for export (FG2 Provincial Government Actor).

- iii. The benefits of developing the long (almost 1 400km) Cape Corridor between the Port of Cape Town and Johannesburg could be realised by improving container port efficiencies (and by developing domestic intermodal solutions) linked to strategically located intermodal terminals. Alternative corridor development, improved port efficiency and innovation in domestic intermodal growth (Academia J; FG1 Provincial Government Actor) would all alleviate road congestion and other externality costs.

Corridor and freight village development interventions (with innovative enabling technologies) must be supported and pursued. Mobilising these interventions will take time, will require creative financial models to install and will need innovation in developing integrated operating models. All have the potential to densify corridors and terminals, reduce costs (and weaken the self-reinforcing feedback loops) and support a longer-term design for a sustainable future freight network and intermodal system for South Africa.

Proposed intermodal network infrastructure innovations are however, unlikely to yield benefits in the short to medium term, even where programmes have already been announced or initiated (e.g. High density automotive and intermodal South corridor). Bimodal technology development and partnering proposals between Transnet and LSPs were initiated at least a decade ago but have not yet borne fruit (TruckTech P), not through want of effort made by innovators. Actors in the industry have expressed their frustration at bureaucratic processes and organisational cultures that slow these critically needed efforts and interventions. This undermines the positive systemic effects that they could leverage and achieve.

5.3.4.4 Improve data, measurement and information flows

The review of literature, and SME interviews, consider the extent to which actors in the freight intermodal sector are willing and able to build critical data, embrace and invest in technologies and innovation, not only for their business gain but to benefit the entire system; and whether this aspect is viewed as an imperative for advancement in South Africa.

Focus Group actors and certain SMEs illustrate the imbalances in South Africa's freight intermodal system. Parameters were proposed to inform targets that change practices and

behaviours and measure implementation relative to objectives. Such parameters include modal split targets or ideals, for example, road-rail modal share split or targets more relevant for intermodal freight such as ship-shore loading efficiency; time to convey containers from a port to the hinterland by different intermodal processes or the share of containers that are uplifted and cleared from ports per mode.

While proxy measures for intermodal performance may be gleaned from such indicators as the World Bank Logistics Performance Index, the challenge here is to develop measures for the intermodal system, or more specifically for its interfaces. Martner and Garcia (2015) reflect the trend “towards the integration of functions and system optimization” and further emphasise that the efficiency of parts is important, but secondary to overall system performance. Their work on measuring the efficiency of intermodal corridors in Mexico include, for example,

- i. Port-Ship interfaces: ship waiting to anchor and time at anchor
- ii. Ship-Yard or Terminal interfaces: Container or Crane hours
- iii. Customs-Port interfaces: Container clearance time at port
- iv. Border-Customs: Processing time (Martner & Garcia, 2015).

The value of integration may be more visible if measures (and KPIs) are developed to reflect overall freight intermodal system measures, as opposed to measures for assessing the sum of the performance of the parts. The need to develop a set of performance measures for intermodal freight was confirmed by researchers in the US (Kelle & Jin, 2014). They developed a complex set of calculations for measuring and evaluating intermodal performance and options across modes and nodes. The integrated set of measures encapsulates measures for mobility (transport time and delays), safety (transport safety and security, including crime), environmental stewardship (externalities and sustainability), direct cost efficiency (cost-benefit ratios) and economic growth (local and regional growth and job creation) (Kelle & Jin, 2014).

Such numbers or parameters serve to create awareness and reflect the state of the system (or the pattern of events in the system) and data could be used to set targets for short-term improvements. Such data could also be utilised for capacity alignment across the system and for future capacity planning. Various parameters are visible (through very recent

developments) to most actors at the Ports of Cape Town and Durban, and are growing in usage to integrate efforts that could change behaviours and trends to arrest the self-reinforcing feedback loops.

An SME also proposed, as does the literature (Brodin *et al.*, 2020; Crainic *et al.*, 2017; Meadows, 2023), that externalities costs should be internalised by transport operators and that this could create a change in behaviour through a significant shift of traffic from road to rail, and to improve intermodal processes and supply chain resilience. Such an intervention would, however, likely be met with resistance. If the authorities were to enforce such a “tax”, it would be critical to ensure appropriate information systems to collect data, calculate costs, charge operators accurately and ensure that these “taxes” are directed and allocated to infrastructure or other processes that promote freight and intermodal systems (Academia J). It is also possible that operators would simply pass these costs on to customers, with extremely negative impacts on consumers in South Africa, many of whom are already challenged in terms of poverty and inequality.

Technology and information systems arising from the 4th and 5th industrial revolutions are being developed and introduced (by system actors or communities) to streamline cumbersome processes and improve interfaces that could lead to system resilience and agility and reduce uncertainty in the execution of complex intermodal solutions. Information systems, are however not always available in real-time, shared nor accessible by all role-players, thus their effectiveness for agile decision-making may be diluted.

An emerging and innovative concept in the fields of logistics, intermodalism and supply chain management is that of synchronomodality, defined as “the identification of the most efficient and effective combination of transport modes” (Acero, Saenz & Luzzini, 2021, p. 52). The sophisticated synchronomodal view indicates that “the different agents involved in the supply chain work in an integrated and flexible way that enables them *to dynamically adapt the transport mode they use* based on real-time information from stakeholders, customers and the logistic network” (Acero *et al.*, 2021, p. 52). It is indicated that such systems could be extremely valuable in overcoming some of the inherent drawbacks of intermodalism.

In the development of data and information systems, South African players could potentially fast-track intermodalism by learning from, building upon, and adopting synchronomodal concepts and striving to build information systems that share real-time information amongst

actors. This would reduce delays in feedback and responses and allow actors to take decisive actions appropriate for that moment in time.

Shared information systems are vital for optimising interfaces; and integrating planning, operating and transacting in a cohesive intermodal system. Shared and accessible information systems may be promoted through actor interaction and their implementation coordinated. Joint decisions and recognising the systemic opportunities of information and data sharing may lead to changes in behaviour, innovation and even transformation of the system. Sophisticated real-time information systems do however, add complexity to decision-making where a huge amount of information could be made available in real-time and may even require sophisticated analytical capabilities and algorithms to inform and aid decision optimisation needed in an immediate operational situation (Caris *et al.*, 2013).

Issues of cost to develop and adopt shared information systems also mean that cyber-security, intellectual property, ethics and fair competition aspects will also have to be dealt with when developing shared platforms, to promote acceptance amongst actors in a world of complexity and uncertainty. Owners and coordinators of integrated information will of course be in a powerful position (Custodian H), which could alter the rules of the system and the dynamics of the system structure. While the development of shared information systems (or making existing systems more accessible) will come at a cost, it should be much less costly than building new physical infrastructure. Better data evidence and knowledge could even contribute to optimising the utilisation of existing infrastructure.

Researchers and actors need to adopt a mindset to think about original and counterintuitive solutions for this complex South African system, for example, integrate versus expand, coordinate on corridors and collaborate within intermodal communities (core system parts) rather than relentless modal competition and national leadership to encourage coordination between system actors.

Almost every solution and intervention proposed by research participants and literature (as discussed above) indicate integration, connectivity and synergistic relationships. This in turn requires inter-operability complementarity and compatibility between parts *and* management of the interactions between connecting parts. As has been indicated in the findings described by the sub-theme “Interfaces driving value”, these interfaces can create value or destroy value in the system.

This finding is in accordance with Gharajedaghi (2011) who views success as an emergent property driven by the management of interactions. He emphasises that an emergent property (e.g. freight intermodal system success) arising from “...compatibility between the parts and their reinforcing mutual interactions creates a resonance, a force, which will be *an order of magnitude higher than the sum of the forces generated by the separate parts.*” Conversely, poor quality interfaces among parts and actors could produce outcomes of “a less potent force than what the aggregate would have been able to produce. In the same way, an organisation, depending on the nature of the interactions among its members, can be a *value-adding or value-reducing system*” (Gharajedaghi, 2011, p. 46). These statements express the true essence of the enormous value that could emerge from exceptional synergies and interfaces between actors in the system.

Direction and common mindsets striving for system value are required to break the self-reinforcing, unbalanced and legacy system. It is imperative to create a vision and an environment that encourages its evolution. South Africans need to become actively involved in enabling small businesses and not only rely on the private sector and big global players to come to the rescue. Major changes in actors and mindsets are required to effect lasting and sustainable transformation relative to the extent of South Africa’s challenges, knowing that we do not know how this very dynamic system and its human actors will respond to changes and developments (Meadows, 2023).

The theme “Seeking solutions” strongly addresses the research question regarding why the adoption of a systemic approach could lead to the creation of superior system-wide solutions and why the *collective efforts by actors* are needed (also how the advancement of innovation, technologies, relationships, interactions and mechanisms may transform the freight intermodal system).

- i. The selection of appropriate solutions requires that all actors embrace a systemic mindset and “win-win” attitudes and relationship in assessing all possible options for improvement, the consequences and benefits of choices and the interdependence of the impacts that will emerge.
- ii. Pooling collective resources, experience, innovation, technologies and knowledge is likely to lead to the creation of more optimal solutions for holistic competitive advantage of the system.

- iii. The appreciation for, development of, and decision to use intermodal solutions, is a strategic choice to be made by policy makers, customers, facilities and transport operators. Since there are huge advantages to choosing intermodalism, there are inherent drawbacks that cannot be ignored. Solutions should seek to mitigate these inherent disadvantages and lessen their effects as weighed against their benefits.
- iv. Not all actors give credence to freight intermodal benefits (and required trade-offs) for the achievement of collective total system (versus individual) benefits and the long-term consequences of choices on the environment, society and the economy. Failure to recognise joint and long-term benefits to all could dilute collective effort and rewards.
- v. Obvious solutions lie in improving individual system parts (notably rail operational performance and road, rail and ports infrastructure network maintenance) and in operations that achieve cost reduction through economies of scale, although these may not necessarily lead to overall systemic results and performance improvements.
- vi. Greater value and value co-creation lie in developing critical interfaces between system parts. A strong, deliberate focus on interfaces and interactions between connecting parts could lead to systemic emergent properties (e.g. success in integrated system performance).
- vii. The value of integration may be more visible if measures (and KPIs) are developed to reflect overall freight intermodal system measures (as opposed to measures for assessing the sum of the performance of the parts).
- viii. Regardless of reputation or individual actor characteristics, the recognition of the value of interfaces in system-level performance could encourage collaboration and partnering between actors.
- ix. Innovation lies in the development of rolling stock, facility or infrastructure technologies; and digital and information technologies [Hard constructs]. Innovation is also required in the development of creative operating models, investment models, business models and interactive actor agreement models [Softer constructs].
- x. Clear problem and issue definition could lead to mitigating or dissolving problems as opposed to seeking imperfect either-or type solutions.

- xi. Interface enhancement for solution efficacy may require catalysing efforts in a modular manner and extending gains to other connecting parts by building on proven capabilities, successes and outcomes.

The South African contextual environment of low economic growth, high debt and many social challenges (e.g. poverty, inequality and crime) will require innovative and perhaps less obvious solutions and approaches.

5.3.5 A CCC network

The research questions that were posed at the start of the study centred around a paradigm of why collaborative and cooperative relationships between actors in freight intermodalism could be beneficial. The study aimed to address prerequisite constructs to promote cooperation and understanding factors for collaborative actor selection. The discussion of this theme reflects on the extent to which the findings address these collective human factors, a critical tenet of this study.

Given that there are many actors fulfilling necessary roles and functions at various levels in a large and dynamic freight intermodal system, the questions extend beyond basic actor relationships to inter-organisational interactions and arrangements (including government departments and agencies and communities within which they operate). For freight intermodalism, where a seamless and integrated process is envisioned, the interfaces and interactions make the concept of working together quite complex.

Interactions take place between government departments and industry, between actors and industry associations, between actors of transport modes, between modal and nodal actors and at various interfaces or touch points where value may be created (or destroyed) in the intermodal value chain. For these reasons, the findings described by the theme “A CCC network”; and the sub-theme “Interfaces driving value” (described within the findings theme “Seeking solutions) are deemed to be critical constructs that are imperative for the advancement of freight intermodalism in South Africa.

The literature review highlighted the importance of interdisciplinary relationships between actors, multiple decision-makers and stakeholders (e.g. customers, government institutions, communities and interest groups) in the system of interest. The findings derived from collected data required further review of the literature on the critical issue of collaboration.

The need for actors to interact at various levels to derive benefits of a well-functioning intermodal system was emphasised by research participants and by literature sources, for example, “Intermodal transport, by definition, involves several decision makers who need to work in collaboration for the transport system to run smoothly” (Caris *et al.*, 2013, p. 110).

The need for interaction was described by research participants generally as working together to make the intermodal system work, or more specifically in terms of cooperation, coordination or collaboration to engage and co-create solutions and better ways of doing things (often using the words interchangeably as one would expect in a flowing dialogue or discussion. Refer to Annexure G for a summation of these quotes).

SMEs emphasised the critical need for various forms of interaction between actors. Discussion extracts reflect imperative prerequisites for collaboration, but that they are perceived to be lacking amongst system actors as a way to improve interactions. Conversely, (and pleasingly) focus group actors reflected willingness and interacted effectively in the discussions. The robust conversations reflected significant commonality in mindsets and congruence of goals. They emphasised the imperative to break down barriers and rise above own interests and work together to facilitate smoother system functioning.

The theme “A CCC network” emphasised the imperative for interaction between actors, particularly to add value at interface points. Actors are willing to collaborate, cooperate or coordinate where opportunities and benefits are visible. Prerequisites (e.g. trust, institutional capability, transparency, accountability, the willingness of Transnet to relinquish control of parts of the huge entity) were indicated by SMEs as characteristics for such interactions to materialise.

Focus group participants, strongly reiterated that the success of intermodalism lies in all actors moving beyond their own goals and vested interests and working together to help each other, including that they should assist Transnet in overcoming their challenges. This reflects a much-needed mindset characterised by coordination, collaboration, cooperation and willingness to co-create solutions (The Da Vinci Institute, 2020, p. 17), because *individual or firm-level efforts are unlikely to deliver distinctive competitive advantages for evolving supply chains*.

Some soft concepts regarding actor behaviours and competencies are critical in the context of the findings presented as the themes “Capability and capacity” and “A CCC network” as intermodal interfaces take place at a human management and relationship level. The DaVinci TIPS™ managerial leadership framework (2020) supports a network approach, that through the management of people and innovation, encourages engagement amongst actors towards jointly developing “performance solutions” (The Da Vinci Institute, 2020, p. 2) in a community, such as the actors in freight intermodal communities.

The TIPS™ framework (2020) thus suggests that actors themselves could probe the challenges and engage to co-create solutions. This could be advantageous for an integrated intermodal freight system that strives for systemic performance gains. Such an interactive approach may be more effective than seeking and selecting from a range of possible interventions (many of which are proposed in “Seeking solutions”).

Whilst research participants indicate that interactions be inclusive (or collective), the TIPS model also emphasises that in a cooperative environment, actors *choose* to participate and contribute (The Da Vinci Institute, 2020). A mindset of voluntary participation of willing actors in a community could prove to be more valuable than the establishment of elaborate formal or centralised structures that compel participation and attempt to over-control actor efforts. The processes of development and innovation could even be delayed and stifled by unwieldy, artificially enforced structures.

A cooperative approach will be critical for intermodal actors who are inextricably linked and interdependent (even though they have their own goals and objectives) and will require actors to practise behaviours and competencies that support multiple levels of decision-making for an integrated process. In this regard, intermodal freight customers must be viewed as system actors and must be allowed to interact with the many actors that provide a service to them (including other customers who may all be competing for available capacity on offer). The public who are members of a community (and broader society) also deserve to be included in situations that may affect them (The Da Vinci Institute, 2020).

Findings suggest that much value may lie in improving relationships that strive to develop innovative solutions and in driving the implementation of interventions developed by actors, in which they have a shared responsibility and interest. The paradigm of actors themselves evolving and putting solutions into practice, by practising the skills, competencies and

practices advocated by the TIPS™ framework, would also be vital (as opposed to over-reliance on policy or master plans, regulations and controls). An appropriate approach of cooperation, collaboration or coordination, as required for the relationship, time, context and circumstances, could potentially be very effective in a dynamic environment characterised by a self-directed choice (The Da Vinci Institute, 2020, p. 2) to engage and share knowledge, skills and ideas towards the development of ideas and creating value for the system and its participants.

Interdependencies are also highlighted by Gharajedaghi (2011) who stresses that organisational effectiveness is more dependent on managing interactions (as required in intermodal processes) between members or actors than it is on merely managing specific actions well. He also notes that the nature of interactions is not static but may differ and change according to context and circumstances. Members, actors or groups may enter into coalitions, “cooperate concerning one pair of tendencies, compete over others, and be in conflict concerning different sets at the same time” (Gharajedaghi, 2011, p. 104).

The researcher postulates (based on the interpretation of definitions in literature as presented by the constructs descriptions in Chapter 2) and by research participants’ contributions that system actors would cooperate *and* coordinate *and* collaborate in a freight intermodal system, at varying inter-organisational levels, contexts and time frames, to harmonise and synchronise decisions and efforts. The nature of the inter-organisational interaction (collaboration, cooperation, coordination or all three simultaneously or at different times) is dependent upon several factors that could encourage (or constrain) cooperation and collaboration:

- i. the characteristics and attributes of the parties to the interaction to catalyse the interaction around joint benefits that are clear to all. Powerful or influential actors who are vertically integrated (often global players) may not be as incentivised to collaborate as they already own and control many aspects of the chain:
- ii. the purpose of the interaction agenda at operational and tactical levels is likely to revolve around the optimisation of interfaces to create greater synergy and value for all actors;

- iii. the time horizon of the interaction and the required interaction frequency. Long-term national planning for capacity and the focus on investment in intermodal infrastructure will require collaboration and cooperation between Government, industry and SOCs. The shorter-term operational and tactical planning would take place amongst operators and requires coordination ranging from, for example, quarterly to daily to constantly;
- iv. interfacing systems and technologies would enable and promote communication, cooperation, coordination and collaboration;

Application of interactive approaches amongst actors could well overcome the inertia espoused by the lack of political will and lack of certainty about who should take the lead in driving change and developing freight intermodalism. The actors need to take accountability and mobilise themselves around a common goal for the intermodal freight sector, and the country, to activate change in their communities and ultimately across the system.

The secondary research questions that were posed at the start of the study centred around collaborative and cooperative relationships between actors in freight intermodalism. The theme “A collaborative network” addresses these questions.

- i. The most important reason *why* actors need to interact, is that an efficient intermodal system requires integration to achieve meso (industry) and macro level competitive advantage because *individual or firm-level efforts are unlikely to deliver distinctive competitive advantages* for evolving supply chains at a national or global level.
- ii. Various forms of interaction are imperative in an intermodal system. Whilst actors express willingness to collaborate (because it is in their interests to have an efficient system that creates confidence), the joint benefits of overall system benefits to multiple actors (who have their own goals and interests) will have to be clear.
- iii. The voluntary choice to participate in collaborating could promote or hinder efforts, especially if participation is forced.
- iv. Integrated best practice KPIs for the intermodal system may provide the rationale and incentive to pursue system benefits and shared accountability for achieving them.
- v. The pursuit of effective interfaces for total system performance should be the basis for fostering interactions amongst and between actors.

- vi. Trust and joint accountability are critical, perhaps even more so In South Africa where these attributes are lacking at present (also see theme “Capacity and capability”). They are vital prerequisites, not mere hygiene factors in the South African context based on the track record of the past decade.
- vii. The concept of inter-connectedness of activities is particularly relevant for freight intermodalism given that it is an integrated and seamless process requiring efficient interfaces. No individual actor can singularly achieve system outcomes and create value, nor actualise emergent systemic properties, alone.
- viii. The interactions, between different actor organisations in freight intermodalism, (that are required for value creation) will potentially take different forms, cooperation, coordination and collaboration (the three Cs), at different times and circumstances in the process of developing and delivering intermodal solutions.
- ix. An interactive approach may be more effective in the co-creation of interventions, than seeking and selecting from a range of possible costly interventions.
- x. The state of rail (in particular) places pressure on complementarity and hinders collaboration.
- xi. Value may lie in Improving relationships that strive to develop innovative solutions and in driving the implementation of interventions developed by actors themselves, and in which they have a shared responsibility and interest. The paradigm of actors themselves evolving and putting solutions into practice, by practising the skills, competencies and practices advocated by the TIPS™ framework, would also be vital (as opposed to over-reliance on policy or master plans, regulations and controls).

Collaboration appears to be happening already, through government engaging with the private sector, industry engaging with Transnet and through strategic alliances between global players, often driving vertical integration.

5.3.6 A better system

While some may describe the need for clearer National plans, and policy certainty, to direct all actors towards a common goal, others simply describe seeing the intermodal system in terms of a national priority to serve markets, to grow the economy such that the “pie gets

bigger”. When the pie grows larger, actors benefit from more freight to handle. The ripple effects of this outcome would be greater levels of investment in the system and more opportunity to create jobs and to address inequalities. This points to a much greater goal of patriotism to make the country better. A noble goal for the common good, rather than the current “tragedy of the commons” or “success to the successful” archetypes (The Da Vinci Institute, 2019, p. 59) that are currently the norm.

Pleas to engage collaboratively and coordinate efforts and actions collectively, stand a much greater chance of success if the system goals are articulated and shared to provide a sense of direction and purpose to multiple actors and stakeholders. “Even people within systems don’t often recognize what whole-system *goal* they are serving...” (Meadows, 2023, p. 16).

Research participants (both SMEs and focus group actors) articulate the goals of a freight intermodal system at a macro level in terms of system cost-effectiveness, efficiency and competitiveness for SA. The researcher views this description as a broad or general desired *outcome* (an outcome that could apply to any system in SA) *rather than a freight intermodal system goal*. Alternatively, an expert described the goal as how the freight intermodal system serves the economy. This is viewed as a more meaningful goal or purpose (although it does not describe *how* this could be achieved).

Rather than stating broad and generic goals, more cohesive value may be gained by articulating goals and actor roles at various levels. This “sorting” of goals could be achieved through the representation of goals in an outcomes chain with the purpose of:

- i. indicating required system inputs with KPIs for performance levels. Of greater importance would be the development of performance indicators driving efficient interfaces between inputs to create value;
- ii. specifying system objectives and KPIs for the outputs, for example, freight intermodal system solutions;
- iii. indicating measurable outcomes to be achieved, for example, competitive supply chains, efficient freight flows, improved modal balance;
- iv. articulating the desired impact of those outcomes on the system, the country and region, society, the economy and the environment over the immediate and longer-term time horizons.

A view of goals articulated at various levels (as in an outcomes chain) could also serve to highlight benefits for all, trade-offs to be made in the interests of owners and much greater systems and the consequences of actions. A system thinking paradigm to explore and embrace is that of “benefit for all”. At an outcomes level, many potential macro benefits could benefit the country and the Southern African region and have a long (and even lasting) impact on society, the economy and the environment.

While all actors are conscious (to some degree) of the benefit of noble impacts, they also need to evidence the benefits of interacting and joining forces at an industry level. Such benefits may be visible in output performance measures such as greater revenue derived from increased throughput, or greater revenue and throughput achieved through reduced costs resulting from less congestion, faster transfer times, asset sharing through consolidation and concentration and so forth.

It is proposed that through collaborative processes, actors themselves articulate the goals (for example, the Durban Port Forum actors articulated an overarching goal for the port precinct stakeholders). Oftentimes, a too precise or enforced goal definition, supplied by authorities, plans or policies, could constrain innovation and broader thinking about the real obstructions, issues and problems to be probed and addressed. Inclusive goal formation could add creativity, innovation and diversity towards a richer statement of a set of goals, to be applied as a strong (and less costly) place to intervene and which could be effectively leveraged (Meadows, 2023). The ideal would thus be the collective pursuit of system-level performance.

The consensus built through the articulation of system goals could be a powerful construct for system improvement. Goal alignment has the potential to unite actors and may also help shape and drive the effectiveness of other interventions: the design of the network and freight flows, the required elements for inter-relationships between interdependent actors (refer to interfaces driving value), information flows and accessibility, the rules of the system, prioritisation of interventions across various planning horizons and how the system is structured in an evolving political, social and economic South African landscape.

As pertinent as the concept of integrated goals is, the notion that the system as a whole must work (indicated by focus group actors) is also apposite. What was most revealing was how the focus group actors interacted and made strong statements regarding the need to co-

operate, exploit synergies, collaborate, cooperate, coordinate and complement rather than compete. They expressed the importance of rising above vested interests and pursuit of own individual goals, to work together as one; for the system to work for the good of the country. Such a perceived collective mindset bodes well for the advancement of intermodalism in South Africa.

A mindset or paradigm shift, in itself, is not a costly intervention but could lead to many desirable outcomes (and both intended, unintended or unforeseen consequences and emerging properties) for the freight intermodal system in South Africa. One speculates how paradigm or mindset shifts could be achieved. Meadows (2023), who considered paradigms, out of which a system arises, as one of the most powerful points of leverage or places to intervene in a system, suggests ways to accomplish this by relentlessly communicating the current system challenges, consequences and impacts and developing lobby groups and networks of like-minded, influential and credible leaders who spread the word of a better system at every opportunity (Meadows, 2023).

Notions of changing mindsets were expressed by research participants as the need to see “the bigger picture”, and to appreciate that the system as a whole must work. This reflects the need to lobby, rally around a common purpose, build a critical mass and transcend current barriers. System actors should be encouraged to share and spread these notions at all possible appropriate forums, and most importantly, in their interactions with influential government actors. It is also recommended that networks place focus on supporting Government in plans for timeous implementation, which is where government also benefits. This is imperative for progress, to overcome inertia and delays and avoid being hamstrung in a quagmire of politics and ideologies. This will take agile leadership, sensitivity, skills, and accountability by all.

The TIPS framework proposes a conceptual approach for developing leadership practices, behaviours, and competencies valuable for building shared perspectives and behaviours that could integrate parts and lead to superior system-level results (The Da Vinci Institute, 2020). The researcher’s understanding is that this conceptual framework can be applied not only within an organisation but also in the context of a system or sub-system such as a community, or a freight system (with local and international actors), at government level or even at country level; because, in a system, the dynamic interaction between people, technology and

innovation is constant, at all levels of all systems, whether that system is an orchestra, a conference, or a freight intermodal system!

The real transformational or transcending challenge, for a system, is to determine at what level, where, how and why the elements of technology, people and innovation could be leveraged to make the most difference so that all the sub-systems are mobilised to optimise inherent synergies between them. The researcher proposes that, for the freight intermodal system in South Africa, the greatest value may be created by not focusing solely on individual elements (such as rail or port terminals), but on the *interfaces* between the freight system parts. This value may be achieved through:

- i. intermodal freight system actors engaging willingly and creatively as they collaborate to collectively define goals and develop interventions that they will implement;
- ii. cooperation to align processes, procedures, activities and resources and communicate to align their efforts such that they achieve seamless and connected flows of freight;
- iii. developing shared information systems to ensure coordinated and agile responses. Coordination could also lead to deploying intermodal technologies such as swap bodies and bimodal (rail-road) units and transfer equipment or facilities that complement and align modal capacities (road-rail-ship).

SMEs also emphasised modular (pilot or concept project) approaches. The researcher is of the strong belief that a modular approach would be extremely appropriate for radically improving the implementation of interventions in South Africa's intermodal freight system (where weak and slow implementation has repeatedly been indicated as an obstacle to progress). Literature indicates that modules may be viewed as "Lego" building blocks. The theory holds that a basic building block is designed, shaped and formalised. It is then replicated and repeatedly installed or implemented in the same way in another area.

Replicating a local or pilot concept (module), for example in one port community to another port or terminal community (another module) reduces costs, lessens the risk of failure and steadily sharpens the learning curve (Chan, Yi, Olanrewaju, Abdelmageed, Hussein & Tariq, 2023; Flyvbjerg & Gardner, 2023). A key success factor lies in a roadmap that presents a future vision, and critically, shows how the different modules will ultimately be integrated into a whole cohesive system (Kerr & Phaal, 2017). Due to the characteristics of repeatability,

learning curve advancement and, most importantly, cost reduction potential, the researcher views such an approach could be extremely beneficial in accelerating the implementation of interventions in South Africa in a paced and affordable manner.

The achievement of levels of system performance for the country would require a significant paradigm shift of commitment and determination; and not merely paying lip service to the goals of “SA Inc.” A changed approach would require embracing a mindset and paradigm of real stewardship, care and shared accountability by all, for the impact of actions to be realised.

The findings of the theme “A better system” closely address the research question of how systems thinking approaches, theories and models may be collectively applied to advance and improve the freight intermodal system in South Africa:

- i. Actors share the notion of common goals for the macro economy and the country, although the means to achieve goals are constrained by actors’ interests or individual goals, which lead to sub-optimal overall system functioning.
- ii. An integrated freight system, by its very nature, requires goal congruence amongst system actors to achieve the objectives of the system, for the benefit of customers, cargo owners, investors, operator actors and the country.
- iii. Goal congruence may be promoted if goals and actor roles are very specifically articulated, potentially in the form of an outcomes chain indicating inputs required, interfaces between inputs, output objectives and KPIs, measurable outcomes to be achieved and the desired impact of those outcomes on the system, society, the economy and the environment, over the immediate and longer-term time horizons.
- iv. Goals articulated at various levels (as in an outcomes chain) could also serve to highlight benefits for all; trade-offs to be made in the interest of their own and much greater systems and the consequences of actions. The ideal would thus be the collective pursuit of system-level performance. Such conceptualisation could unite actors to collaborate and act collectively.
- v. Accuracy in isolating and addressing obstructions (e.g. deep-rooted structural issues) and identifying opportunities (especially at interfaces) will be as critical as fostering goal congruence.

- vi. No single actor has the resources, the capacity or even the jurisdiction to fix the entire system and modular, incremental, local programmes and approaches may be required to advance intermodalism in the South African context.
- vii. An integrated vision, and shared roadmap (or National Master Plan) that enables systems and guides efforts could promote the integration of efforts (and guard against system fragmentation).
- viii. A patriotic and collective mindset is critical for South Africa at its current level of national challenges. Change must be driven by a real desire and intent to change behaviours and collectively improve the state of the system for the country.

South Africa requires leaders and thinkers who embrace systems thinking concepts. Individuals skilled in such approaches could be powerful campaigners in developing actor alignment around systems thinking methodologies and paradigms.

5.4 Proposed Freight International System Conceptual Framework

The findings support the premise of this research study that it would be valuable to apply systems thinking approaches to the intermodal freight system challenges. Actors (represented by the proxy of system actors in focus groups) have not only portrayed the willingness to work together but have expressed a mindset that collective, collaborative, cooperative and coordinated approaches are imperative. More specifically, the research aimed to develop a strategic framework to advance intermodalism in South Africa.

A systemic mindset allows for a deeper understanding of the system's characteristics. Most critically, the development of interfaces and interdependencies between system parts can be leveraged through the power of the dynamics between people, technologies and innovation. If actors were to apply the basic principles of systems thinking theory collectively, this approach could lead to the development of innovative technologies, models, relationships and viable rules of the game. The TIPS™ framework is an extremely valuable model for developing the conceptual framework. The continuous interplay (at various levels) between innovation, technology and people in a system is vital for working with systems. The conceptual model envisioned by the researcher poses that without the collective mindset and systems thinking paradigm, the “People” aspect may weaken the approach. The conceptual model illustrated in Figure 21 thus deliberately expands on the “People” aspect which would

be critical for a successful approach in South Africa. This paradigm dilemma may be harnessed through lobbying by influential actors to build a critical mass for real system-level interaction to take place.

The conceptual framework also reflects that the outcome of the system working could be reflected by how balancing or strengthening feedback loops are altered by actor efforts. As changed outcomes are evidenced, the rate of system change could accelerate as the designed interventions build confidence for ongoing performance and transformation. This could lead to the broadening of the critical mass as paradigms and mindsets are aligned through visible progress. The ultimate would be that emergent properties come to the fore with real innovation and changed system performance.

To further support the conceptual framework, Figure 20 reflects that several building blocks and tools may be applied by system actors as they constantly move between technology, people and innovation in the system in their quest for advancement and accelerating a systemic mindset that gathers momentum as planned outcomes are realised.

The proposed conceptual framework for systemic advancement is illustrated in Figure 21. The building blocks and elements are numbered, for ease of reading, in reality, actors (or practitioners) would be constantly zooming in and out of the TIPS layers and interacting in a cyclical and iterative manner.

Building a Conceptual Framework

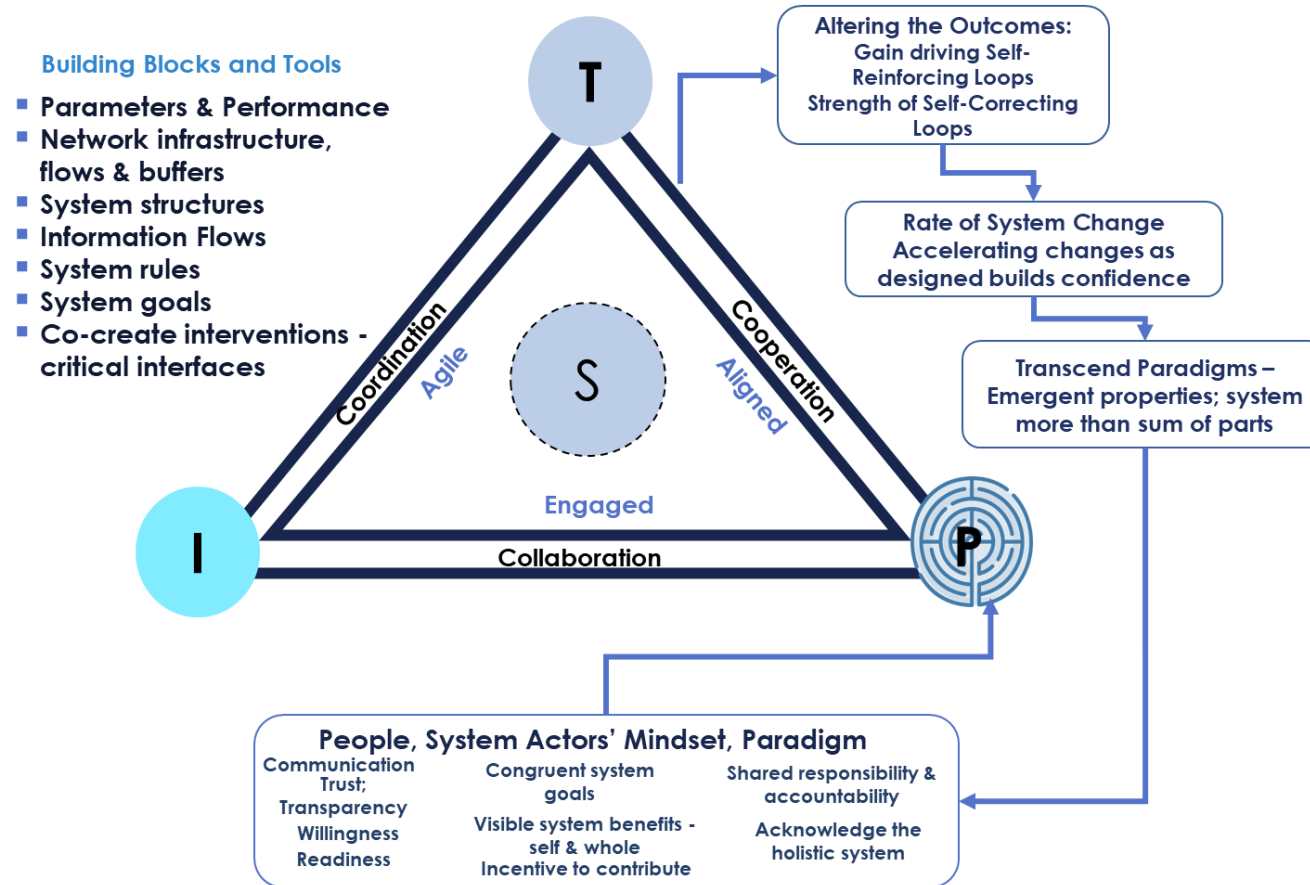


Figure 20: Conceptual framework building blocks and tools (Researcher adaptation and construction)

Conceptual Framework Building Blocks and Tools : Systemic Advancement

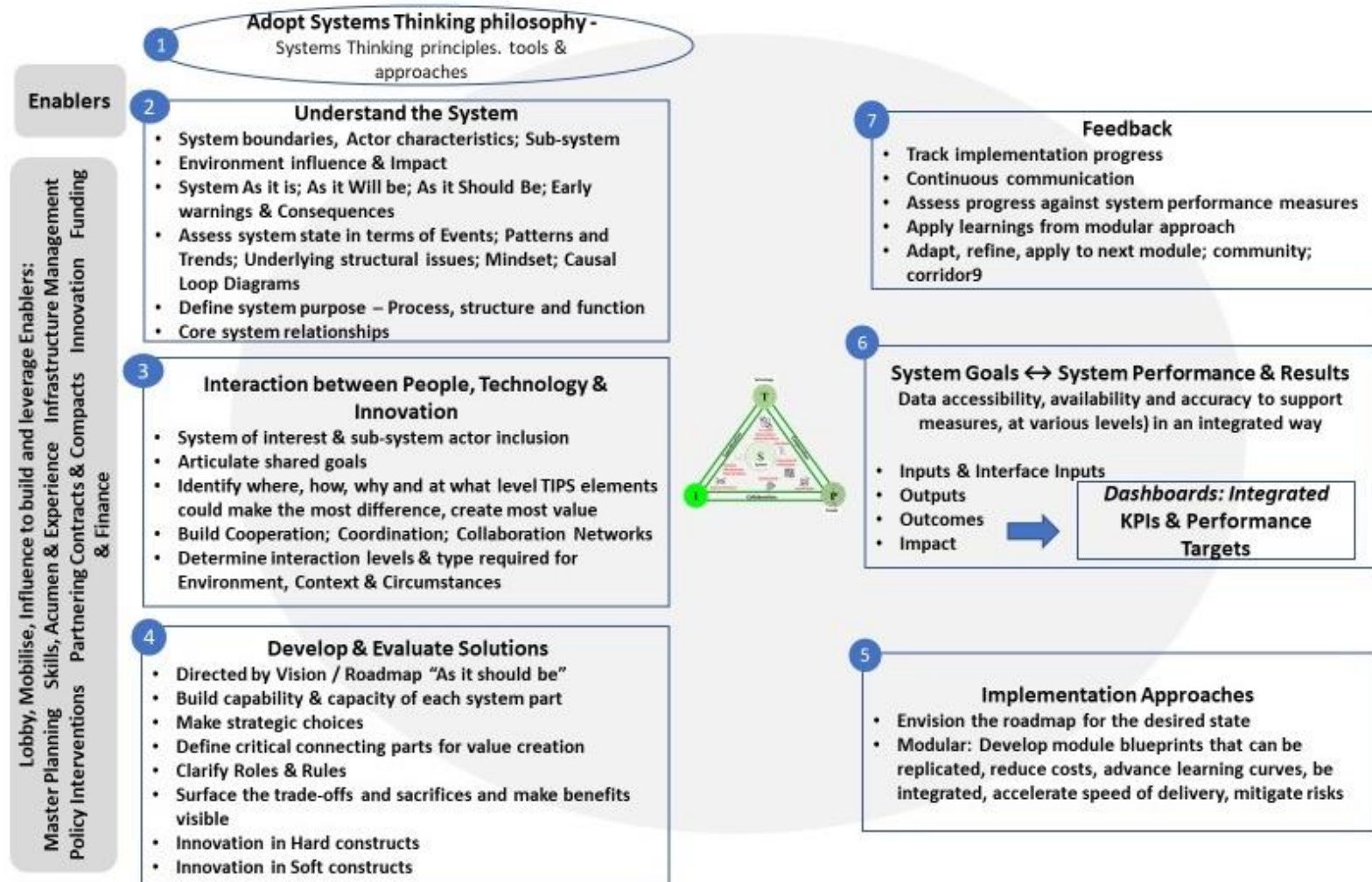


Figure 21: Conceptual Framework

5.5 Conclusion

Discussion and triangulation of findings do not provide a prioritised list of interventions that are deemed to be imperative to advancing freight intermodalism in South Africa. As reflected by the proposed conceptual framework, the greater value would lie in the adoption of a systems thinking philosophy and paradigm, along with complementary approaches to relationships for superior or emergent outcomes. Various systems thinking tools aid in building a thorough understanding of the system and the nature of changes that may be required. Such tools used were conceptual mapping, iceberg models, scenario development, outcomes chain, envisioning a system “As it should be”, ascertaining possible consequences and identifying core relationships between system parts.

The development of interventions for improving or advancing the system are deemed to lie in intermodal constructs that improve the interfaces between intermodal system parts. Value-creating interventions for intermodalism lie in leveraging technology, innovation and people for the best potential to build interfaces that enable a seamless, integrated and connected system. Such leverage embraces both hard and soft constructs that are required for the co-creation of interventions suited to the system characteristics.

The proposed development of integrated intermodal freight measures that drive improvement of interfaces (as opposed to the sum of KPIs of separate parts) is another imperative that could advance the system. The theoretical advantages of developing modular programmes to be implemented may be a practical way to bring about change in a system that is financially, institutionally and resource constrained. A shared roadmap would be imperative for ensuring the integration of developed modules or parts that would ultimately lead to the development of competitive corridors that promote domestic, regional and global trade.

A systems thinking philosophy reflected in the proposed conceptual framework supports the originally stated research problem, aim and objectives and addresses research questions. The framework and discussion attempt to contribute to the theory in a manner that is specific to South Africa, its freight intermodal system and its future.

Research recommendations, limitations and significance of research outcomes are discussed in the final chapter.

6. CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter concludes this qualitative and pragmatist research study by summarising and relating the findings to the original research problem, aim objectives and research questions (re-stated below).

Problem Statement

The advancement of freight intermodalism is a national development priority. The lack of freight intermodal solutions development and implementation in South Africa hinders total freight logistics system performance. Self-perpetuating systemic imbalances and challenges have accelerated over the past five years and sorely detract from the country's competitiveness, economic growth and resilience. Despite policy and strategic intent, implementation inertia and ineffectual interaction between multiple system actors at an industry (or meso level) are evident. System enablement is lacking in South Africa.

A greater collective effort, willingness, coordination, collaboration and cooperation between system actors, with a win-win mindset, are posited as key mechanisms to urgently address macro objectives. The study strives to identify innovative insights for systemic change, turnaround and improvement.

Aim

To advance freight intermodalism, as advocated by policy, for outcomes that include competitive and cost effective modal share, national infrastructure renewal, assets utilisation, connected terminals, ports and borders. Imperatives such as innovative intermodal solution development and effective implementation would contribute to sustainability, job creation, economic growth and development.

The study thus aimed to determine the systemic imperatives, the hard and soft constructs or mechanisms, the importance of the constructs and the relationships between them that must be collectively developed by government, public and private sector role-players to build a

systemic framework that could leverage, advance and enable intermodalism in South Africa's freight transport logistics system.

Objectives

The objectives of the research are:

- i. To evaluate the inter-relationships and inter-dependencies that are imperative for the development and implementation of actions to improve South Africa's intermodal freight performance.
- ii. To understand the rationale and mindset of actors in building collaborative inter-organisational relationships , and to identify aspects that could impact effective implementation, in an integrated freight system.
- iii. To analyse the interventions that may be practically implemented for the advancement of freight intermodalism, specifically in the South African context.
- iv. To create a systemic framework of constructs that may be collectively applied by the system actors (e.g. freight transporters, intermodal operators, customers and policy makers) to implement practices that lead to transformation and advancement of intermodalism in the country, from a total system perspective.

Primary research question

Why has freight intermodalism in South Africa lagged in development and implementation and why a systems thinking approach, if applied collectively by system actors, could develop and transform freight intermodalism in the country towards the attainment of macro level system outcomes?

Secondary-Questions

- i. Why may the pursuit of common or collective (vs individualistic) objectives "unite" the actors and lead to intermodal system optimisation?
- ii. What factors determine with whom system actors will associate, build relationships and co-create to better the performance, functioning and macro-level outcomes in the intermodal system?

- iii. Why it is important to identify the prerequisite hard and soft constructs and system interdependencies that promote (or constrain) cooperation between actors towards the advancement of intermodal solutions and outcomes?
- iv. How the identified constructs for freight intermodalism may be systemically arranged to form a conceptual framework for application in advancing intermodalism?

In summary, the researcher sought to view the phenomenon of freight intermodalism through a systems thinking lens in order to identify the technology and people innovations, interventions and imperatives for bringing about change that could advance and mature the South African freight intermodal system, with macro level benefits. The researcher aimed to identify hard constructs for example:

- i. plans and policies required for nodal infrastructure development;
- ii. plans and investment in transport rolling stock and equipment and capacity integration; and
- iii. intermodal practices for connectivity and consolidation.

More explicitly, the study also sought to reveal the softer aspects for system performance improvement. For example:

- i. to understand the required nature of cooperative, collaborative or coordinated relationships between actors in a dynamic system;
- ii. why a collective paradigm could promote goal congruency and prioritise system level interests over self-interests
- iii. why actor interactions and relationships result in inertia, conflict or complementary actions;
- iv. the impact of competitive micro (firm level) goals and interests or of industry (meso level) structures on the system and on outcomes at a macro level.

The researcher sought to synthesise the various interdependent variables and constructs into a systemic conceptual framework that could be practically applied by actors in the real world context.

The discussion in this chapter appraises the extent to which the research intents were achieved, addressed and expectations met, in the process of studying the phenomenon of freight intermodalism and its complexity, through a systems thinking theoretical framework. The study is specific to the South African system, and is nevertheless impacted by, and has an impact on, systems within and beyond the country's borders.

Reflections are also contemplated concerning the study's repeatability, perceived limitations and areas for improvement where aspects could potentially have been approached differently. The originality of the study and its possible value in contributing to the body of knowledge on freight transport and logistics specifically in the South African context are considered. A personal reflection of the study journey and insights on the researcher professionally, academically, and personally are also shared.

6.2 Key Findings and Recommendations

The detailed description of themes and the discussion of findings reflects the manner and extent to which the six themes have addressed the research problem, aim, objectives and questions.

6.2.1 Key Findings

The core findings emphasised by the researcher as imperatives for advancing freight intermodal in South Africa are encapsulated in several concepts and indicate the fulfilment of the research purpose:

Firstly, *A systems thinking approach is appropriate for the freight intermodal system*: The selection of appropriate solutions requires that all actors embrace a systemic and win-win mindset in assessing all possible alternatives for improvement, the consequences and benefits of choices and the interdependence of the impacts that will emerge. The systemic application of collective resources, experience, innovation, technologies and knowledge is likely to lead to the creation of optimal solutions for holistic competitive advantage of the system.

The use and application of systems thinking tools enable visual representation of the system of interest its boundaries and relationships between parts and actors. Tools also aid in surfacing deeper issues or insights and in conceptualising the impact and consequences of

actions on parts and the holistic system. The adoption of a systems thinking philosophy is viewed as imperative for the study and understanding of a complex and integrated system such as freight intermodalism, one that requires interactions between the many system parts. Definitions of intermodalism most often emphasise the interaction between the “technologies” (e.g. the single loading unit, the transfer between modes, and the terminals’ exchange points in a chain across a network). Not all authors emphasise the human actors, who integrate and connect the parts of a system, as do Crainic *et al.* (2017) who stress the roles of multiple actors, stakeholders, planners, operators, government and decision-makers interacting in a complex system. The researcher upholds this paradigm of the freight intermodal system complexity and emphasises the vital role of human actor interaction as reflected in the themes “Institutional capability and capacity”; “A CCC network (collaboration, cooperation and coordination)”; “Interfaces driving value” and “A better system”.

Secondly, *the collective pursuit of system purpose and performance is a means to unite system actors*: This concept specifically addresses secondary research question (number i). The systemic, and very human paradigm, requires actors to step back and view the impact of their actions on the whole. Actors are logically accustomed and attuned to focusing on optimising their own business improvement and maximising value for their shareholders, that they could naturally lose sight of their impact on the greater freight intermodal system goals, and even the macro outcomes for society, the environment and the economy. Attempts by each to maximise their own interests and parts may result in sub-optimal performance of the whole.

The most important reason *why* actors need to interact, is that a competitive intermodal system requires integration to achieve meso (industry) and macro level competitive advantage because *individual or firm-level efforts alone are unlikely to deliver distinctive competitive advantages* for evolving supply chains at a national or global level.

Social sciences theories, organisational theory, stakeholder theory and systems theories (discussed in the literature review) reflect the notion that pursuing own versus system goals and interests should not be an either-or-choice. Recognising that they are an integral part of the system (Argandona, 2016), and thus support the goals of a greater, common good or clear system purpose, (Friedman & Allen, 2014) suggests that dissonance can be reduced and congruence promoted. Actors may even better achieve their own goals in their contribution to the accomplishment of greater system goals (Adams & Mun, 2005; McNamara, 2012). The

view of actors rising above their own, vested or individual interests or goals, for improved system performance is ratified by the theme “A better system” and was very explicitly stated by focus group actors.

Thirdly, *all parts must work, however, interfaces drive value*: Research questions (numbers ii and iii) sought to identify criteria, and hard and soft constructs, that actors may deploy in selecting partners and building relationships for cooperation, co-creation and improved system performance. Research participants stressed that such attributes as trust, accountability, institutional capability, business acumen, clarity of a national vision and clear roles are a foundation for working together. The aspects that surfaced as being most deterministic of successful relationships were that a systemic approach requires the assurance of efficiency and reliability of each transport mode and each node, and more critically, that each of these efficient parts must be properly integrated for the system to work. The researcher posits that the key imperative for creating value lies in a collective focus on the interfaces between the parts, i.e. the modes, the nodes, the transfer equipment, the processes and the procedures. The relationships between human actors who steer, direct and operate those parts are vital for leveraging the value-creating potential that lies in effective interfaces between them. This finding provides deeper insights into the research questions than were originally posed and is supported primarily by the thematic descriptions “Seeking solutions: Interfaces driving value” and “A better system”.

This finding is also supported by views expressed by Gharajedaghi (2011) who stresses that system effectiveness is more dependent on managing interactions (as required in intermodal processes) between members or actors, than it is on merely managing specific actions well. He also notes that the nature of interactions is not static but may differ and change according to context and circumstances. Members, actors or groups may enter into coalitions, “cooperate concerning one pair of tendencies, compete over others, and be in conflict concerning different sets at the same time” (Gharajedaghi, 2011, p. 104).

Ferrell, Ellis, Kaminsky and Rainwater (2019) indicate that there are many opportunities for logistics actors to interact and collaborate horizontally (not only vertically) to reduce costs and create value in areas of freight consolidation (e.g. for load sharing and improved asset utilisation), inventory management, facilities and asset sharing (promoted by deploying the physical internet (PI)). The authors also indicate the need, at the outset, to clarify the

incentives to collaborate and interact by determining how gains and cost savings are to be distributed amongst actors. Such incentives could be the basis for increasing system goal congruence. These authors furthermore, show that the benefits of horizontal collaboration between actors have been well researched but that “there is little effective collaboration in practice, and the issues related to this gap remain largely unexplored by academic researchers” (Ferrell *et al.*, 2019).

Fourth, *collaboration, coordination and cooperation between actors are all required*: Since the inception of the research, the concept of collaboration has been a core tenet of the study (reflected in the research questions). The nature, contextual formation and quality of the relationships between multiple actors were posited as a possible imperative for intermodal system advancement or performance improvement. Adams’ systems theory approach proposes that “an interdisciplinary collaborative approach” (Adams & Mun, 2005, p. 496) between actors is needed to develop ways to meet the needs and acceptance of both customers and the public. Caris (2008) stressed the need for collaboration to make decisions at multiple, multi-actor levels. Decision-making occurs at operational levels of freight movements and at tactical and strategic levels to plan and determine appropriate resource and capacity allocations and to target investment in future intermodal infrastructure developments.

The theme “A CCC network” (and a more extensive review of literature) expanded the notion of collaboration. Findings determined that the interactions, between different actor organisations in freight intermodalism, (that are required for value creation) will take many forms: Cooperation, coordination and collaboration (the three Cs) constantly, and that interaction is dependent on the circumstances, context, agenda, technology, specific characteristics of actors and the timeliness of the required response (Gharajedaghi, 2011; McNamara, 2012; The Da Vinci Institute, 2020). The findings also provide a more meaningful understanding of the concepts of collectivism, collaboration, cooperation and co-creation than were posed in the original research questions. This study, being grounded in South Africa thus resonates with the philosophy of *Ubuntu*, which is about acknowledging the communal value as greater than individual interests.

Sixth, *system advancement requires constant synthesis of people, technology and innovation*: The research questions called for the identification of hard and soft constructs that are

imperatives to system improvement and questioned whether the constructs could be systemically arranged as a framework for potential application by actors. The researcher adopts and applies the TIPS™ framework (The Da Vinci Institute, 2020) to illustrate that, in a system, technology, innovation and people are constantly deployed and evolved, and in doing so, simultaneously leverage both hard and soft constructs. This implies that agile leadership, the actors themselves, (LSP intermediaries or government representatives (Ferrell *et al.*, 2019)), who are skilled at engaging key system actors, can obtain the cooperation of actors required at key interfaces in the freight intermodal system. Strong actors can coordinate efforts for the development of innovative interventions that could be implemented, by the role players to advance freight intermodalism.

As advocated by the TIPS™ model, it is the interactive nature of collaboration, coordination and cooperation (the three C's) that provide the power to systemically leverage technology, innovation and people to make the system perform in the most optimal way (The Da Vinci Institute, 2020). Figure 13 details the nature of intermodal practices and actions that could be addressed through the three C's, for example:

- i. intermodal freight system actors engaging willingly and creatively as they collaborate to collectively synchronise capacity, influence master plan development, define goals and develop shared alternatives and interventions that they will implement;
- ii. cooperation to align processes, procedures, activities and resources and communicate to align their efforts such that they achieve seamless and connected flows of freight;
- iii. developing shared information systems to ensure coordinated and agile real-time responses. Coordination could also lead to deploying intermodal technologies such as swap bodies and bimodal (rail-road) units and transfer equipment or facilities that complement and align modal capacities (road-rail-ship) and nodal capabilities.

This finding is supported by the themes “Seeking solutions”, “A CCC network” and “A better system”.

Seven, *South Africa could adopt local, modular approaches to accelerate implementation*: Secondary research question (number iii) sought to identify hard and soft aspects that constrain (or promote) relationships and system development. The actual *implementation*

of existing plans and policies to promote intermodal practices has been identified as a significant obstruction that hinders progress. Effective implementation in South Africa is compounded by the lack of master planning (and vision and role clarity), weaknesses in financial affordability, institutional capacity and capability, and the challenge of prioritising interventions to be leveraged. For these reasons, it is proposed that the advantages of adopting the theories of modularity be explored to develop module blueprints for improving freight intermodal system interfaces.

Apparent benefits of modular approaches lie in the ability to be replicated (at increased speed, learning and reduced cost) and then integrated to strengthen the interfaces that optimise the whole precinct, corridor or region. The requirement for a blueprint (envisioned future state and preferably a freight transport Master Plan) is imperative to ensure that modules are not fragmented but can ultimately be integrated into a whole cohesive system (Chan *et al.*, 2023; Flyvbjerg & Gardner, 2023; Kerr & Phaal, 2017). The themes “Need capacity and capability”, “A National view” and “Seeking Solutions” support this finding.

An integrated performance framework to communicate and track progress and successes: The final imperative is to develop an integrated freight intermodal system performance framework that contains measures to address overall intermodal efficiency, and one that specifically focuses on measures to track the improvement of the interfaces in a connected freight intermodal system. At a systems level, measures that sum up the performance of individual parts, to assess system performance, would miss the effort required to improve the interfaces needed to advance system-level results. Actors in South Africa’s intermodal system could learn from the research done on the development of KPIs for connecting parts of container corridors in Mexico, a developing country with similar characteristics to South Africa, and one that also prioritised intermodal development in the country’s National Development Plan (Martner & Garcia, 2015).

At the time that the researcher embarked upon this field of study (in May 2019), her paradigm was that the implementation of intermodal practices for conveying freight could hold many advantages for the railway, the greater freight and logistics industry and the country. The view then, was that intermodalism was at a very immature level and that greater interaction between government, private sector role players and the state-owned logistics company

(Transnet) could collectively work towards advancing intermodal practices that many could derive benefits from.

By the time data had been collected, (through SME interviews and freight system actor focus groups) in the first half of 2022, after the worst of the Covid-19 pandemic had passed, research participants' perceptions indicated that the state of freight intermodal development in the country was not merely immature, but variously described as non-existent, collapsing, at tipping point and chaotic.

The research study considered all proposed freight intermodal solutions to advance the system. The notion of *intermodal interfaces* increasingly became the focus as a probable place to intervene in the system. A place that could have significant leverage to change behaviours and advance the system.

The application of various systems thinking tools and principles aided in revealing the systemic nature of the challenges. The use of systems thinking tools and methodologies was useful in gaining a deeper understanding of the system. Tools included graphical depictions of the system and relationships between actors and system parts. Analysis of the system events, patterns and trends showing early warning systems and acceleration of negative consequences, structural issues (misguided policies and minimal and fragmented implementation, lack of enforcement, etc.) and beliefs about the institutional capability of core actors in the system, surfaced challenges and alluded to aspects of the system requiring intervention.

Perceptions that were shared did not bode well for fostering cooperation, coordination or collaboration in uniting actors around goals and purpose. The focus on interfaces driving value, and the emphasis that focus group actors placed on working together, were, however, extremely encouraging. The adoption of the DaVinci TIPSTM model synergistic properties of technology, innovation and people, showed how the system may be improved at the interfaces for better overall system results.

The researcher has demonstrated that all research questions were addressed and that, even greater insights surfaced than were originally posed by the questions. The methodology, and particularly the use of focus groups representing actors in the real South African system, truly

confirmed the research paradigm that meaningful relationships amongst system actors are imperative and have the potential to advance the system and achieve macro-level outcomes.

6.2.2 Recommendations

It is recommended that system actors develop relationships and interact to apply the imperatives, as described by the key findings, to advance the freight intermodal system in South Africa.

The core findings described, facilitated the development of a conceptual model that may be applied to a system for radical transformation. Figure 22 (depicted overleaf) summarises how the model may be applied to South Africa's freight intermodal system, as derived from the research findings.

The circular and iterative nature of the conceptual framework is imperative. It is recommended that the conceptual model be applied to South Africa's freight intermodal system to overcome current challenges and inertia towards bringing about real change in the interests of South Africa.

Conceptual Framework : Freight Intermodal System Advancement

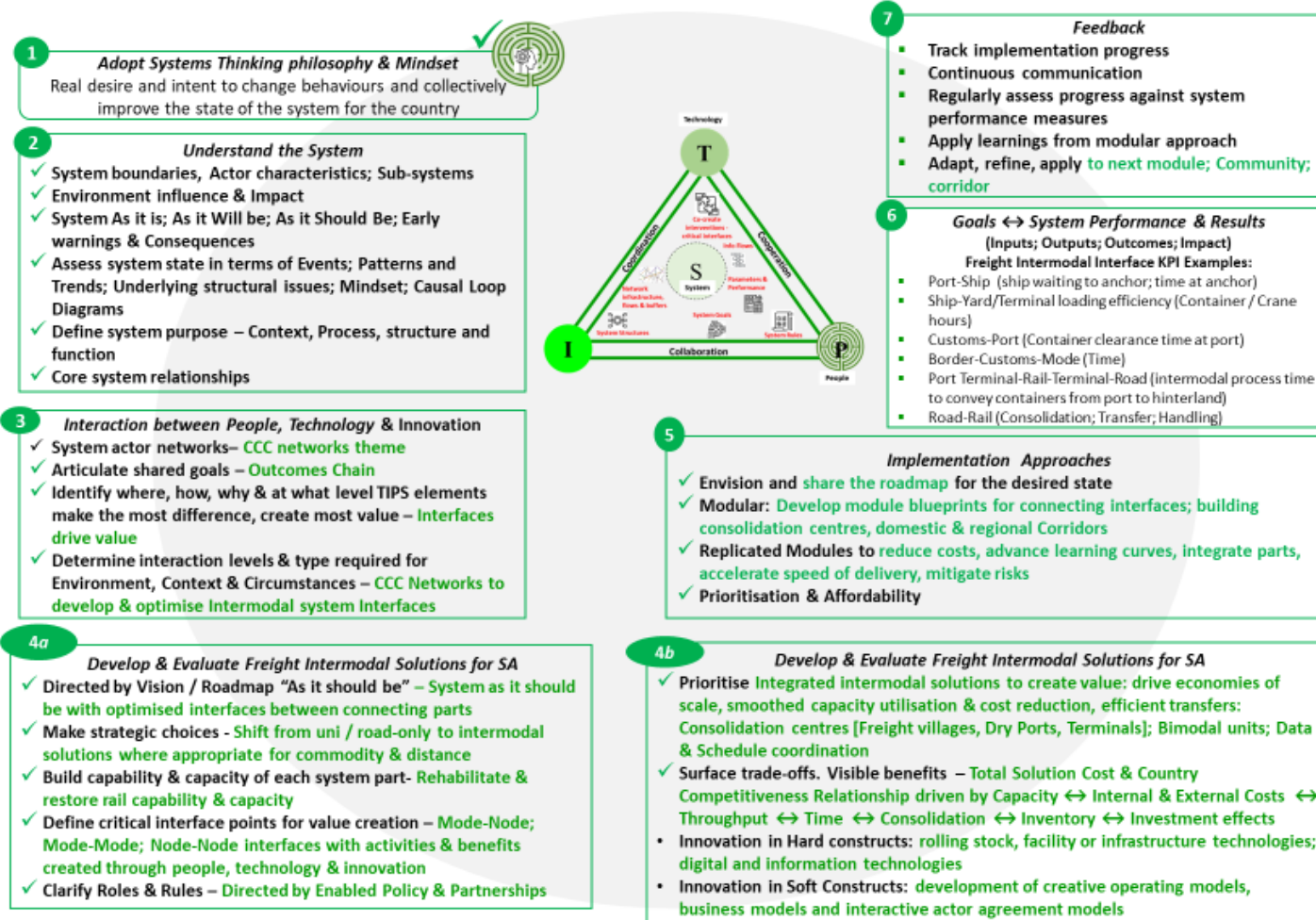


Figure 22: Conceptual framework: SA Freight intermodal system advancement (Researcher construction)

6.3 Study Limitations

The research methodologies employed, and the in-depth study of the system enabled the development of a novel conceptual framework that may be applied to many large and complex systems. There are of course, limitations that could be addressed in repeating the study and in applying the findings.

- i. Even more value could have been derived from focus groups had more South African representatives of global shipping and logistics companies participated. Such organisations had been identified as crucial actors and were invited and accepted the invitation, although not all ultimately attended.
- ii. Influential focus group actors are operationally active in the system and are extremely busy executives. The time allocated for the discussion was thus limited to one hour of online participation (focus group 2 actors requested another half hour to continue interacting!). Although actors were engaged and vocal in robust discussions, more time could have been spent on developing a richer picture of the system as it should be (the facilitator had to steer the discussion away from current events, challenges and their impacts). In future, even more, creative ways could be identified to use graphical representations (rich pictures) to steer the discussions for the co-creation of innovative interventions.
- iii. The freight system is so complex and dynamic that, despite efforts to avidly track developments through documentary analysis and other sources, issues may have evolved without the researcher being able to incorporate key aspects in the findings.
- iv. Most research participants were not personally known to the researcher, but they nevertheless sensed or established her past career involvement in Transnet and railways and sometimes over-emphasised those parts of the system.
- v. Oversight may be construed as not having invited labour representatives or community interest groups that are impacted by and even influence system dynamics.
- vi. Greater consideration could be given to the use of digital tools or programmes for thematic analysis and the development of system diagrams, which were all done manually.

6.4 Contribution and implications

The researcher is of the view that the novel contribution of the research study is founded in conducting focus groups, as a proxy representation of actors in South Africa's real freight intermodal system, to illustrate the value of applying a systems thinking approach to the phenomenon of freight intermodalism. Focus group interaction reflected the willingness of actors to collaborate, cooperate and coordinate to advance system performance, as well as the urgency of the issue. Discussions were most encouraging in the collective mindset of actors expressed in their statements of aspirations to rise above their own interests for the good of the system and the country.

The mindset of willingness to work together, expressed by focus group actors, also alludes to the value of voluntary participation in contributing to system betterment and that enhanced outcomes could potentially be derived, than if participation were to be enforced or mandated by an authority, which could lead to cumbersome forums or central structures that may delay decision-making and detract from timeous implementation, a situation that the system can ill afford.

The study can also be seen as contributing to knowledge by reflecting on how the philosophies of systems thinking and transdisciplinarity intersect. Both are viewed as appropriate approaches for addressing wicked or complex problems (Neely, 2019). Transdisciplinarity may be viewed as an effective approach for exchanging diverse perspectives by drawing on many disciplines, and in so doing, finding a common "language" to evolve ideas and co-create ideals and futures. This thinking is also embedded in the systemic TIPSTM framework (The Da Vinci Institute, 2020). If applied by the diverse group of freight intermodal system actors, (who have different outlooks and diverse areas of expertise) innovative and emergent properties have the potential to surface.

The uniqueness of the contribution to freight intermodalism, lies specifically in the focus on system interfaces. The development of relationships to optimise the core interfaces can be used to prioritise and leverage potential interventions and to focus performance measurement. The graphics and diagrams as well as the proposed conceptual framework provide a visual way of communicating a practical approach for understanding and improving a complex system.

The researcher believes that the findings and the conceptual framework could have positive implications for system stakeholders:

- i. Freight intermodal industry and system actors could apply the concepts to their organisations and interfacing communities to lobby and build support for integrated strategies that benefit actors and their customers or stakeholders and positively impact national outcomes.
- ii. Policy makers may find the approach valuable in aligning policies and prioritising local, provincial or national projects to create capacity and capability. The approach may be extended to the development of critical interfaces that enable and facilitate interactions with countries in the Southern African region.
- iii. Academics may critique the approach to build knowledge and stimulate further research in related areas.
- iv. The systems thinking approach and the conceptual framework could be used by lobbyists and interest groups to garner support for intermodalism in the freight and logistics industry, and within the communities that it affects.

The proposed theoretical approach and resultant conceptual framework are particularly relevant to the current challenging South African environment and could stimulate creativity and resilience at a time when it matters most. The fact that influential system actors (at levels of Chief Executive, executive and general management, government director-general), willingly participated in the focus groups reflects the appreciation of the urgency of a critical national issue and the imperative to find fresh approaches and a place to start implementing them.

6.5 Proposals for future research

The research findings, consideration of their relevance and applicability as well as acknowledgement of research limitations, raise some insights for future research on related topics, or to provide counter-arguments to proposals made in this study. Possible lines of future research could include addressing questions such as:

- i. The quantification of the value to be derived through the coordination of intermodal freight interfaces;
- ii. Proxy intermodal measurements were explored and future studies could place more emphasis on the development, definition and quantification of a performance framework with measures and KPIs developed specifically for intermodal system interfaces;

- iii. The importance of effective intermodal freight interfaces in growing African intra-regional trade as the African Continental Free Trade Area agreements gain momentum;
- iv. How the value and benefits of information-sharing and digital coordination in freight intermodalism may be impacted by ethics, protection of intellectual property and anti-competitive behaviours;
- v. How global shipping and logistics conglomerates are shaping their strategies and partnerships for investment in logistics operations in developing countries such as South Africa;
- vi. The value and practicality of applying modular approaches for mega project development, investment and implementation for freight logistics solutions;
- vii. The economic, societal and environmental impact of developing and locating intermodal Freight Villages in large metropolises in South Africa;
- viii. Collaboration, cooperation and coordination amongst system actors to build innovative freight intermodal skills development models for South Africa.

The phenomenon of freight intermodalism is an extremely broad subject in freight transport and transport economics and the practice, while required in South Africa, is under-developed. Studies using systemic and other disciplinary approaches should be encouraged to develop strategies that are appropriate for, and specific to South Africa, the Southern African region and the African continent. Diligent institutions, skilled practitioners and agile and accountable leadership are required to entrench effective implementation.

6.6 Reflection

My journey in the development of this thesis can best be described in terms of a cycle of discovery, learning and oscillating confidence! I had to build my knowledge of the techniques of the academic process and exert discipline in following it, even when it required of me to step back to review, rethink what I thought was the “answer”; and then rewrite. I had to learn to trust the process and stick to it, which became enlightening as each new insight was revealed.

A systems thinking approach is a transdisciplinary one compelling me to delve into all my past academic learning from psychology to economics, transport to communications, rail

operations to performance frameworks and strategy to policy. I also derived real value and personal pleasure from interactions with individuals from many disciplines who willingly gave of their time and wisdom to assist and found that help and support sometimes came from the most unexpected sources.

Drawing on my almost four decades of career experience in the air, rail, ports freight and passenger transport industries, compelled me to seek proposals and recommendations that were entrenched in current realities (without becoming mired in current politics at play in the country), and to search for proposals that would be palatable and realistic to the diverse local and global stakeholders and actors active in the South African freight logistics industry.

What started as a fascination with systems thinking approaches became an ongoing quest to better understand the tools and principles of the discipline. While some view systems thinking as outdated or faddish, I believe that it is an insightful way to view our complex and dynamic world from many perspectives.

The study has also compelled me to objectively question and re-evaluate my belief in the role of rail in advancing freight logistics practices such as intermodalism. Reading and ongoing discussions, with a growing network of peers, have helped me to make sense of trends and to seek possible options towards discovering original recommendations that would apply to the realities of the current South African context, such as the fears and speculation around the Covid-19 pandemic, the tragedy of State Capture, failing SOCs, poor economic growth and that Rail could not step up and fulfil its role when South Africa needed it most. At the same time, I have been encouraged by the resilience and collective efforts of South Africans in times of adversity.

My academic journey has also heightened my awareness of the consequential and interconnected nature of everything and the lasting impact of current interventions on sustainability for future generations. We all need to think deeply about the impact of our actions and behaviours on others. I remain committed to contributing to the future of South Africa in any small way that I may be able, and to share what I have learned with others so that together we may develop new and innovative behaviours, competencies and practices.

6.7 Conclusion

There are many ways to co-create a future that we desire. Intermodalism may be a way to improve South Africa's performance in the global market in which the country competes. The implementation of intermodal practices could stimulate job creation and positively impact the increasingly visible effects of climate change and environmental harm. Solutions must be pursued to include small businesses to address poverty and inequalities in South Africa and on the African continent.

The advocacy of intermodalism is less about balancing choices between road and rail modes, and more about the imperative for collaborating, cooperating and coordinating efforts to collectively develop solutions that positively impact society, the environment and the economy.

The devotion to the topic of intermodal freight in South Africa reflects a sincere and humble call to action, for actors to work together to make the best of our country – there is so much at stake!

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9. ANNEXURES

Annexure A : Ethical Clearance Certificate

The Da Vinci Institute for Technology Management (Pty) Ltd
PO Box 185, Modderfontein, 1645, South Africa
Tel + 27 11 608 1331 Fax +27 11 608 1380
www.davinci.ac.za



Reference: 01221
Date: 26 March 2021

Ethical Declaration

I, the undersigned, hereby declare that the Doctorate Research of the student named below has received ethical clearance from The Da Vinci Institute Ethics Committee. The student and supervisor will be expected to continue to uphold the Da Vinci Institute's Research Ethics Policy as indicated during the application.

Proposed Title: Imperatives for advancing Freight Intermodalism in South Africa: A Systems Thinking approach

Student Name: Gertenbach Sandra Jean

Student number: 12427

Supervisor: Prof Paul Singh

Co-Supervisor: N/A

Period: Ethics approval is granted from 2021/03/26 to 2025/05/13

Chairperson: Research & Ethics Committee

Prof HB Kloppe
Executive Dean: Research and Institutional Partnerships

Directors: B Anderson (Vice-President and Chief Executive Officer), B Mkhize
Company Registration No. 2001/009271/07
Registered with the Department of Higher Education and Training as a private higher education institution under the Higher Education Act, 1997.
Registration No. 2004/HE07/003

RESEARCH • DESIGN • EDUCATION

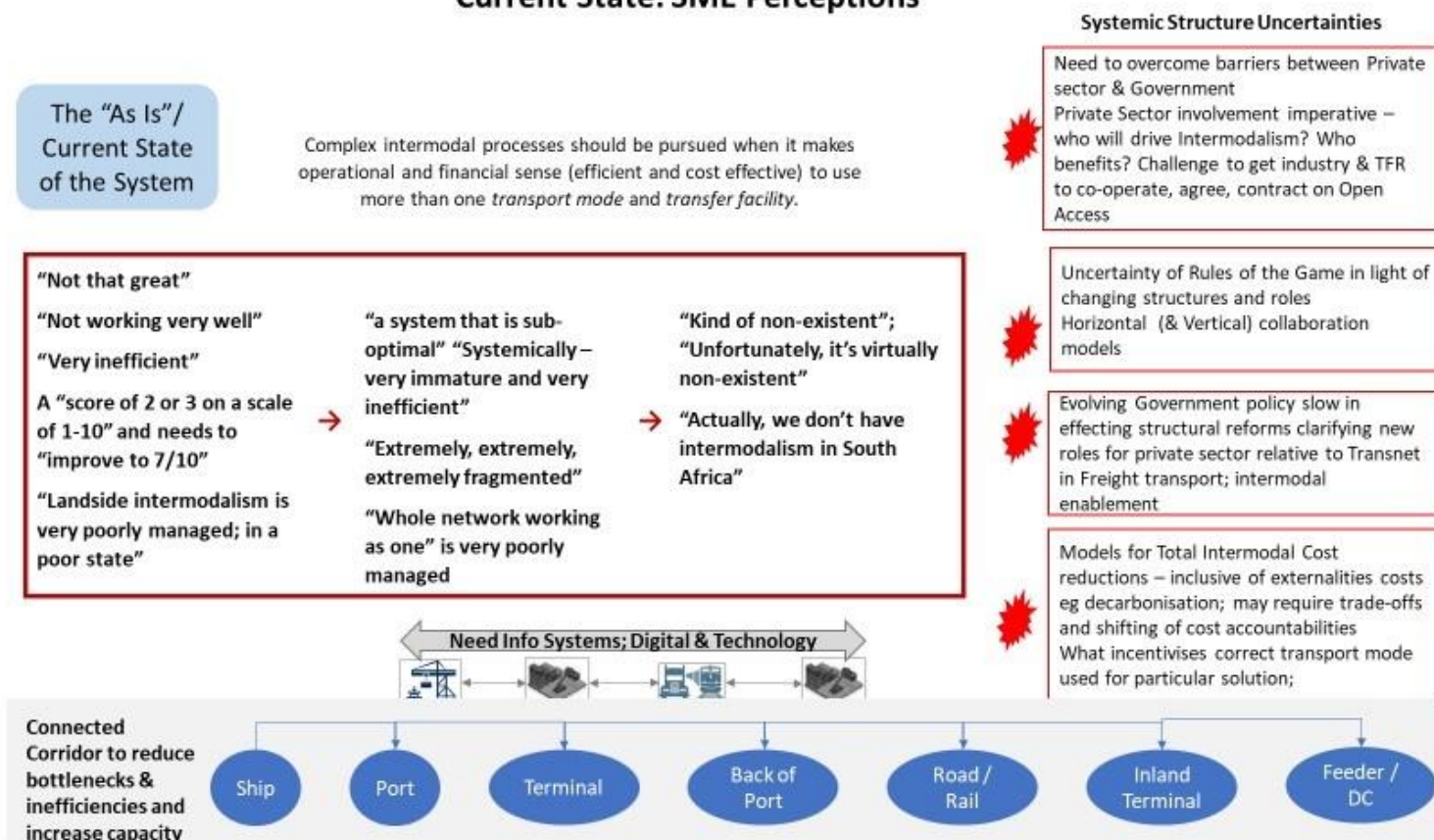
Annexure B: SME Interview questions and rationale

Discussion Question	Possible for Probing Aspects [To stimulate discussion & achieve SME Interview objective & purpose]	Rationale – Link to Research Objectives
1) How would you define or describe the concept of Freight Intermodalism?	Transport modes vs Links, Nodes Connections Relationships.	<i>Determine depth / view of Intermodalism to ensure focus of questions that follow. Assurance of credibility & expertise.</i>
2) How would you describe the current state [interpretation of reality] of South Africa's Freight Intermodalism system? a) And why do you describe it this way?	Improving; Growing; Declining? What's going Right / Wrong / Well / Badly Order or Chaos? Which parts of the system need intervention to advance the whole? Have past interventions proven to be quick fix vs sustainable solutions? Is Freight Intermodalism viewed as a system?	<i>Refine perceived AS IS state – various perspectives. Why? – Depth & Richness Is there a real problem; Who sees it as a problem; Determine views / opinions of level of complexity. Probe problem towards sustainable solutions. Surface the views and perceptions to surface the themes & constructs. Determine extent / nature of the problem to determine why it needs to be researched. Identification of system Archetypes.</i>
3) What are the Top 3 core challenges / problems / obstructions and gaps to improvement that need to be addressed to advance Freight Intermodalism In SA? (To advance the system from its current state.)	If we were to get all the right people in the room – what are the imperatives that they should address. Always room for improvement.	<i>Identify core themes as well as issues & topics to be addressed / discussed in Focus Groups. Identify opportunities and areas for improvement. Identify potential points of leverage.</i>
4) What are the core goals that the Key Players & System Actors <i>are / should be</i> striving for? How could success be measured?	Who should be striving for what Freight Intermodal ideals? Is the sum of the parts contributing to a holistic outcome? What is the system purpose?	<i>Aspects leading to the “To Be / Ideal State”. Determine if Collective vs Individual Goals are expressed. Determine if goals are viewed at a Micro; Meso or Macro level. Are system level goals expressed? Is there congruence of Actor goals amongst different Actors? What aspects would lead to emergent properties of the system?</i>

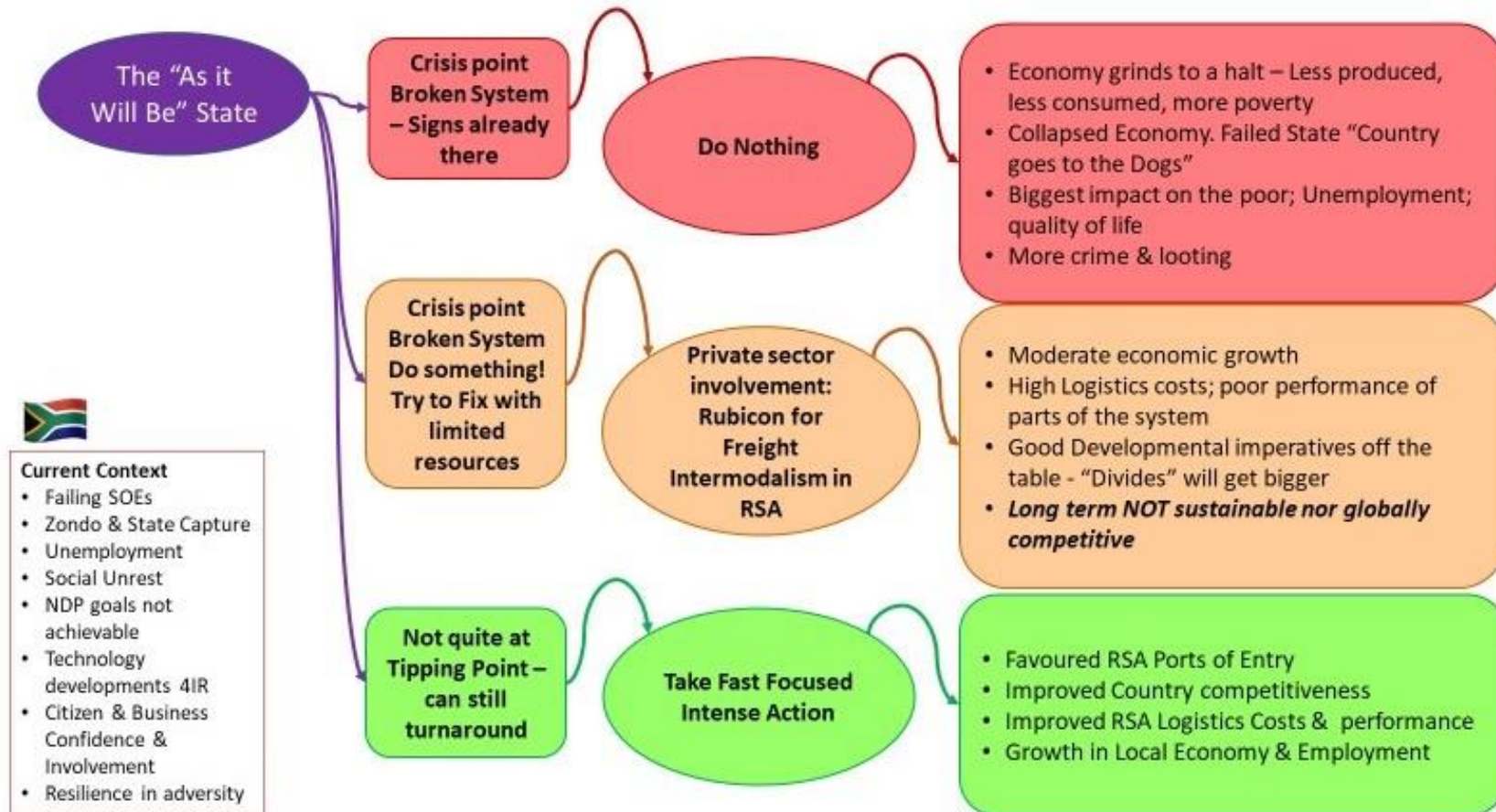
Discussion Question	Possible for Probing Aspects [To stimulate discussion & achieve SME Interview objective & purpose]	Rationale – Link to Research Objectives
5) What (if any) interventions or solutions should be developed to advance the development of Freight Intermodalism in SA? a) Who (Which Key Role Players) should drive such interventions? b) Are Actors likely / willing to cooperate / collaborate to seek and implement solutions?	What more could we do? What relationships, processes; technologies; models; operational improvements; investments and best practices could be pursued to improve the current state? What synergies could be exploited?	<i>Aspects leading to the “To Be / Ideal State”.</i> <i>Determine view of where responsibility lies and who could intervene to change the state.</i> <i>What are the key interventions required to move closer to a designed ideal?</i> <i>Where do the greatest points of leverage lie?</i> <i>Surface Key themes and constructs.</i>
6) What could happen with regard to the development of Freight Intermodalism in South Africa if nothing is done; no interventions are implemented; opportunities are not decisively pursued; if the system is left unchecked? a) What may be the Tipping Point? Or the point where the system “reorders” to advance and mature?	What may be the Tipping Point? What are the system consequences (intended / unintended), sacrifices, compromises & trade-offs. Opportunity Cost of doing nothing.	<i>Determine view, opinion or perspective of what it “Will Be”.</i> <i>Surface the Intended / Unintended Consequences.</i> <i>How does the described “Will Be” State relate to the Goals; Interventions and Actor Responsibilities?</i> <i>Who is Committed?</i> <i>How could we experiment?</i>

Annexure C : Analysis for Focus Group Preparation

Current State: SME Perceptions



Scenarios SME Perceptions



Proxy Indicators of System Performance

% of total freight (by payload) moved by Rail
2008-2021



StatsSA



Road fulfils a massive transport task - Share on General Freight Corridors : ~65% of TonKm; Containers by Road vs Rail ratio unsustainable

Road Trucks: PBS Fleetseg 44 Pallet (30m total length) PBS Fleet results in fewer trucks on road (but trucks are longer). Aim reduced congestion, reduced carbon emissions (fewer trucks) improved road safety reduced overloading

Borders congested & inefficient : Truck queues +20km; Delays 315 days

RSA logistics sector value
~R480 billion

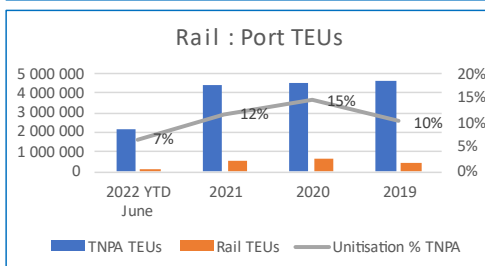
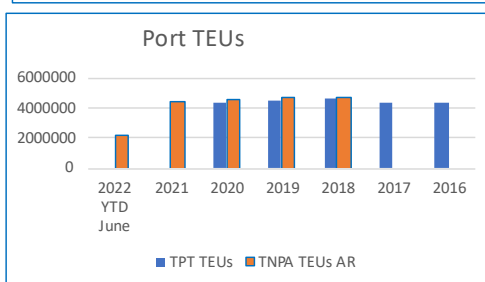
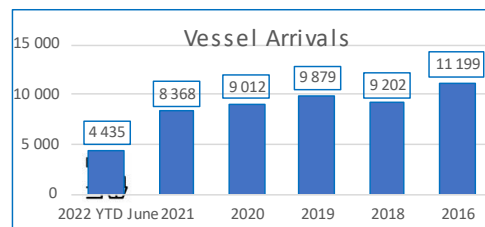


Road Safety : 62% of South African road accidents involve trucks

Rail Safety : Increased number and cost of incidents- maintenance backlog, theft, vandalism, sabotage. Reliability of Rail compromised

Rail condition Deterioration evident; National Roads condition (transporting 70% of traffic in fair to good. Rural & Provincial roads in poor condition]

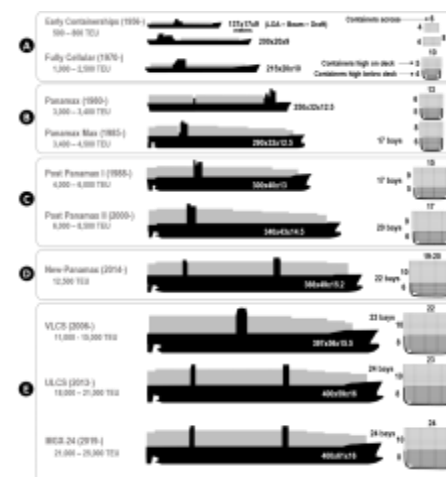
20% Improvements reefers transported by rail in 2021 vs 2020 [2021 TFR record season 3 662 FEUs]



Imbalances causing Container shortages and high freight rates

Cars Units	2021	2020
Imports	8 434	35 932
Exports	80 381	99 754

Transnet Annual Report 2021



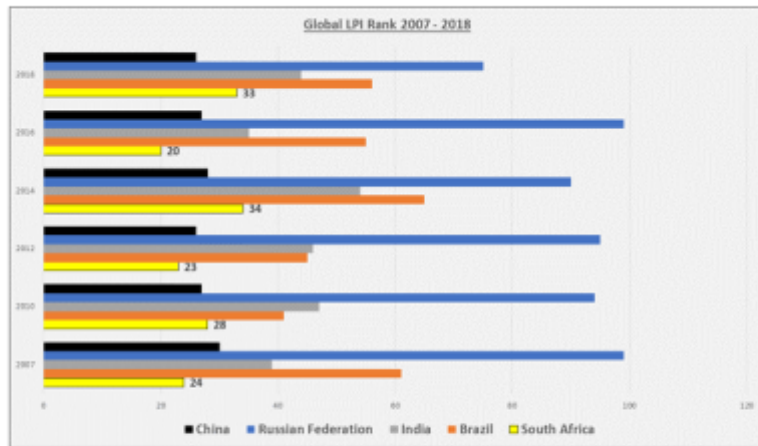
South Africa needs to improve its ability to receive large container vessels, warns SAAFF – Ship berthing; capacity; stacking capacity; inland rail capacity

Port Container throughput : Durban handles ~66% of RSA Container Traffic

351 global **Container Port Performance Index 2020 :** Cape Town 347; Port Elizabeth 348; Durban 349; Ngqura 351.

Unitisation : In 2020, the share of container transport in total rail transport performance in the EU was estimated at 20.6 %

Macro Indicators of Freight Intermodal Performance



Intra-Regional Trade
13-15%



Unemployment
>34%



Carbon Footprint :
RSA global ranking 14
& world GDP ranking 41



Country Competitiveness
59/63

Logistics Costs 11.8 % of GDP
[Global average 13%; most efficient countries 5-8%]
~55-60% of logistics comprise Transport Costs – Will increase with Fuel Cost increases



South Africa's **Logistics Costs** as % of GDP rising. Logistics Barometer 2016

SOUTH AFRICA

GDP: \$368 EXPORTS: \$110 IMPORTS: \$109 US FDI: \$8

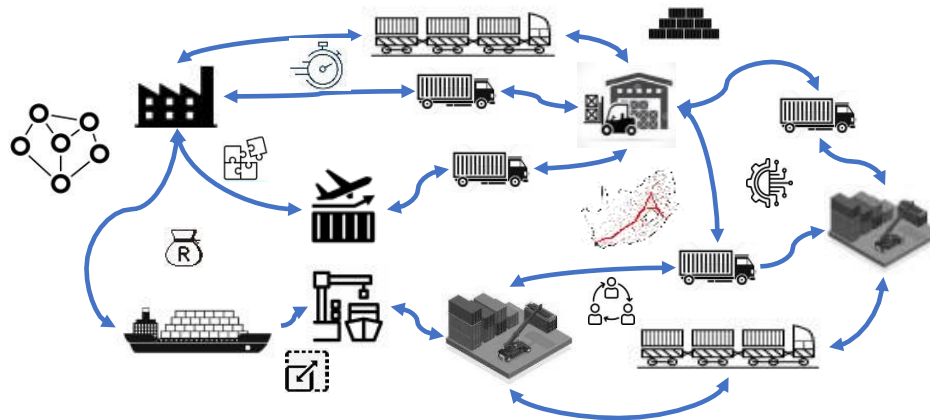
WORLD BANK LPI SCORE: 3.38 Logistics Performance Index 2020

The IMF sees the second- biggest economy in the continent as having *weak private investment* and *productivity growth*, with pockets of *high unemployment* in a *divided society*.

- Services are growing, but other traditional **industrial sectors** are flat or declining.
- State-run power firm in heavy debt, causing **power outages** particularly in mining.
- Growth** predicted at less than 1%.
- Credit rating** drop is a threat

Focus Group Discussion
Thursday 28 July
MS Teams 17h00 – 18h00

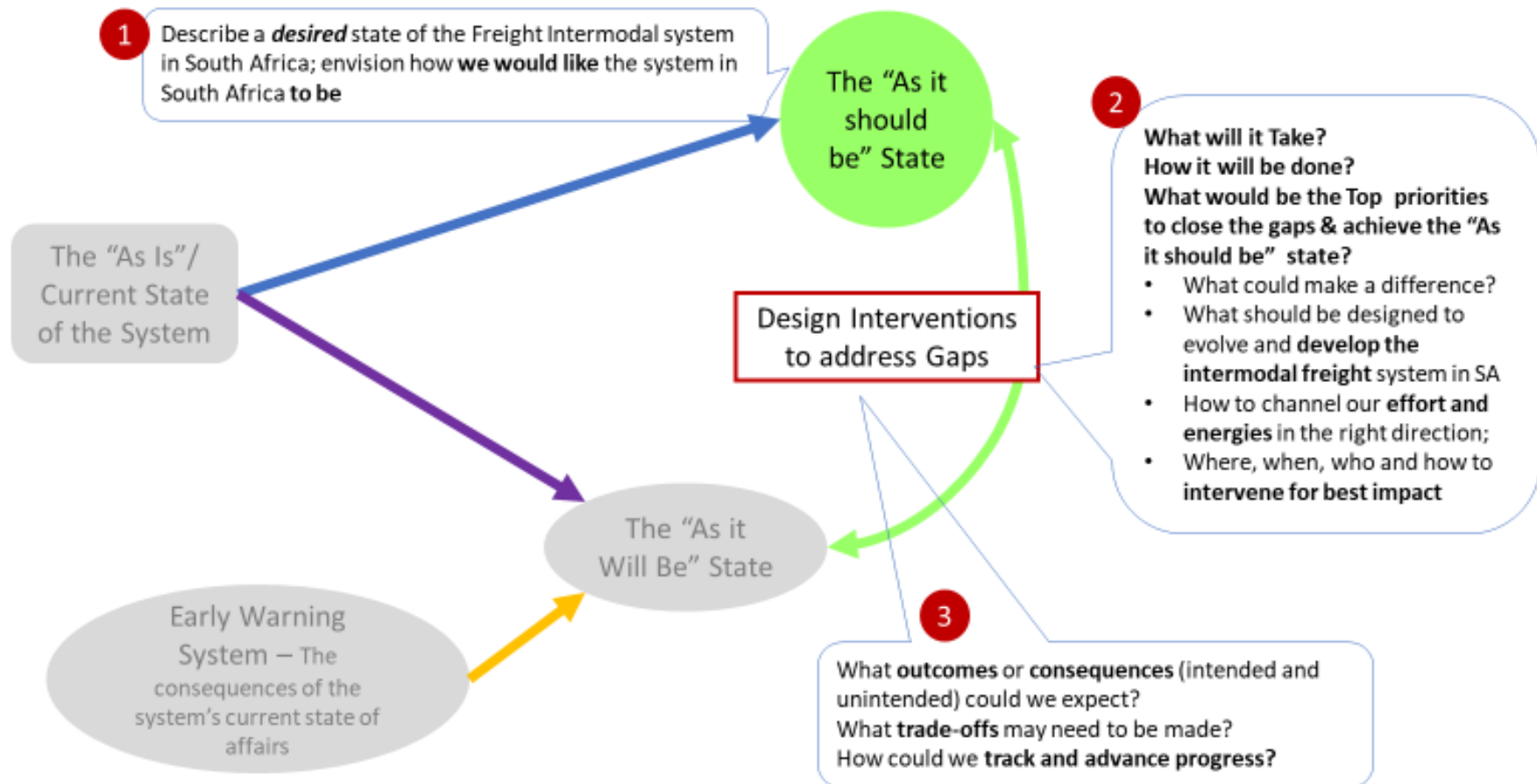
*“Imperatives for the Advancement of Freight Intermodalism in South Africa:
A Systems Thinking Approach”*



Thank you for joining

Agenda

"Imperatives for the Advancement of Freight Intermodalism in South Africa: A Systems Thinking Approach"



Annexure E : Coding - Codes and Definitions for Categories

#	Code	Definition [Concepts Included]				
1	Capacity	Condition: - Poor - Good - Destroyed - Impacted by challenges - Inherent Constraints	Investment in: - Maintenance - Expansion - Renewal / Upgrade - Practices: Life-cycle, Retrofit	What Infra: - Road - Rail - Ports - Terminals / Freight Villages - Facilities - Shipping	Qualities - Aligned, integrated, coordinated - Assets utilisation / optimisation - Shorter distance; last mile; consolidation; concentration	Role - Meet market demand - Access to market
2	Institutional	Timing - Pace - Urgency - Talk vs Action	Who - Government - Operators - Agencies (Border, Roads) - Authorities (Policing; Law; Judicial) - Operators - Transnet - Private sector - LSPs - CSIR; Universities	Enabling - Political Will - Right people & Skills - Engagement - Relinquish control Constraining - Corruption - Hidden agenda - Locus of Transnet management focus & energy	Qualities - Commitment - Skills - Capability - Competence - Stewardship / Care / Citizenry - Accountability - Responsibility - Ideology [Nationalise / Privatised] - Reputation; - Proactive [Reactive]	Role - Lead, sponsor champion - Allocate investment funding - Law enforcement - Manage contracts - Implementation - Drive and manage Process - Comply - Commercialise
3	Collaboration & Cooperation	Nature / Level of Engagement / Relationship - Collaborate - Cooperate - Coordinate - Communicate	Engagement Agendas - Precinct / Corridor performance - R & D - Third Party Access - Supply chain visibility	Actors - Multiple Actors - Multiple stakeholders	Qualities - Willingness - Actor behaviours - Work together	Enabling - Incentivise - Make joint benefits clear - Guarantees

#	Code	Definition [Concepts Included]				
		- Compete - Complement - Partnering / JV - Collaboration Agreements - Synergistic; Symbiotic	- Commodity for asset sharing - Service delivery - Interfaces & connectivity for Seamless process - Opportunity identification - Investment; Financing Models	- Government-Transnet-Private Sector - Organised Labour - Global players	- Help each other - Trust - Synergistic	- Readiness for adoption Constraining - Vested interests - Risks - IP Protection - Dragging of feet
4	Interfaces / Touchpoints	Nature - Interfaces / Touchpoints: different Modes & Nodes - Touchpoints - Ways of linking modes & nodes - Ancillary Logistics Services - Transfer Equipment	Purpose - Enabling Value / Supply Chain; Logistics; - Consolidation - Densification - Load Concentration; - Creating Value - Exploiting synergy opportunities - Optimise System Asset utilisation - Interoperability	Parts - Modes: Road Rail Ship / Maritime - Nodes: Ports, Terminals; Dry ports; Hubs; SEZs; Freight Villages - Borders	Qualities - Connectivity - Integration - Enable Transfers & Exchanges - End-to End -	How - Point in Process & Locations where consolidation / transfers / integration should take place - Operating models - Info sharing - Develop intermodal products - Terminals network - First-Last mile functionality
5	Intermodal / Modal Choice & Solutions	Rationale - Why choose Intermodal vs a Single Mode - Advantages & Disadvantages of Intermodal - Modal shift	Modal Choice - Road : Rail : Air - Maritime / Sea : Hinterland / Landside - Modal balance / split - Pros & Cons - Simplicity / Complexity	Intermodal - System Process; Structure & Function - How it could and should work	Corridors - Parts that constitute - Investment in Corridors; - Dedicated intermodal corridors (Pallets; Cars; Containers);	Solutions - Imperatives / proposals / solutions for improving Intermodal Freight; - Concession Models - Open access - Modular; Concept test / Pilot

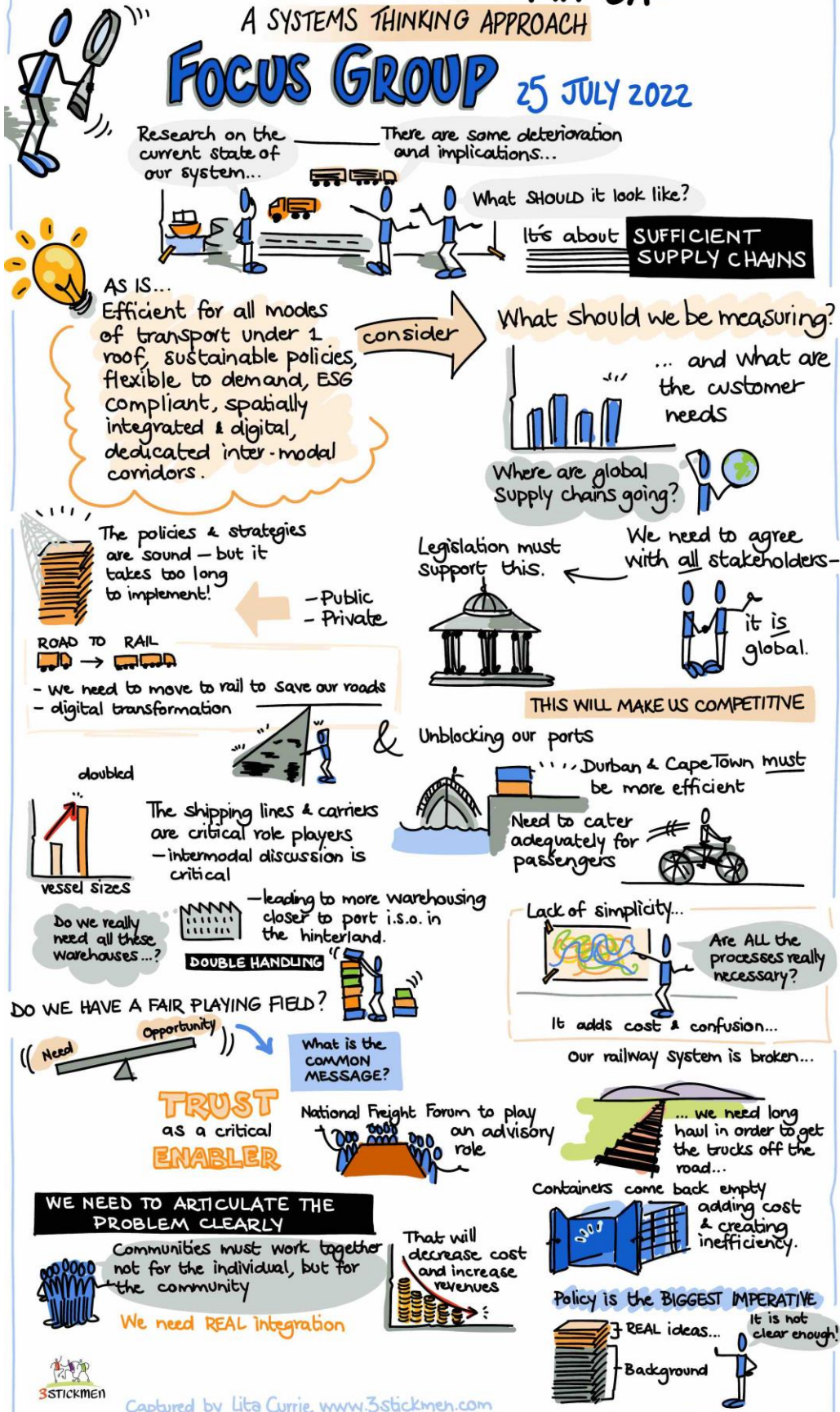
#	Code	Definition [Concepts Included]				
6	Plans & Policies	Plans to guide / direct - National / Master Plans - Intermodal / Freight Plans - Logistics Plans - Infra planning	Policies - Regulation - Regional : AfCFTA	Role - Development - Strategies - Scenarios	Qualities - Data-based - Evidence-based - Evolve vs Control - Enabling - Conducive	Planning Levels / Size - Strategic - Tactical, - Operational - Long Term; Sustainable : Quick Fix - Programmes; Projects; Contingency
7	Goals & Interests	Levels of Goals and Interests - National - Community - Firm or Individual - System Goals - Common / Vested Interest	Purpose / Rationale - Who benefits - Intent - Ends to Means [Means to End]; - Incentivise - Interest in making it work		Qualities - Paradigm / Mindset - Common / congruent goal - Compromise [Sacrifice; satisfice; trade-offs]	
8	Tech & Innovation	Type / Use of: - Information [IT] - Digital - Data - Bimodal transport - Technologies - Future technologies - AI - Blockchain - Platforms to communicate or integrate	Purpose - Innovation to enable; - Improve or advance system - Connectivity		Qualities - Privacy - IP Protection - Visibility; - Transparency	
9	The System	System description - Systemic - Big picture - Holistic system working	Purpose / Rationale - Problem-solving - Integration	Nature and Extent of Change required - Twinge, Large, System - Tipping Point - Turning Point	Models - Iceberg [Events, Patterns, Structures, Beliefs & Assumptions]	

#	Code	Definition [Concepts Included]				
		- Outcomes Chain / Linking concepts / process - Weak points - Entire process		- Rubicon to cross - Crisis - Death spiral - Band Aid vs Surgery	- Meadows Points of leverage - ST Principles & Properties [Consequences]	
10	Challenges / Barriers / Constraints	Description - Problems in the system; - Issues to overcome; - Root causes of challenges [Legacy; System structure]; - Perpetuating the challenges; consequences - Systemic challenges	Challenge resulting from: - Constraint [Capacity] - Bottleneck / Imbalance - Lack of law enforcement - Challenge severity & impact - Corruption	Evidenced by / in: - Loss of gateway; - Congestion - Delays - Inefficiencies - Theft - Vandalism - Social unrest		
11	Costs	Costs components; - Cost drivers - Cost effective - Cost competitive - Cost of Risk - Cost of Logistics	Internal Costs - Fuel - Time - Congestion surcharges - Drivers / Ops staff - Overheads - Handling / Double handling	Externalities Costs - Accidents - Emissions - Congestion - Policing - Noise - Land use - Driver Health	Investment Costs - Money to fix	Pricing - Uncompetitive - Subsidised
12	Performance	Performance - Targets & Measures - KPIs	National / Regional - Country performance index - Competitiveness; Efficiency; Effectiveness - Sustainability – Economic, Social, Environment - Regional Integration - Trade Enablement	System - Optimal / Sub-optimal - System Level	Organisation - KPIs - Profit - Service delivery - Market share	- Reputation - Reliability - Predictability - Productivity - Meet customer need / demand - Throughput

IMPERATIVES FOR THE ADVANCEMENT OF FREIGHT INTERMODALISM IN SA

A SYSTEMS THINKING APPROACH

FOCUS GROUP 25 JULY 2022



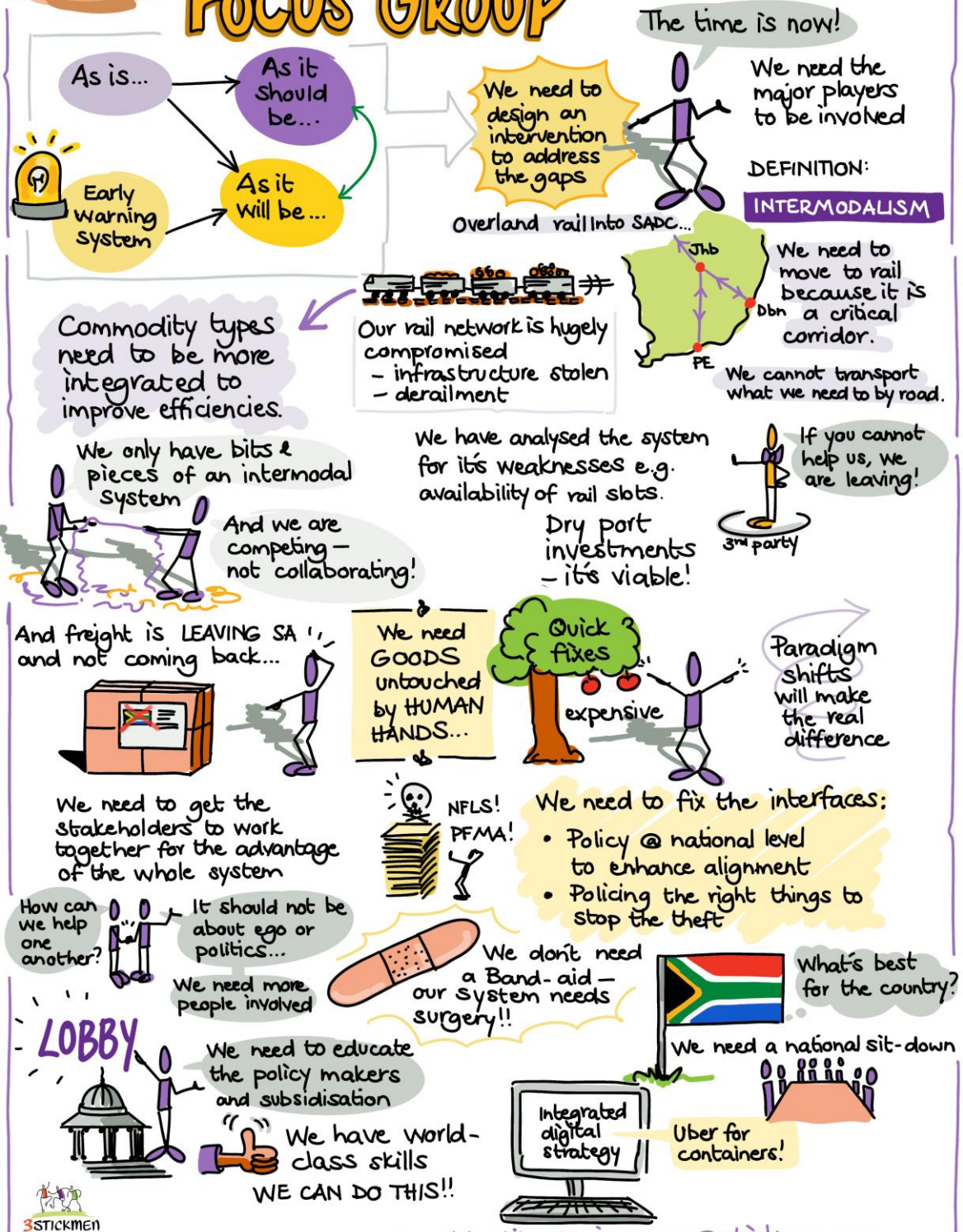
IMPERATIVES FOR THE ADVANCEMENT OF FREIGHT INTERMODALISM IN SA

A SYSTEMS THINKING APPROACH

28 JULY 2022



FOCUS GROUP



Captured by Lita Currie www.3stickmen.com

Annexure G : Actor interactive relationships analysis

Source	Extract	Nature	Parties	Function
Logistics I	The rail operators and the transfer points of the terminals have <i>got to work hand in hand</i> ; otherwise, it's not going to work	General	Rail Operators; Terminals transfer points	Efficient interfaces / transfer points
SCConsult G	The private sector has got different key performance indicators, and because they've got different key performance indicators, it means we need to <i>rope them in</i> The trigger or the turning point, the Rubicon we have to cross in South Africa in terms of intermodalism is to get the private sector to play a bit of a bigger role. I'm obviously, absolutely convinced the private sector such as the shipping lines and third party service providers can help us out of this dilemma	Participation	Private sector	KPI measurement
SCConsult G	Whoever is a player in that supply chain, needs to <i>work together</i> with other players for the joint benefit of all in the supply chain	General	All actors	Supply Chain benefits
SCConsult G	It takes <i>two to tango</i> . If Transnet is prepared to negotiate and play fair, the private sector will bend over backwards.	General	Transnet; Private sector	Fair negotiation
SCConsult G	Shipping lines must be part of our thinking on the corridors, shipping lines must be part of it. get the shipping lines involved again in the terminal. Why do I say that? Because the private sector has different incentives. - I'm trying to say who's got a reason to make it work. Align terminal operations to vessel stack dates and sailing	Alignment	Shipping Lines; Terminals; Private sector	Operational alignment; Align terminal operations to vessel stack dates and sailing; Incentives
SCConsult G	<i>Bring in help</i> . Bring in your Big Brother, the private sector and say come and help us to offer a supply chain that can compete better. And it's not to try and beat the road. It's to try and have a sustainable transport solution that can provide a service which is acceptable. And because it's sustainable, it obviously hopefully, is better than the roads because so many trucks on the road	Partnership	Private sector; Rail; Road	Competitive supply chain; sustainable transport service
Analyst D	If you have an efficient system between the port and rail, maybe there's more <i>incentive to invest</i> in e.g. a fleet of trucks, and your warehouse to offload more containers. Could have quicker turnaround times for exporters. They would be willing to invest as well. Get international investment coming into the country	General	Investors; Port; Rail; Road	Intermodal investment incentives; Competitive; Benefits of best practice

Source	Extract	Nature	Parties	Function
	because it's worthwhile to set up manufacturing facilities because you have an efficient intermodal solution and it is basically competitive Private sector coming off bench with best practices, transfer of skills - a benefit for us			
Intermodal L	need to get the port <i>to cooperate</i> with rail to make this thing work	Cooperate	Ports; Rail	Interface; connectivity
Intermodal L	Intermodalism will be private sector driven. At the moment its very much government driven because government just stops a lot of the processes. Who's going to build a terminal in Gauteng, unless they know that the rail service is going to be supporting it. So now they will rely on Transnet to improve its rail service, but that's not going to work. But if there's private sector guys out there, they can do a deal because got the port run privately, the rail run privately and the terminal run privately, so then the three parties that have <i>to work together</i> . Then it's a <i>symbiotic relationship</i> . There's no question - They have to <i>work as one</i> , in <i>cooperation</i> , but at least they trust each other. They will provide the service	Cooperate	Government; Private sector; Transnet; Ports; Rail	Rail-Terminal interface; Rail service; Deals; Private sector fulfilling operations; Symbiotic relationship
Intermodal L	Going to have to break our intermodalism away from government management. To more <i>shared participation</i> and more private sector involved participation.	Participation	Private sector; Government	Private sector involvement
Intermodal L	More cost effective supply chain - cheaper and more efficient built around rail. It's going to be <i>private sector involvement</i> in rail. I don't think the government sector or Transnet will or is capable of resolving the problems that it has. And. Private sector involvement in terminals. Private sector involvement in association with Provincial governments in terminal developments	Participation	Government; Private sector; Transnet	Terminals development; Private sector participation
SysIntervene I	...to get freight from one mode to another, as seamlessly as possible. Equipment needed to make that transition. But then more importantly, <i>the coordination</i> between systems, - being able to plan and schedule and have the stuff available when things need to transfer; having good visibility of what freight is where and when, to be able to make that transition	Cooperate	All actors	Interfaces; Operational level functions; Information systems; System coordination
SysIntervene I	Needs to happen not only at government SOE level. Needs to be truly inclusive. It needs industry. Needs to really have the key actors in there - Transnet centre; Government. But in <i>putting that together</i> , the right people need to be	General	Government; SOE; Industry	Right actors; inclusivity

Source	Extract	Nature	Parties	Function
	playing the right roles as well. Not have it government lead with the other guys as an add on- really needs to be driven by industry demand			
SysAca N	What does the system look like? And does it include universities? the CSIR type of company? Research Group, R&D-type groups. Who does it include? How do you <i>bring everybody together</i> ? And who's incentivized to do what? So, you understand. And then you might actually get something going. Plan. Do. Check. Act. Plan again. The Demming cycle	General	Define actor inclusion	Incentivise and specify roles
Custodian H	People won't want to share their IP with other people. Especially in competing industries. So, should be wise in how you are doing it to allow people to cooperate , knowing that they compete but <i>also collaborate</i> at the same time. But if somebody sees that, barriers and trade will be diminished, they will definitely collaborate	Cooperate	Actors in competing industries	IP Protection
Custodian H	One challenge is overcoming the barriers between the private sector and government. Collaboration. And then to understand who's playing what role in the industry? The industry is positioning itself in terms of roles, freight forwarder vs what type of 4PL or 3PL or 5PL and what role you're playing in the supply chain	Collaborate	Private sector; Government	Breaking barriers; Roles
TruckTech P	Big challenge to get industry, road transport and Transnet Freight Rail to <i>cooperate</i> and agree on how to do 3rd Party Access. Aware of two projects some years ago - Barlow World Logistics and other with Imperial where there was an intermodal contract. But both of those contracts failed for various reasons. Role players need to get these contracts in place. Identify what are the shortcomings	Cooperate	Industry, Road transport, Transnet Freight Rail	Reach agreement; Concluding contracts that enable intermodal
SysIntervene I	Need <i>coordinated</i> decision making. Needs to be a good National view that stretches across silos to say this is how we're going to do this. Needs to be a <i>coordinated, targeted focus</i> planned for investment in Intermodalism"	Coordination	Government; Investors	Decision-making; National, integrated plan; Investment in intermodalism
SysIntervene I	Need understanding of readiness for adoption. understand at the firm level, how- whether firms are ready to take this up, to actually <i>engage with it</i> and make it work, and what is required to enable them	Engage	Firms	Readiness for intermodal

Source	Extract	Nature	Parties	Function
SysAca N	Intermodalism, it's what is incentivizing the correct mode of transport to be used for a particular movement. What is incentivizing entities collaborating or bringing about the concept of co-opertition? For operation and competition in one.	Collaborate; co-opertition	Entities	Incentivise
Container M	it's just so piecemeal at this point in time, we don't have a <i>coordinated effort</i>	Coordination	All Actors	Coordinate efforts
Container M	To a greater or lesser degree organizations, any one of those five bodies [actors] is just paying lip service to those things and that's why it doesn't work because they seem to be unable to <i>get around a table to pull it all together</i>	General	All actors	Integrate for intermodal
Container M	Two big moves in last 18 months: Dubai Ports World and imperial Logistics. And along with Imperial acquiring JJ Group in Mozambique. The other is Maersk through APM (Terminals) with Grindrod intermodal. So, these guys are vertically integrating further and positioning for Open Access in the South African market, If you've got three or four of those big vertically integrated players operating within our system, that would be really the absolute icing on the cake.	Integration	Global players	Vertical integration; Market positioning; Open access
Custodian H	As long as they believe their IP is protected in the process, then they will <i>collaborate</i>	Collaborate	Actors	IP Protection [to improve willingness]
Custodian H	The government should rather empower people than regulate them. And once that happens, there will be trust between private sector and government. A more <i>collaborative approach</i> than, seeing government as just taking taxes and stuff. And trying to regulate them.	Collaborate	Private Sector-Government	Trust and Empowerment
Custodian H	Proper communication. A platform is going to enable them to conduct business and safer and more efficient transportation. They will make use of it To get input together and to properly communicate to each other. And share common goals. And <i>start collaborating</i> . Communication is most important because on different levels, people working in silos. Developing and doing good work. But it's not integrated and they're duplicating stuff that other people are doing as well and they're wasting time and money. There should be a proper platform for integration where people know what the other people are doing	Collaboration	All Actors	Communicate; Goal congruence; Safe info sharing; Platform for Integration [will make use of it]

Source	Extract	Nature	Parties	Function
SysIntervene I	For actors to <i>collaborate</i> - make the benefits clear to them. And ultimately, also all sectors of the economy are using the same logistics system. And if they can see benefits of that <i>collaboration</i> - Then you know it may happen more broadly.	Collaborate	All sectors using the logistics system	Clear benefits of collaboration [to improve willingness]
TruckTech P	Political will is definitely a big factor. To get the changes to start it's got to be political will. to get the parties to talk together, to <i>collaborate meaningfully</i> . And I think industry would be willing if there's a business opportunity. But I think, Transnet needs to be open to options to address the challenges. It's just going to be that political will to make a change or make the necessary changes that are required on different corridors in different regions	Collaborate	Transnet	Corridor optimisation; address change [Political will; Industry willing]
Academia J	<i>Partnerships</i> . Many intermodal terminals in Europe, jointly owned by the railways and by intermodal operators. Terminals that are jointly owned by e.g. Bundes Bahn and Deutsche Bahn and by various terminal operators; sometimes even truckers or big LSP's. So, what we need in South Africa is the will to actually put these terminals in place, wagon fleets and the contracts in place to actually make this happen. But the railway on their own won't be able to do it. And the LSP on their own will not be able to do it. So, it's a political will to force these people to <i>actually talk to each other</i> and much more quickly and more efficiently	General	Railways; Terminal operators; Truckers; LSPs	Partnerships; Intermodal contracts
Analyst D	First starting point is <i>open, transparent</i> relationships between public and private sector. Government doesn't have the money to fund all the actual requirements, and they need the private sector. Seen Cyril speak about it, so hopefully some traction will take place there. But you need trust. The private sector needs to trust that Transnet will deliver on what they intend to deliver on - it's private sector's money. They're not just going to give it away, and it gets misused, so that'll be my very first starting point. Is having a transparent process there to show that you're serious and build up the trust	General Relationships	Public sector; Private sector; Transnet	Trust; Funding
Analyst D	Joint ventures, partnerships - they want the kind of management controlling stake. Maersk - has APM terminals. CMA; MSC, Cosco. There's so many of them and they're all showing <i>willingness and keenness to get involved</i>	General Partnerships	Shipping lines; Terminal operators	Management controlling stake
FG 1 Rail Actor	The relationship between government and private sector. How do we build that trust? Who's going to trust enough or who's going to take the leap forward?	General Relationships	Government; Private sector	Trust

Source	Extract	Nature	Parties	Function
FG1 Transport Infrastructure Actor	If the State is going to Champion the process - there must be some form(s) of incentives / private sector concessions within the current legislative and regulatory frameworks	General	State; Private sector	Lead the process; Incentives
FG1 Transport Infrastructure Actor	Just looking at the freight perspective from South Africa's economy, it's something that I raised with Government in 2018 and 19 around unblocking of our ports and getting better integration. So for me the priorities would be both Durban and Cape Town ports and looking for ways to get a lot more private sector involvement. The priorities are there, but it's going to take complete <i>cooperation</i> between the state and the private sector in order to address those gaps going forward	Cooperate	State, Ports and Private Sector	Unblocking ports; improving integration
FG 1 Rail Intermodal Actor	How do we create legislation to support such <i>partnerships</i> , especially going into open access. Open access and legislation are two worlds apart, but there could be deliberation in understanding how government plays a role in fostering open access with some sort of legislation that doesn't throw away the Intermodal business players like road, because those players have definitely got a space to play the spectrum.	Partnerships	Government; Business partners	Open access; Legislation; Actors fulfilling roles
FG1 Industry association actor	I want to see <i>a group putting together</i> a comprehensive landside strategy for Durban Port. We're making a lot of noise about getting that together - would involve a <i>comprehensive group of people who are involved</i> in landside operations - TPT, TFR, road haulers and shipping lines, etc. One of the critical elements we need if we're going to improve the performance in Durban port	General	TPT, TFR, road haulers and shipping lines	Landside strategy for Durban port performance improvement
FG 1 Rail Intermodal Actor	government legislation could actually create that type of scenario where the opportunities start being unpacked. And it's important that we define this <i>collaborative strategy</i> that creates the synergy because there's definitely synergy; but with each one of us not knowing where we are going	Collaboration	Government for All Actors	Collaborative strategy for exploiting opportunities through synergies
FG 1 Rail Intermodal Actor	<i>Stakeholder agreements</i> that we create will definitely help us create competitive supply chains,	General; Agreements	All actors	Competitive supply chains
FG 1 Rail Intermodal Actor	<i>Possible agreement between stakeholders</i> , private sector, government and SOEs. We are battling against each other; how do we create that synergy? How do we move forward in terms of some form of <i>stakeholder engagement</i> plan to	General; Agreements	Private sector, Government and SOEs	Country; Economy

Source	Extract	Nature	Parties	Function
	reach agreement for the betterment of the country for the betterment of the economy?			
FG 2 Dry Ports Actor	instead of trying <i>to collaborate</i> and building up trust together, there's a bashing exercise going on. Which doesn't help us come to <i>working together</i> for a solution that, with many role players all needing to do their parts well and communicate what they're doing	Collaborate	All actors	Solutions and roles [Build trust]
FG 2 Logistics Actor	Can always fix the railway system but also need to fix the interfaces. We need to fix the <i>collaboration</i> between all these systems. And as South Africans, we've never done that	Collaborate	Rail and Interface actors	Efficient Interfaces; System collaboration
FG 2 Logistics Actor	For the system to work, has to be a South African National effort. Say we are all going to sacrifice a little bit; all going to give up a little bit of the turf which we want to control and we want to be right. Ultimately to get the logistics system to work - Got to break through political barriers, personal barriers, commercial barriers. And to really get <i>collaboration</i> ; create a little bit of discomfort through the whole system.	Collaborate	All Actors	Break down barriers; make the logistics system work National South African effort
FG 2 Customer association Actor	Understanding corridor freight movement by type. Combining commodity demands to utilise network capacity and <i>collaboration</i> on asset utilization	Collaboration	All Actors	Asset utilisation; Network capacity utilisation Centralised database of freight flows
FG 2 Port Operations Actor	There needs to be a focus on ports as well and more importantly, the connectivity with rail. We need to have the overall view of the whole system (we mentioned cargo connect,) but even without that, it's about the <i>collaboration</i> between the port and rail and road to facilitate the seamless process	Collaboration	Ports, Rail and Rail	Facilitate a seamless process; connectivity Overview of whole system (Info system)
FG 2 Road Actor	We've been using band aids instead of surgery, but our supply chain needs surgery. And needs active role players in order to roll up their sleeves, put their vested interest aside and start working together to start moving cargo in the country	General	All actors	Supply chain; cargo moving
FG 2 Road Actor	The system is not working and all of the modes aren't collaborating properly	Collaborate	Road; Rail	Mode compete vs complement

Source	Extract	Nature	Parties	Function
	we don't have an Intermodal system. We have bits and pieces that try and work alongside one another and generally compete with one another. And, from the road point of view, that is what we need to fix first There can only be an intermodal system where the various modes are operational, reliable, efficient and complement (not compete with) one another			
FG2 Logistics Actor	The outcome is to really get ourselves to move past our own self-interest. Or vested interest and actually start literally saying how can <i>we help each other</i>	General		Vested interests
FG2 Logistics Actor	My view is to talk about value chains as ecosystems where the interactions between the players is where value is created and the ecosystem survives and thrives as a result	Interaction		Interactions where value is created
FG2 Customer association actor	Transnet is a major player in our logistics system - it connects ports and connects rail and any advancements, it's got to <i>involve Transnet</i> and the ability to drive a lot of these things	General	Transnet	Actor involvement; Roles in driving the process
FG2 Rail Actor	this Intermodal system and this rail system itself. It's so flat right now. I don't see how, without private participation, it will be resuscitated	Participation	Rail; Private sector	Improve performance through private sector participation
FG2 Road Actor	There are far too many trucks on the road and we cannot sustain this. The xxx has been pushing for rail to play its part and to grow The challenge is HOW and where to start		Road; Rail	Modes Where and how to start

Annexure H : Outcomes chain analysis

Extract	Source
Efficient freight flow. We need to move stuff from point to point in a way that's efficient - now next level, whose efficiency? Freight owners need to get stuff moved as and when they want to get it moved. Given the economy that we are at, needs to be cost effective. If we get that right, there will be a positive economic impact. Look at the outcomes chain – Start with inputs, are we putting in the investment that we need; is it targeted at the input level. Then at the output level - Are we improving efficiencies and reducing costs? And then at the outcomes level - are we moving freight better. And at the Impact level is our economic performance better? Is Logistics support of economic performance improving?	SysInterven I
This fight between road and rail – It's like a fight. But if they can work together (In), the pie will get bigger (Op), which is the amount that the economy grows, then freight transport grows (Op). They're inextricably linked. So, if we can improve the efficiency of freight transport (Op), the pie gets bigger (Oc). So then both road and rail will gain (Oc). If the economy grows by 10%, then everyone benefits (Oc). And so, the bigger picture is to make the transport of whatever product as efficient and as cost effective as possible (Oc).	Truck Tech P
Make our transport more competitive or lower cost - short term intervention (Op). And that's where intermodalism (Op) can come in, on certain corridors. an urgency to make the transport cost as low as possible (Op), which will then have a positive impact on the economy (Im), and if the economy grows then there's opportunity for investment (Im leading to In). Government would get income from taxes (Oc) and then there's money for investment in improving intermodal options and facilities (Im leading to In).	Truck Tech P
If it's just done right, going to get so much job creation around infrastructure. (Oc) Roads to be built and port upgrades. (Op) Manufacturing (Oc). Then suppliers become important. So many spinoffs that can take place besides the obvious ones (Oc) - getting contracts to do actual infrastructural work (Op). Going to create other opportunities for local manufacturers or international suppliers of the components and products. (Oc) Then all the maintenance Main goal - start with Investing in maintenance (in).	Analyst D
General efficiencies (Op), that will be driven on, and derived from a sound intermodal solution (Oc); environmental impact (Im). Look at Companies and their supply chain structuring (In). Once you have efficiencies and productivity where it needs to be (Oc), can create end to end supply chain solutions or Intermodal solutions (Oc); that become seamless. When you have an efficient port (In) - also going to get the shipping lines being willing to deploy the right type of capacity into the market (Oc). That's the most recent capacity being removed from our market (Oc). You create predictability for, as best as possible, for multiple stakeholders (Oc).	Analyst D
Private sector dying to invest (In), improve efficiencies (Op)- not just locally but internationally (Ou); Then have to look at, who are the players that you've got? Shipping lines, the rail operators? Private rail operators. (in) That's big, because people want control of what they're doing and to tailor things to meet their business requirements. Could get freight forwarding companies (in) who will be keen to support the drive for more efficient supply chains (Oc). And importers and exporters will definitely back a seamless intermodal type of a solution (Oc).	Analyst D

Extract	Source
Don't believe that we have full integration with the community (In) - all the players in the in the supply chain (In). Having just a relationship because we know each other and we basically maximize revenues and operations under our control for a part of a logistics chain and containers. Then we believe we have an Intermodal relationship with one another. Real integration if you want to be systemic, and solve a systemic problem, have to get real integration between first mile and last mile (In). The Port terminal (In). Have to join forces in the real sense of the word (In) to make that change. We should maximize for the value chain (Oc) itself by generating volumes (Op) but each player should not take too much for themselves. Then when you come to the end, how do we make money out of that if we have this real integration (In), the integrated system must guarantee a lower cost than the individual parts put together (Oc). And it might seem like a ridiculous statement. But if we get that right and we have the entire system running at a lower cost, then we can churn out more and then maximize revenue for all parties mutually along those lines (Oc), otherwise independent costs and looking after ourselves in each community of that supply chain just will not give us the maximum efficiency and revenues.	Focus Group 1 Intermodal Actor
All of this creates confidence (Oc). And that's when you get the momentum coming from (Oc). And they need to get buy-in from multiple stakeholders (In), the one's investing in it; piggy backing off it too. To contribute to the overall economy and employment (Oc). So, it's a critical part of our economy, never mind the efficiencies that you drive through being a hub for southern Africa (Im). And we are facing competition from Maputo and Walvis Bay. The returns will flow (Oc). Just need the investments to be made.	Analyst D
Objective is to get the boxes out (Op), but that's to serve the market (Oc).	SCConsult G
Value chain e.g. containers. Each and every node of the value chain has communities, economic or commercial communities (In). Talk about the congestion at the port, people talk loosely. What they don't tend to extrapolate is the fact that there is a port community (In) but it does not work as a unit for the benefit of the community (Ou). They work as a unit for the benefit of the individual not the value chain, not the total community, not even the South African problem (Ou). Because once one problem is solved, then everybody or some of the members whose problem has been solved, they then move away leaving the members whose problem is not yet being solved. Another step into resolving some of these things when it comes to the system thinking perspective.	Focus Group 1 Intermodal Actor
[Road and big LSPs] continually looking at costs (Op) and how they can run operations more efficiently (Op). And of course, there's triple bottom line now (Im). So, it's the environment as well. amazing the extent to which they go, to look at cost, efficiency, emissions (Op), the environment (Im).	TruckTech P